INTERNATIONAL UNION OF
GEOLOGICAL SCIENCES
COMMISSION ON STRATIGRAPHY

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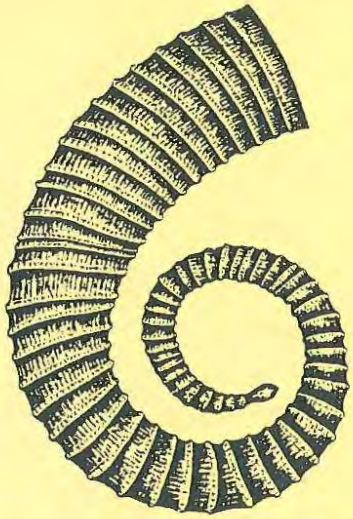
SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

NEWSLETTER NO. 11



December 1994

I.U.G.S. Subcommission on Devonian Stratigraphy

***Newsletter No. 11*, December 1994**

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The *Newsletter* appears biannually at approximately 6 month intervals in the spring and fall. This schedule will generally coincide with SDS meetings to better serve the membership. Contributions may be sent to the Editor any time during the year for inclusion in the next issue. If at all possible, contributions (text and graphic) should be submitted as computer files on standard 5 1/4 or 3 1/2 inch disks. Short contributions may also be transmitted via e-mail. If these media are not available, please provide a clean typewritten or drafted copy suitable for processing by OCR (optical character recognition) software (for text) and image processing software (for graphics). The optimum type size is10 point or greater and the optimum fonts are nonproportional spaced and sans serif. The initial printing of this issue is 150 copies with 94 mailed to titular and corresponding members, 20 to honorary members, Chairmen of the Carboniferous and Silurian Subcommissions, IUGS and ICS officers, friends, and libraries. Remaining copies are available from the Chairman, Secretary or Editor.

The cost of preparation, printing and postage for the *Newsletter* is shared by SDS and The Department of Geology, University of Texas at Arlington.

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EDITORIAL NOTES

Jess Johnson (1932 - 1994)

The SDS membership and the sciences of paleontology and stratigraphy lost one of its most productive members with the death of John Granville (Jess) Johnson in July 1994. John Talent has provided the membership with an extremely well written and informative tribute to this very special person and scientist. A list of Jess' publications compiled from GeoRef follow the tribute.

SDS Folder on Internet

A Gopher folder entitled Subcommission on Devonian Stratigraphy has been created on the University of Texas at Arlington Gopher Server (UTA Gopher).

The structure or path for the SDS folder is:

UTA Gopher
- Academic Departments
  - Geology Department
    - Subcommission on Devonian Stratigraphy
      - Current Events
      - Membership Directory
      - Publication Database
      - Current Newsletter
      - Member News
      - Member Reports
      - Time-Scale Forum
      - SDS Reports
      - ICS Reports
      - Archival Materials
        - Newsletters

The SDS folder will appear static to those accessing the folder -- that is, members may read and download any and all material in all SDS folders but will not be able to add materials directly to folders. The process of adding materials requires submission to the Editor as is done for the Newsletter. The major difference is that all material placed in folders must be in digital form. Thus submissions must be via computer files unless members do not have access to computing facilities to prepare computer files. These members may submit contributions as requested for the Newsletter (see submission requirements on the title page of this Newsletter) and the contributions will be converted to digital format.

The growing number of contributions by SDS membership to the Newsletter and the delay in publishing materials has prompted the establishment of an alternate outlet for materials of time sensitive nature as well as those of limited interest to the membership and the growing database of publications relating to Devonian topics. Subfolders and files within the SDS Folder will contain all materials contained in Newsletters but will not be a replacement for the Newsletter. The cost of reproducing and mailing the Newsletter has grown to approximately $500 (US) and limiting its content to news and reports of general interest to the membership will help keep costs in line with the budget. Newsletters following No. 11 will contain an index to SDS materials on Internet. Those in the membership without Internet access who wish copies of materials on Internet may contact the Editor. In the near future, access to the SDS Folder will also be possible through WWW (World Wide Web) and Mosaic. The latter allows direct access to graphic images while Gopher and WWW allow the downloading of graphic images which can then be opened on the members computer. Happy Internet "surfing". Please address any problems you encounter accessing or using the SDS folder to crick@albert.uta.edu.

Devonian Time Scale

The Devonian time scale on the outside of the back cover is that being currently used by Crick, Ellwood and Hassani in their magnetosusceptibility stratigraphy work in Morocco and elsewhere. The scale is an outgrowth of discussion with M. R. House, R. T. Becker and Gil Klapper and incorporates the Eifelian/Givetian GSSP decision, the T-R cycles of Johnson, Klapper and Sandberg, and the chronometric scale of Barry Fordham. Criticisms and comments are expected and welcomed. Contributions are solicited for a forum toward establishing a "standard" Devonian scale. See R. T. Becker's comments under Time Scale Forum

Nominations of SDS Officers

Please respond to the request of Bill Oliver for suggestions of nominees for Chairman, Vice-Chairman and Secretary (see pg. 15).

Membership

Dr. Alexander O. Ivanov, Institute of the Earth Crust, St.Petersburg University, 16 Linija 29, St.Petersburg 199178, Russia; Palaeozoic microvertebrates; Dr. Oleg Lebedev, Palaeontological Institute of the Russian Academy of Sciences, Profsoyuznaya St. 123 Moscow, 117647, Russia; Palaeozoic vertebrates; Dr. Vitalii Sorokin, Geological Institute of the Stratigraphy of the East European Platform were elected Corresponding Members of the SDS at the Moscow meeting.

The well deserved nomination of CM Susan Turner, Queensland Museum, P.O. Box 3300, South Brisbane, Qld 4101, Australia, for Titular Membership was unanimously accepted by TM's present at the Moscow Meeting

SDS membership addresses and telephone numbers (where known) are appended as a separate enclosure. Please check your entry and notify the Editor if corrections are in order. The number of members with e-mail addresses has increased by 100%.

THE INIMITABLE JESS JOHNSON

(13 JANUARY 1932 — 5 JULY 1994)

At about 1 pm on 5 July, with wife Miriam and daughter Jeanette at his side, John Granville ('Jess') Johnson, hero to brachiopod and conodont workers and to lovers of things Devonian, passed away painlessly from pneumonia at his home in Corvallis, Oregon. Jess' broad spectrum of elegant contributions in the fields of paleontology, stratigraphy, paleogeography, paleobiogeography, and sedimentary tectonics - and especially his holistic approach to such matters - mark him as having been one of the more seminal minds in contemporary sedimentary geology.

Jess produced at least 180 publications that included some 25 incisive contributions on eustatic events, extinctions, speciation, tectonics, stratigraphic concepts, and faunal provinciality. These were backed by numerous monographic and other major contributions on brachiopods, conodonts and, to a lesser degree, gastropods. Above all, he authored or co-authored three of the most outstanding works of grand-scale synthesis on things mid-Paleozoic of this generation: his global analysis (with Gilbert Klapper, 1980) of the Devonian conodont record as regards endemism and dispersal, his much cited elucidation (with Charlie Sandberg and Gil Klapper, 1985) of the Devonian eustatic pattern and, more recently his major synthesis (1990 - *Journal of Paleontology* Outstanding Paper Award for the year) on Early and Middle Devonian brachiopod paleocommunities of Nevada in relation to a biofacies\realm\province model. In his later years Jess had become involved with event stratigraphy, especially in carbonate sequences, and undoubtedly would have gone on to have written perceptively in that area too. Jess had a remarkable capacity to shed light where there didn't appear to be any. He was a fount of wisdom and unpretentious charm, totally lacking in chutzpah. He uniquely stimulated all who came in contact with him and was always generous in giving prominence to his coworkers. He was the powerhouse in most of the enterprises in which he became involved.

Jess was born in the mid-continent, in Jefferson City, Missouri. His father was of Swedish descent, though born in the USA. His wife Miriam Anderson Johnson, a unique person whom he had the good fortune to marry in 1954, was also of Swedish parentage; her parents had migrated to the USA from northern Finland in the early 1920s. Miriam was to devote a large slice of her life to looking after Jess; together they survived the raising of five children. There were already three children, Marlene, Jeanette, and Caroline Eve ('Carrie'), the last only 6 weeks old, when, in early October 1959, Jess contracted the bulbar-spinal poliomyelitis that was to leave him permanently debilitated, paralyzed from neck to waist, and with virtually no diaphragm function. The discovery of the first effective polio vaccine by Jonas Salk in 1954 had resulted in a grand scale program of vaccination, but, after a number of children in California and Idaho had contracted the disease from a defective batch of vaccine, there had been reluctance by many to undergo vaccination. Jess had been among those disinclined to be vaccinated; he gambled and lost.

It was 11 months before Jess emerged from hospital. For the rest of his life, except for brief intervals, he had to be attached to a respirator, night and day. He required regular attention from Miriam and other family members, or, at work, from a medical attendant. A few of these, especially Claudia [nee Dubois] Regier, his medical attendant for his last 21 years, were also skilled research assistants. It was no easy task. As Miriam says, "Some lasted only a few days or weeks. The good ones we could count on our 10 fingers. Claudia was the best! And the most reliable". Through it all there was always Miriam, a bastion of patience and good cheer, tirelessly looking after him; it is hard to imagine the creativity of his research, his phenomenal productivity, or for that matter his survival without her. There were to be two more children: Valerie (deceased) and Ian.

Jess out-survived nearly all those who had been afflicted with bulbar-spinal poliomyelitis during the 1950s-early 1960s polio era. The discovery of the Salk vaccine, followed by discovery of the first oral vaccine by Albert B. Sabin, between 1957 and 1958 (but not licensed until 1961, after Jess had contracted the disease) eliminated the need for production of respirators. As a consequence, Jess' last years were punctuated by increasingly frequent servicing of respirators, construction of replacement parts, and a quest for respirators (for spare parts) from the families of polio victims who had passed away. At the time of his death a respirator was being custom-built for him by Peter Meyer, an Oregon State University machinist. Pete, who took care of Jess' respirators after the Johnsons had moved to Corvallis, designed and built several rock-splitters and other devices for Jess.

Jess' tertiary education was undertaken entirely at the University of California, Los Angeles, where he commenced engineering in September 1949 but switched to a BA in geology. The latter was interrupted by military service (February 1954-January 1956) as an air traffic controller. For a time he thought his career may have been in that direction, but abruptly abandoned this dream after attempting to land two US Air Force planes from opposite directions, simultaneously! We, who have been involved with Devonian and Silurian brachiopods, conodonts and associated stratigraphies are grateful for this near tragedy; it brought Jess into our mid-Paleozoic bailiwicks.

Returning to UCLA, Jess completed his BA and then did an MS in geology (1957-1959). Nevada figured prominently in Jess' geologic career. He had been camp manager for a UCLA summer field camp in central Nevada in 1957 run by Jerry Winterer. Jerry was to supervise Jess' MS dissertation; it was on Nevada geology, based mainly on mapping in the Coal Canyon area. His PhD program (1959-1964), focussed on the Lower Devonian brachiopods of central Nevada, was under the super-

vision of Jerry Winterer until Jerry left UCLA to go to Scripps; it was completed with crinoid worker Gary Lane as UCLA supervisor, though effectively it was supervised by Art Boucot.

Jess had had the good fortune to correspond with Art Boucot while the latter was still at MIT. In July 1961 Art had relocated to the Division of Geological Sciences at Caltech and swiftly set up a factory operation that included an underground acid-leaching facility built to Art's specifications in the corner of a Caltech car park. Art soon made Jess' acquaintance, and, with his enterprise expanding impressively with NSF and other grants, was able to offer Jess a position as his research assistant. In July 1962 Jess joined the Boucot "stable". As Jess was no longer able to go to the field, Art collected copiously from silicified horizons in the Lower Devonian of central Nevada and dissolved a considerable tonnage of such materials for Jess' thesis in the subterranean acid-leaching facility. The resulting cornucopia of taxonomically diverse material enabled Jess to complete an exceptionally large and elegant dissertation for which he was awarded a PhD by UCLA in October 1964. The degree-conferring ceremony and Jess' triumph over adversity featured on the CBS evening news.

Jess had already become the second pivot in the Boucot group. Now, with his PhD behind him, and with the title of research associate, his productivity seemed to accelerate. Commencing in 1963, a remarkable series of 54 papers, co-authored with Boucot, poured out in journals around the globe; 11 of them were of monographic proportions. The rate of production was prodigious. Jess proved to be hyper-productive in his own right. Monograph after monograph came from his pen, commencing in 1970 with his GSA memoir on *Great Basin Lower Devonian Brachiopoda*. The latter was supplemented in 1973 and 1976 by the two University of California volumes, co-authored with Art Boucot and Mike Murphy, dealing with silicified Wenlock to early Lochkovian brachiopods from the Roberts Mountains Formation, also in the Great Basin region of Nevada.

By the early 1960s, Mike Murphy, who had come to know Jess as an undergraduate at UCLA, was the only remaining member of the UCLA faculty still taking students to Nevada. He had noticed brachiopods in the Roberts Mountain Formation, until then thought to be entirely Silurian, but had not collected them because no one seemed interested. It was a query from Art Boucot regarding the possibility of brachiopods in the Roberts Mountains Formation and a positive response from Mike that led to a joint field trip from which one limestone block produced 80 species of brachiopods by Jess' first count. A formidable team came into being: Jess and Art on brachiopods, Bill Berry on graptolites, and Mike, who until then had focussed much of his research on Cretaceous ammonoids but soon took up conodonts. As Mike says, "Before I knew it Art had me working for Jess most of the time and I finally abandoned the Cretaceous because I couldn't do both. From the time Jess became an assistant professor at Corvallis, we collaborated and worked in tandem. He took most of the inner shelf areas with his students and I took the basin with my students. I tried to visit all of his students in the field at least one time since he couldn't and we worked that way to the end. Of course, all the brachs any of us found went to Jess".

Jess supervised 4 graduate students for PhD: Richard Aerts Flory, Roy Edward Smith, Thomas Lee DeKeyser, and Constance Jefferson Sansome. He supervised 27 for MS; most worked on aspects of the geology of Nevada. Notable among the latter on whom he left his stamp and who went on to make their mark elsewhere have been Maya Elrick, Dave Johnson and Jed Day. A dozen of his graduate students were to co-author substantial papers with him. Jess was an inspiration not only to his students but to countless fellow scientists around the globe: by letter, by e-mail, and, by repute, to many who never had the chance to pass through Corvallis. Many never knew that a pilgrimage to Corvallis was necessary to meet him.

Jess' many reports on brachiopods (including 5 of monographic scale) contributed greatly to refining understanding of the mid-Paleozoic geology of western North America, especially as regards its chronologic and bathymetric framework. His impact became even greater when, in the mid-1970s, he branched into conodonts. His first paper on conodonts was a seminal revision (with Willi Ziegler and Gil Klapper, 1976) of the *varcus* Zone. From then on he continued to work with brachiopods and conodonts in tandem.

In October-December 1967 I had the pleasure of spending nearly 3 months with Art Boucot and Jess at Caltech. Jess and I had co-authored 4 papers and were in process of cleaning up a manuscript with Art on Early Devonian brachiopod zoogeography for a GSA special paper. Although wasted in appearance, confined to a wheelchair and attached to a respirator, as though to a trailer, he had exceptional presence. Most who met him for the first time were struck, as I was, by his large, pale green eyes and the twinkle in them. He had dry sense of humor and relished incongruity. His son, Ian, has said that "It was a most astounding experience, even for us in the family, to walk into his office, and have him turn and smile. He didn't have contact with a lot of people, and appreciated visitors very much, I think. He was, as Marlene [his eldest daughter] observed, more focussed on the experience of human interaction than anyone we have met. I think part of that was shown in his eyes."

Jess did not have the strength to lift anything heavier than a coffee cup nor the dexterity to handle one well, but he would dictate manuscripts and letters (great numbers of them) into a dictaphone to be typed by the ever cheerful and positive Miriam. Later he regained sufficient co-ordination to be able to type.

As a consequence of a general shrinkage in NSF funding and unwillingness of Caltech to pick up the shortfall, Boucot sought a professorship elsewhere, with a condition that Jess also be given an academic appointment. Jess was the difficult item to sell because there was no way he could pass any sort of medical fitness examination; he had already, independently, contacted sev-

eral institutions but without success. Art negotiated a deal with the University of Pennsylvania in which Art would take up a professorship and Jess would be appointed Assistant Professor of Geology. The head of the Geology Department at the University of Pennsylvania, the late Henry Faul, a pioneer geochronologist of some distinction, had been instrumental in engineering this offer.

In April 1968 Art left for 6 months in the USSR as a National Academy of Sciences exchange fellow. In July of the same year, with high hopes, Jess and Peggy Losee, Art's aficionado of isopach compilations, and a train-load of Art's collections, moved from Pasadena to Philadelphia. By the time Art returned in October the disastrous nature of the move had become apparent. The energies that Henry Faul had put into persuading the university to hire Art and Jess were now focussed, as Art says, "on putting them in their place". Henry announced that they were to take his orders and that Art's NSF grant money would be utilized by Henry. It was thus vital that alternative employment be found, quickly. Again Art sought a university that would offer appointments to both him and Jess. Oregon State University (OSU) made such an offer.

I visited Philadelphia in June 1969 to find that Henry was away on field work in New Mexico or elsewhere in the south-west, seemingly happy that he had triumphed over his unruly underlings. However not only Boucot and Johnson, but sedimentologist George de Vries Klein, and structural geologist Reg Shagam, having lined up employment elsewhere, were in the midst of a packing frenzy, determined that when Henry returned he would find the department virtually empty except for a few bits of paper, sawdust, and splinters from crates. Which is exactly what happened!

So, after not quite 12 months, Art and Jess and the inevitable train-load of fossils had headed back westwards, this time to Corvallis, but without Peggy Losee for whom the Philadelphia experience had been too traumatic. The trans-continental transfers, however, had been highly disturbing for Jess. He continued to despair of making a career in geology, deprived of contact with rocks in the field, and believed he was fated to remain without tenure for the rest of his days. In Art Boucot's view, however, the battle to get him established in academia had been won from the time OSU hired him, and especially when he received his first NSF grant in 1970 and was no longer dependent on the grant-winning capabilities of others - until then, specifically Art. Among the people who buoyed Jess up in the early years at Corvallis when his spirits were down was geochemist E. Julius Dasch, then on the geology staff at OSU, Paul Ritcher, a colleague from another department at OSU who, though crippled from having contracted poliomyelitis from live Sabin vaccine, had been able to establish a research profile that earned him a full professorship, Arlene Demaris, one of Jess' research assistant-cum-medical aides (May 1971-February 1973), and Sallie Hee who worked in the Department of Oceanography at OSU. Sallie was killed by an avalanche on Mt Hood; Jess had thought a lot of her. All were supportive; all were insistent that there was indeed a career for him in science.

Jess, trying his best not to be involved in departmental politics, poured his energies into research and teaching, punctuated by generation of his autobiography. He remained teaching and researching at OSU for almost 25 years until death took him. His physical condition notwithstanding, Jess was promoted to associate professor (1973-1978), and then full professor (September 1978) with a highly successful interlude (January 1986-August 1988) as an efficient and more than usually compassionate head of department. Something of the latter role continued on. Right to the end, his office at OSU was a bastion of sanity and humanity for students and staff beset by personal problems. This I noted when I had the good fortune to spend a few weeks with Jess and Miriam in September-October 1993. Serendipitously, in March 1973, Jess had obtained the services of Claudia Regier as research assistant-cum-medical aide. Claudia, quietly unflappable, acid-leached samples, picked conodonts, chased literature, and in myriad other ways meticulously helped his research go forward.

Despite being confined to a wheelchair, Jess was an uncommonly good teacher, always well prepared, always quick with illuminating insights and droll repartee. Typical is an occasion when, while he was lecturing, one of the students, noticing Jess' respirator had come free from the power point, swiftly plugged it in again. "That student gets an A!" dryly observed Jess. In 1977 Jess received the OSU College of Science Carter Teaching Award for "inspirational teaching"; he was a finalist for this award on many occasions.

It was necessary for Jess to follow a precise timetable at home and at work. The family car was fitted with a respirator. Morning and evening, 5 days a week, he would be driven to work by Miriam to a side door of Wilkinson Hall, the geosciences building at OSU, where he would be met by Claudia Regier, who would usher him to his room; he always walked in, breathing from a hand-pump. Jess would pass the day in his office in a wheelchair, linked to a respirator. In the late afternoon Miriam would call for him and drive him home where he would be linked to another respirator, by which time too much of his energies had been drained to contemplate further work. After dinner he would relax watching the news on TV, watching videos of generally recent movies, or listening to music. He liked a wide range of rock music, including Annie Lennox, Van Morrison, and Pink Floyd, especially their album *The Wall*. He had earlier taken a liking to folk music, especially the Weavers, and early Bob Dylan, but never developed empathy for 'heavy metal'. Other favorites included Big Bill Broonzey, Dire Straits, early Fleetwood Mac, Joe Cocker, Nina Simone's jazz-soul-folk meld, and the pianistics of Keith Jarrett, especially his *Kln Concert*.

Jess was a lover of quiet satire, a connoisseur of comedy. He loved the irreverent Jay Leno and, perhaps even more so, Dave Letterman and his theatrical gestures, but insisted that no comedian was the best. It was a ritual when I stayed with the Johnsons in 1993 to record the Dave Letterman shows each night and watch them the following

evening, zapping the commercials by remote control.

Jess enjoyed company, but it was impossible for him to participate in social gatherings other than those organized at the Johnson home. At work, He enjoyed having lunch with friends at work. Some of them lunched with him regularly for many years, among them Anita Grunder and John Dilles of the OSU Geology Department, Bob Frank of the OSU English Department, Elizabeth Mannarino of the Corvallis Public Library, and a neighbor, Linda Barstow. Discussions would range widely, rarely focussing on geologic matters.

Amazingly, during the 1970s, Jess recovered limited diaphragm function. On weekends, in sunny weather, he would sometimes sit outside for an hour or so, simply feeling glad to be alive, but always with a respirator at his side, pumping. On such occasions, completely free of stress and not directly hooked up to a respirator, he could go for several minutes without taking a machine-reinforced breath.

Jess was an efficient worker, an innovator, ready to probe unexplored pathways. There were times when he felt he was no longer a creative force, but there were soon new challenges. He received continuous NSF support, commencing in 1970; dollar-for-dollar he must have been one of their most economic producers. Project after project were always swiftly and neatly carried through. His office was always laid out for maximum efficiency. The heavier specimens and tomes had, however, to be brought to his desk, overlooking which were two large inspirational portraits: of Los Angeles poet Charles Bukowski, and actress Faye Dunaway as she had appeared in the film *Bonnie and Clyde*. A large-screen, state-of-the art computer, an Apple Macintosh Quadra 700, housed in his office at OSU, became a great love. He delighted in having an almost endless choice of fonts and the complete *Random House* dictionary at his fingertips. The instantaneity of e-mail communication with a wide spectrum of colleagues around the world especially delighted him. At one point during my 1993 visit to Corvallis, Jess opined that he was giving some thought to retirement. There were symptoms, he said, that his system was starting to slow down, and he was not sure how much longer the NSF might continue funding his research. In October 1993 he bought an Apple Notebook which enabled him to give more attention at home to his poetry and letters to newspapers.

Jess was a lover of words, both prose and poetry. The region around Corvallis, Benton County, is one of the few relatively liberal counties in Oregon; much of the state is a land of lumberjacks, farmers and pick-up trucks. It has therefore more than the usual share of conservatives who see little value in paying taxes to be used on water, power, national parks, and education, including tertiary education, Some of them have a remarkable penchant for expressing their anti-progressive views in letters to the editor. In his later years Jess stepped into the fray with gusto. It seemed that every week or so he would pump out an elegantly worded letter to the *Corvallis Gazette-Times* taking the conservatives to task, demolishing their logic, and, *inter alia*, defending the core values of a liberal society. In this, as in everything else, he was fearless, like a latter day Ambrose Bierce. Jess developed excellent rapport with the editor of the *Corvallis Gazette-Times*, Norm Lewis. Like Bierce, Jess was always seeking new ways to phrase double entendres and turn cliches inside out, unleashing them with devastating effect. To some of his targets he must have been as popular as a hedgehog in a long-jump pit. None of them bested him. Miriam would deliver his letters to the *Corvallis Gazette-Times* by hand to save a day in the mails, but by late 1993 he had started firing them off by e-mail. Having his letters appear in print the following day delighted him. "I love instant publication!", he would say.

There is a legacy of unpublished J.G. Johnson material, much of it not in the domain of scientific writing. The major scientific item left for publication is a voluminous manuscript on the Silurian and Devonian spiriferidines for the revised volumes on Brachiopoda of the *Treatise on Invertebrate Paleontology*. For this he had been organizer and chief contributor. Typically, the text had been completed well ahead of schedule and, apart from a few figures, was ready to go to the editors. An extension of the *Treatise* enterprise, a planned monograph covering nearly 600 nominal genera of spiriferidines, sadly, will not now come to fruition.

An autobiography of considerable length, *The second life is harder*, details Jess' relentless fight for physical survival and professional satisfaction; he began the manuscript in December 1971. He wrote several short stories and had completed his part of a novel in which he and son Ian were contributing alternate chapters. As Ian says, "He was able to produce five times as much material as I was, despite his one-fingered approach to typing". Jess was a great admirer of the prose works of Jerzy Kozinsky and Anais Nin; he had a copy of almost everything written by the latter.

Over many years much of Jess' innermost responses to the world around him had been distilled into poetry, vast amounts of it: spare, unrhymed, often passionate, singularly lacking in self pity. It too is a legacy that must be put into print. Jess had an especial penchant for the writings of anti-establishment Californian poet Charles Bukowski; he had a large collection of Bukowski's uninhibited writings and taped interviews. 'Buk' (or Hank, from Hank Chinaski, his fictional alter ego) pre-deceased him, on 9 March.

And now Jess is no longer with us, who will take his place? I, for one, can't think of anyone! We have lost not only a great mind but a powerful catalyst as well. He has established a lofty benchmark for future workers concerned with sedimentary geology in general, and with things mid-Paleozoic in particular. I suspect it will be a long time before anyone in the earth sciences with such a physically fragile frame will have a comparable committment to productivity and excellence. The last words are best left to long-standing friend and confidant, Mike Murphy, who accompanied him on his final voyage to Nevada.

"We (Gil and I) met Miriam in Eureka [Nevada] on the 29th of July... and the following morning we went with [the family and students] to the Roberts Mountains. One of the students

was doing field work in the area and had a jeep. He ferried us to a high saddle below Roberts Creek Mountain (10,200 feet) and we then climbed to the peak, which is the highest Devonian outcrop in the state. In the saddle we scattered most of Jess' ashes... [We] scattered the remaining ashes from the peak. It was a beautiful morning and storm clouds were gathering. As we scattered the ashes, cliff swallows swirled and dived around us just as though they were celebrating the fact that his spirit was now free - no more of the indignities of respirators, tubes, loss of privacy, dependency - the constant bonds of his life. It was releasing for all of us. Miriam and the children read some of his poetry and some other pieces or said something about their father and it was very wrenching, but all in all it was more like a wake in which there were moments of sadness, but everyone was glad to have come."

Miriam and Ian Johnson, Art Boucot, Gil Klapper and Mike Murphy, all of whom knew Jess' world better than I, provided corrections and general comments — for all of which I am very grateful.

John A. Talent
Macquarie University

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SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

Minutes Business Meeting, Moscow, Russia (July, 13th, 1994)

Meeting held at Palaeontological Institute and Orlov Museum of the Russian Academy of Sciences, Moscow, Russian Federation, on the occasion of the "Devonian Eustatic Changes of the World Ocean Level" Symposium.

PRESENT. Titular Members: P. Bultynck, M. House, W. Kirchgasser, V. Menner, J. Richardson, E. Yolkin. Corresponding Members: T. Becker, A. Blieck, M. Ginter, E. Luksevics, J. Marshall, W.A. Oliver, A. Pedder, G. Racki, P. Sartenaer, H.H. Tsien, S. Turner. Guests: O. Artyushkova, S. Cherkesova, E. Chibrikova, C. Fong, R. Masagutov, V. Nasedkina, T. Obukhovskaya, N. Ovnatanova, M. Snigireva, V. Tchizhova, M. Ynusov.

1. INTRODUCTION

The Chairman, M. House, opened the meeting at 5.30 pm by thanking Director A. Rozanov of the Palaeontological Institute RAS, Drs. M.A. Rzhonsnitskaya, O.A. Lebedev and S.V. Yatskov for the organisation of the meeting in Moscow and Drs. V.I. Bogatsky, V.V. Menner and Y.A. Yudina for organising and leading the field trip to the Ukhta region. He reported with deep regret the death of CM J.G. Johnson who was especially involved in the study of Devonian sea-level changes. The meeting stood in silence in memory of this colleague.

The appointment of a Nominating Committee for election of new SDS officers was added to item 8 of the agenda.

Apologies for absence were recorded from TMs Chlupac, Garcia-Alcalde, Hou Hong-Fei, Morzadec, Sandberg, Weddige, Ziegler and from CMs Blumenstengel, Brett, Dineley, Edwards, Hladil, Mark-Kurik, Paproth, Rzhonsnitskaya, Walliser.

2. MINUTES OF THE GÖTTINGEN MEETING 1993

The following correction was made: on p.43 (SDS Newsletter n_10), item 13C, "the next International Geological Congress would be held in Beijing in 1996".

3. CHAIRMAN'S BUSINESS

The Chairman reported that he had received a request from the ICS regarding future objectives and achievements of the SDS. He submitted a memorandum listing future objectives in the Autumn of 1991 (see document E, Frankfurt SDS

Meeting 1990) and did not receive the courtesy of a reply. He now sent a new memorandum with planned achievement from 1994 tot 2000.

He reported that a new Subcommission on Genetic Stratigraphy has been set up, that the IUGS supports the ICS proposal to revitalize the International Stratigraphic Lexicon (see item 6) and that a revision of the currently applicable ICS statutes was completed.

4. REVIEW OF WORK SINCE GÖTTINGEN MEETING

a. Base of the Emsian

The ICS request a report on the basal Emsian GSSP in a form that can be published in Episodes. TMs E. Yolkin and J. Talent will bring up to date the original version.

b. Base of the Givetian

The basal GSSP at Jebel Mech Irdane, near Erfoud (Morocco) has been approved by the ICS and ratified by the IUGS. A report for Episodes will be prepared by O.H. Walliser.

c. Base of the Famennian

A paper on "Definition of the Frasnian/Famennian Stage boundary" by Klapper, Feist, Becker and House will be published in Episodes (vd. 16, 4) in August 1994.

d. Newsletter

Newsletter n_10 was distributed in December 1993.

The Chairman wishes to especially thank Prof. Rex Crick (University of Texas at Arlington) for the quality of the Newsletter and for the financial support from the University.

CM Becker proposed that SDS members should supply every year a list of their publications to be included in the Newsletter.

e. Courier volume on "International Devonian Correlation Review".

In May a circular with general information and a draft contents was sent to 32 SDS members charged with the task of organising with co-authors the different contributions. The first part of the volume will give the details of the GSSP's, the second part concerns recognition of the stage boundaries in many areas of the world and the third part will provide a systematic review of taxonomic groups, important for boundary correlation. Twenty-seven of the organisers who had been approached sent in the requested information (A circular will provide more information). It was stressed that TM Yolkin will co-ordinate the contributions on the Asiatic part of the Russian Federation and TM Menner those on the European part and the Urals. TM Menner suggested that bivalves and crinoids should be included in the review of important taxonomic groups.

5. DEVONIAN MARINE-NONMARINE CORRELATION AND COOPERATION WITH IGCP 328

CM Blieck will submit a report for 1994 to be published in Newsletter no. 11.

The final meeting for the IGCP 328 project will be held in Paris, on the occasion of the International Congress "Premiers Vertébrés-Vertébrés Inférieurs" (4-15 September 1995). Project leader Susan Turner considered the project to be very successful and she will propose the prolongation of the project or submit a new one.

6. IUGS MATTERS

a. International Stratigraphic Lexicon

The IUGS supports the plan to establish a Global Computer Data Base as the replacement of the International Stratigraphic Lexicon. SDS members will approach their National Devonian Commission on this subject and inform the SDS of what is happening.

b. Sequence Stratigraphy

The Chairman reported that he had answered the ICS Letter of last year recommending that the ICS subcommissions should become actively involved in sequence stratigraphy. He especially mentioned that sequence stratigraphy is mainly based on seismic data and not on biostratigraphic data (see also minutes 1993, item 3).

7. FUTURE TASKS

a. Documentation of Devonian Taxa Ranges and Bioevents

IGCP 328 will present data on the ranges of Palaeozoic vertebrate taxa at the meeting in Paris (September 1995). SDS should start collating data on the ranges of Devonian taxa, not only a the stage boundaries but through all the Devonian. It is expected this will document what is happening at and after the extinction events.

b. Magnetostratigraphy and radiometric dates

As mentioned in item 3 the Chairman sent a memorandum to ICS with planned achievements until early 2000. This program requires that some Devonian specialists more familiar with radiometric data and other new forms of stratigraphy should be elected member.

CM Becker drew attention to the potential of isotopes in Devonian studies and he stressed that the SDS should collaborate with the Subcommission on Geochronology and other groups.

c. Consideration of other priorities

CM Sartenaer drew attention to the term Strunian, still used as a substage in recent publications and he thought that the SDS should make a recommendation. In discussion it was stated by the Chairman that the ICS is not in favor of formal substages, CM Becker mentioned that the German Devonian Working Group made a proposal for a formal subdivision of the Emsian Stage in Germany and CM Oliver thought that subdivision of stages should be discussed in a working group. In conclusion the Chairman invited members to submit, in advance of the business meeting, a formal memorandum on the subdivision of some stages.

8. MEMBERSHIP

a. There were no withdrawals from membership.

b. Election of new CMs

Three nominations for election had been received. There were:

1. Dr. Alexander O. Ivanov, Institute of the Earth Crust, St.Petersburg University, 16 Linija 29, St.Peters- burg 199178, Russia; Palaeozoic microvertebrates; nominated by CM M.A. Rzhonsnitskaya and the Chairman;
2. Dr. Oleg Lebedev, Palaeontological Institute of the Russian Academy of Sciences, Profsoyuznaya St. 123 Moscow, 117647, Russia; Palaeozoic vertebrates; nominated by CM M.A. Rzhonsnitskaya and the Chairman;
3. Dr. Vitalii Sorokin, Geological Institute of the Stratigraphy of the East European Platform; nominated by TMs V. Menner and E. Yolkin.

After a vote the three nominees were elected Corresponding Members of the SDS.

c. Election of new TMs

CM Susan Turner, Queensland Museum, P.O. Box 3300, South Brisbane, Qld 4101, Australia, has been proposed for Titular Membership by TMs W. Kirchgasser and J. Richardson. As project leader of IGCP 328, she has largely contributed to the activities of the SDS and she is an outstanding expert of Palaeozoic microvertebrates. The nomination was unanimously accepted by TMs present.

d. The Secretary received a letter from Dr. D. Kaljo recommending to add Dr. M.E. Johnson, Deptm. of Geology, Williams College, Williamstown, Massachusetts 01267, USA and Chairman of the Silurian Subcommission, to the mailing list instead of his name.

e. Nominating Committee

The Chairman said that a new SDS Bureau has to be elected and ratified by the ICS before the next International Geological Congress in Beijing in 1996. CM Oliver was asked to serve as Chairman of the Nominating Committee and he accepted.

9. REPORTS

a. South American activites

CM Turner reported that TM Hünicken proposed to organize a field trip to Palaeozoic sections in Argentina (1997).

CM Marchal reported that he is investigating the Bokkeveld Group (Emsian-Givetian) on the Falkland Islands, including the study of brachiopods, trilobites and spores.

The Secretary received a letter from CM Edwards. She is working on Devonian plants from Argentina and adjacent countries. She has seen very interesting ?Upper Devonian plants from an area (Qda Potroro Rincon) south of Floresta and wonders if any SDS member has contacts or is working in the area.

b. Financial Report

Income for 1994	**US $**
Carried forward from 1993	238.00
Gift	250.00
IUGS Subvention for 1994	1552.00
TOTAL	**2040.00**

Expenditure for 1994

Attendance support Moscow meeting	1150.00
General Expenses	768.00
Circulars	60.00
Newletter: Allocation for N_11	350.00
Address list	10.00
Postage	348.00
Cost of bank transaction	24.76
TOTAL	**1942.76**
Balance carried forward November 1994	97.24

10. FUTURE MEETINGS

a. The first Australian Conodont Symposium (AUCOS-I) will be held in Sydney (Macquarie University) during 18-21 July 1995. There are two pre-symposium excursions, Ordovician-Devonian of southeastern Australia (8-7 July) and Late Devonian - Early Carboniferous of Canning Basin - Ordovician of Amadeus Basin (5-17 July). A post symposium excursion will investigate the Ordovician - Early Carboniferous of the Broken River area (22-28 July). In addition to this field trip there will be an introduction into reef dynamics at the Heron Island Research Station (22 July-3 August). Organizers: R. Mawson, B. Nicoll & J. Talent.

b. It was agreed that the next SDS meeting would be held jointly with IGCP 328 at the Paris Congress "Premiers Vertébrés-Vertébrés Inférieurs" (4-9 September 1995) followed by a field trip to Devonian, Carboniferous and Mesozoic vertebrate localities and stratotypes in Belgium and northern France (10-15 September). The SDS will organize a half-day session on "Ranges of Devonian taxa and extinction events" (see also item 7a). Ranges of taxa should be documented using the "standard conodont scale" reproduced in Newsletter n_10, p.44. **Would those who intend to speak at the session please send the title of the talk as soon as possible to the** Secretary.

c. International Geological Congress Beijing (August 1996)

The Chairman reported that he had received a letter from the ICS Chairman regarding SDS participation. A discussion followed on appropriate activities. In conclusion it was agreed that the SDS will organize a meeting on the subject of Devonian High Resolution Stratigraphy.

11. ANY OTHER BUSINESS

- TM Kirchgasser proposed to organize a field trip in New York State in 1996.
- TM Yolkin reiterated his proposal of last year to hold a meeting with field trip in Siberia after 1996.
- CM Racki wondered if the results of the SDS meeting on Sea Level Changes will be published. The Chairman said that contributions will be published in "Modern Geology" and that he will discuss the results in a preface.
- TM Yolkin thought that contributions by Russian colleagues could also be published in "Russian Geology and Geophysics".
- CM Turner asked that contributions on Sea Level Changes and dealing with microvertebrates should have the IGCP 326 label.
- CM Becker reported that a Courier volume on Devonian Stratigraphy of Germany will be published in 1995.
- The Secretary received a letter from CM Hladil stressing that GSSPs should be completed with parastratotypes in different facies.
- The Chairman thanked members and guests for their attendance and closed the meeting at 7.30 p.m.

P. Bultynck, Secretary, October 1994.

SDS ANNUAL GENERAL MEETING

Moscow, July 13, 1994

Marine/Non Marine Correlation Working Group Annual Report 1994

A. BLIECK with contributions by C. DERYCKE, D.K. ELLIOTT, D. GOUJET, R.R. ILYÈS, P. JANVIER, H. LELIÈVRE and ZHU MIN

This contribution is to be included within the SDS annual general report 1994. It is concerned with recent publications dealing with problems of correlation of vertebrate-bearing localities and formations throughout the World. Data come from the French Working Group of IGCP 328, from other IGCP 328 participants, and from unpublished papers (after recently reviewed manuscripts, with authorization of the authors).

DEVONIAN

BOLIVIA: A small inlier west of lake Poopo has long been known to be Devonian, due to lithostratigraphical correlations. The first fossil assemblages were discovered in this series during the 1991 field expedition to central Bolivia. They give a Middle Devonian age to the equivalent of the Icla/Huamampampa Formations in this region. Among a rather rich invertebrate assemblage (brachiopods, trilobites, bryozoans, conulariids, corals, tentaculitids), spores have been prepared and are congruent with an Eifelian/Givetian age. Few chondrichthyan remains have also been collected. During the same field trip, a prospection of río Iglesiani localities, in the supposed Capinota Formation, Cochabamba department, has been organized in order to find more remains of the recently described vertebrate *Andinaspis suarezoruni* Gagnier 1991 (the type Capinota Formation underlies the lower Upper Ordovician Anzaldo Formation). No more fish remains could be found but several invertebrate and spore localities have been sampled: they all give a Middle Devonian age to the series! (Blieck *et al.*, in prep.).

USA: After a preliminary presentation at the Gross Symposium in August 1993, Elliott & Ilyès worked more on the Early Devonian vertebrate biostratigraphy of the western USA. The age of such vertebrate-bearing formations as the Water Canyon and Beartooth Butte Formations has indeed been under debate for many tens of years. A reappraisal of their correlation and revision of their vertebrate contents show the upper part of the Water Canyon of N. Utah, i.e., the Grassy Flat Member, to be much younger (Givetian) than its lower, Card Member which is correlated to the Emsian. The latter is of the same age as the type Beartooth Butte Formation (BBF), at Beartooth Butte, N. Wyoming, while the BBF at Cottonwood Canyon, N. Wyoming, would be older and correlated to the Lochkovian/Pragian. New vertebrate localities of both the Sandy Member of the Sevy Dolomite at N. Egan Range, E. Nevada, and the Cherty Argillaceous Unit above the Hidden Valley Dolomite of Death Valley, California are dated Emsian on the basis of a correlation to other, conodont-bearing units of the *inversus-serotinus* zones (Elliott & Ilyès, in press; Ilyès & Elliott, in press).

BELGIUM - FRANCE: The Lower Devonian sequence of the classical Ardenne region has provided us with "Gedinnian to Emsian" Old Red Sandstone-like ichthyofaunas. Due to the scarcity of conodonts in this mainly siliciclastic series, the ichthyofaunas have been correlated to the spore-zones from Great Britain to Belgium, through N. France (Blieck *et al.*, in press). However terrestrial plant macroremains may also be not unfrequently collected in several of the vertebrate-bearing formations: a review of these early land plant assemblages with their location within the spore-zone framework is provided by Gerrienne (1994). In this connection, all the Lower Devonian formations of the Ardenne Massif are reviewed and redefined by the Belgian National Committee on Devonian Stratigraphy (Godefroid *et al.*, in press).

EASTERN EUROPE: A collaboration between nine paleopalynologists from Belorussia, Russia, France and Belgium lead to a synthetic correlation chart of the spore-zones in the late Emsian to late Famennian of the East European Platform. It is correlated to the Ardenne-Rhenish type miospore-based zonation, which is correlated to the standard conodont scale. This study should give a basis for correlating numerous fish localities of the Devonian of the East Baltic and Russian platform (Avkhimovitch *et al.*, 1993).

SAOUDI ARABIA: Twelve horizons have been sampled in 1992 in the Early Devonian, Jauf Formation of the Al Huj region. They mainly yielded chondrichthyans, acanthodians, placoderms, and rare sarcopterygians. Placoderms are represented by acanthothoracids, rhenanids, ptyctodonts, petalichtyids, and arthrodires (actinolepids, phlyctaeniids, and primitive eubrachythoracids). One of the assemblages, within the Hammamiyat Member of the formation, is compared to the Khush-Yeilagh fauna of Iran. Recent preparation of the Hammamiyat Member has provided with the first conodonts from this part of the sequence, however the mainly siliciclastic Jauf Formation is very poor in these phosphatic microfossils and a correlation to the orthochronological scale of the Early Devonian cannot be provided as yet (Lelièvre *et al.*, in press). In the same time, the climatic conditions and erosional environment of the Al Huj region prevent from finding good spore assemblages (S. Al Hajri, pers. comm., 1994).

VIET NAM: A new phlyctaeniid arthrodire has been collected in the presumably Middle Devonian Ly Hoa Sandstone, Quang Binh Province, Central Viet Nam. It represents the first discovery of a determinable vertebrate in the Devonian of Central Viet Nam, in terrigenous sediments associated to the Indochina (Kontum) block. It displays anatomical features suggestive of *Gemuendenaspis* from the Emsian of Germany, and, at a first glance, does not share affinities with the

Chinese faunas. However this first record from the Indochina block is still too weak to allow wide palaebiogeographical comparisons to be made (Tong Dzuy & Janvier, in press; Tong Dzuy *et al.*, in press).

CHINA: Several biostratigraphical syntheses of the Early Devonian ichthyofaunas of South China have already been published. However recent new discoveries of vertebrates in the classical Qujing region, Yunnan lead to a redefinition of the fish assemblages within the Xishancun, Xitun, Guijiatun and Xujiachong Formations, which also yield bivalves, ostracodes and plants. Four fish assemblages are defined and used for correlation through South China (Zhu Min *et al.*, 1994).

DEVONIAN / CARBONIFEROUS

BELGIUM - FRANCE: The Middle Devonian to Upper Carboniferous sequence of the Boulonnais-Ardenne area has been sampled for conodonts for several years. Lots of acid leaching residues and new sampling have provided with vertebrate microremains which are the subject of C. Derycke's Ph. D. thesis on *Late Palaeozoic vertebrate microremains between the Channel and the Rhine River (France, Belgium): biodiversity and biostratigraphy* (defence on Oct. 14, 1994). Sampled localities come from upper Givetian to Namurian levels of the Ferques inlier, Boulonnais, France, and the Ardenne Massif, Belgium. The greatest diversity and abundance of ichthyoliths is encountered in Famennian and Namurian localities, the Tournaisian-Viséan ones being much poorer. The chondrichthyans are the most diversified taxon with Holocephali (few Bradyodonti) and mainly Euselachii (Ctenacanthiformes, rare Xenacanthida, Symmoriida, Eugeneodontida, Orodontida, Petalodontida, rare Neoselachii). Other fishes include Acanthodii (mainly *Acanthodes*), Actinopterygii (*Kentuckia*?, *Moythomasia*, *Elonichthys*?), and Sarcopterygii (rare Dipnoi). Preliminary comparisons are made with equivalent strata of the USA, UK, Spain, Poland and Russia. The Frasnian/Famennian biological event cannot be evidenced as the Frasnian samples are from Boulonnais (with abundant actinops and rare chondrichthyans) while the Famennian ones are from the Ardenne (with mainly chondrichthyans). The chondrichthyan assemblages do not show any major change at the Devonian/Carboniferous boundary.

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Lelièvre H., Janvier P. & Goujet D., in press - Les Vertébrés de la Formation Jawf (Dévonien inférieur), Arabie Saoudite. *In* Rapport Technique du BRGM & Ministère du Pétrole et des Ressources Minières, Jeddah, Arabie Saoudite / Notice de la carte géologique de Qualibah.

Tong Dzuy Thanh & Janvier P., in press - The Early Devonian vertebrate fauna from Trang Xa, Bac Thai, Viet Nam, with remarks on the distribution of the vertebrates in the Song Cau Group. *Jl. S. E. Asian Earth Sci.*

Tong Dzuy Thanh, Janvier P. & Doan Nhat Truong, in press - First Devonian placoderm from the Indochina terrane. *Nature.*

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NOMINATIONS OF SDS OFFICERS FOR TERM 1996-2000

Election of subcommission officers requires a long leadtime. Terms of office begin and end at International Geological Congresses so current terms will end during the Congress in China (August 1996). The nominees for the text term (ending at the succeeding Congress, presumably in 2000) are selected by the Titular Members but "elected" by the Stratigraphic Commission and ratified by IUGS. SDS nominations must be submitted to the Commission 9 months before the Congress, i.e. October 1995.

At the Moscow meeting, I agreed to serve as Chairman of the Nominating Committee which, in effect, consists of the Titular Members. To insure that reasonable procedures are followed, I have appointed as auditors, CM F. M. Hueber and Devonophile J.T. Dutro, Jr.; both have accepted.

SDS has three officers: Chairman, Vice-Chairman, and Secretary. All of the current officers are eligible for reelection but only Pierre Bultynck, Secretary, is willing to serve a second term; he is also eligible to serve in either other office. Michael House, Chairman, and Raimund Feist, Vice-Chairman, are unable or unwilling to serve second terms and presumably would not accept nomination to any office.

The purpose of this first notice is to invite all specialists interested in the work of the Subcommission to submit suggestions for the consideration of the Committee. Eligibility to be nominated is not defined by ICS Statutes and is not limited to SDS members, but clearly we should nominate active, stimulating individuals who have demonstrated an interest in the work of SDS. Suggestions of not more than two names for each office should be sent to the Chairman as soon as is practical but no later than March 1995. Nominating Committee members (i.e. TMs) will receive additional notices and instructions but the Newsletter is the only practical way to communicate with CMs and non-members. Send Suggestions soon, by Fax if feasible; please include your Fax number. TMs should send me their Fax number at their early convenience in any case.

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64TH. ANNUAL MEETING OF THE DEUTSCHE PALÄONTOLOGISCHE GESELLSCHAFT

The 64th. Annual Meeting of the German Palaeontological Society took place from 26 to 30 September at Budapest (Hungary) and was hosted by the Hungarian Geological Society. Although the meeting took placae far away from any classical Devonian outcrop a number of contributions dealt with Devonian subjects as follows:

Becker, G., Eine merkwürdige Schalenstruktur bei Ostracoda - Narbenmuster oder Artefakt? [on a peculiar shell feature in a Northern Spanish *Polyzgia*]

Blind, W., Röntgenfossilien aus dem Hunsrückschiefer. [e..g, new findings of *Pyrgocystis* (Edrioasteroidea) and *Palaeocucumaria* (Holothuria)]

Blumenstengel, H., Probleme einer Parachronologie des Oberdevons nach Ostracoden des Thüringer Ökotyps.

Hubmann, B., Zur Blastogenese und Astogenese von *Argutastrea quadrigemina* (Anthozoa, Rugosa).

Hüsken, T.-C. & Eiserhardt, K.-H., Incertae Sedis Muellerisphaerida aus den unterdevonischen Schichten des Schübelberges (Bayrische Faziesreihe, Frankenwald).

Fenninger, A. & Hubmann, B., Ostalpine und südalpine Kalkalgen des Devon: Systematische, ökofazielle und florengeographische Implikationen. [Poster]

Tragelehn, H., Mikrofazies und Fauna de "Korallenkalke" (Frasne) des Frankenwaldes - Relikte von "Riffen" am Nordsaum Gondwanas. [Poster]

R. Th. Becker

IGCP 328 Annual General Meeting

Moscow, July 9, 1994

Annual Report 1994

A. BLIECK with contributions by C. DERYCKE, D.K. ELLIOTT, R.R. ILYÈS, D. GOUJET, P. JANVIER, V. KARATAJUTE-TALIMAA, A. BRAZAUSKAS, H. LELIÈVRE & ZHU MIN

This is to be included within the general IGCP 328 annual report 1994. Data come from the French Working Group, from other IGCP 328 participants, and from unpublished papers (after recently reviewed manuscripts, with authorization of the authors).

ORDOVICIAN

BOLIVIA: *Sacabambaspis*, the oldest vertebrate of South America, has been recently described by Gagnier (1993). It comes from the Anzaldo Formation of central Bolivia. This formation was classically considered as Caradoc in age. However some preliminary palaeontological data lead to the conclusion that it might be older, viz., Llanvirn, thus making *Sacabambaspis* as old as *Arandaspis*, its phylogenetically nearest relative from Australia. Field sampling was processed in 1991 in the Anzaldo Formation as well as in the overlying and supposed underlying formations. All the results, based on brachiopods, acritarchs and foraminifers, come to the conclusion that the Anzaldo Formation is most probably Caradoc in age. An older, Middle ordovician age may be supposed for its lower part in some localities, but this has to be demonstrated after published data (which is not the case for the time being) (Gagnier *et al.*, in press).

SILURIAN

LITHUANIA: A thorough study of borehole samples from west and east Lithuania has provided with a conodont zonation from the upper Llandovery to the Pridoli. It ranges from the *P. amorphognathoides - P. processus* to the *O. eosteinhornensis remscheidensis* zones. Vertebrates range from the middle Wenlock *K. amsdeni* to the upper Pridoli *O. e. remscheidensis* zones (and higher up through the Early Devonian which is devoid of conodonts). Nine fish assemblages ("complexes") are defined, based on thelodonts. They are correlated to the previously described assemblages of Estonia (Karatajute-Talimaa & Brazauskas, in press).

DEVONIAN

BOLIVIA: A small inlier west of lake Poopo has long been known to be Devonian, due to lithostratigraphical correlations. The first fossil assemblages were discovered in this series during the 1991 field expedition to central Bolivia. They give a Middle Devonian age to the equivalent of the Icla/Huamampampa Formations in this region. Among a rather rich invertebrate assemblage (brachiopods, trilobites, bryozoans, conulariids, corals, tentaculitids), spores have been prepared and are congruent with an Eifelian/Givetian age. Few chondrichthyan remains have also been collected. During the same field trip, a prospection of río Iglesiani localities, in the supposed Capinota Formation, Cochabamba department, has been organized in order to find more remains of the recently described vertebrate *Andinaspis suarezorum* Gagnier 1991 (the type Capinota Formation underlies the lower Upper Ordovician Anzaldo Formation). No more fish remains could be found but several invertebrate and spore localities have been sampled: they all give a Middle Devonian age to the series! (Blieck *et al.*, in prep.).

USA: After a preliminary presentation at the Gross Symposium last August, Elliott & Ilyès reworked on the Early Devonian vertebrate biostratigraphy of the western USA. The age of such vertebrate-bearing formations as the Water Canyon and Beartooth Butte Formations has indeed been under debate for many tens of years. A reappraisal of their correlation and revision of their vertebrate contents show the upper part of the Water Canyon of N. Utah, i.e., the Grassy Flat Member, to be much younger (Givetian) than its lower, Card Member which is correlated to the Emsian. The latter is of the same age as the type Beartooth Butte Formation (BBF), at Beartooth Butte, N. Wyoming, while the BBF at Cottonwood Canyon, N. Wyoming, would be older and correlated to the Lochkovian/Pragian. New vertebrate localities of both the Sandy Member of the Sevy Dolomite at N. Egan Range, E. Nevada, and the Cherty Argillaceous Unit above the Hidden Valley Dolomite of Death Valley, California are dated Emsian on the basis of a correlation to other, conodont-bearing units of the *inversus-serotinus* zones (Elliott & Ilyès, in press; Ilyès & Elliott, in press).

BELGIUM - FRANCE: The Lower Devonian sequence of the classical Ardenne region has provided us with "Gedinnian to Emsian" Old Red Sandstone-like ichthyofaunas. Due to the scarcity of conodonts in this mainly siliciclastic series, the ichthyofaunas have been correlated to the spore-zones from Great Britain to Belgium, through N. France (Blieck *et al.*, in press). However terrestrial plant macroremains may also be not unfrequently collected in several of the vertebrate-bearing formations: a review of these early land plant assemblages with their location within the spore-zone framework is provided by Gerrienne (1994). In this connection, all the Lower Devonian formations of the Ardenne Massif are reviewed and redefined by the Belgian National Committee on Devonian Stratigraphy (Godefroid *et al.*, in press).

EASTERN EUROPE: A collaboration between nine paleopalynologists from Belorussia, Russia, France and Belgium lead to a synthetic correlation chart of the spore-zones in the late Emsian to late Famennian of the East European Platform. It is correlated to the Ardenne-Rhenish type miospore-based zonation, which is correlated to the standard conodont scale. This study should give a basis for correlating numerous fish localities of the Devonian of the East Baltic and Russian platform (Avkhimovitch *et al.*, 1993).

SAOUDI ARABIA: Twelve horizons have been sampled in 1992 in the Early Devonian, Jauf Formation of the Al Huj region. They mainly yielded chondrichthyans, acanthodians, placoderms, and rare sarcopterygians. Placoderms are represented by acanthothoracids, rhenanids, ptyctodonts, petalichtyids, and arthrodires (actinolepids, phlyctaeniids, and primitive eubrachythoracids). One of the assemblages, within the Hammamiyat Member of the formation, is compared to the Khush-Yeilagh fauna of Iran. Recent preparation of the Hammamiyat Member has provided with the first conodonts from this part of the sequence, however the mainly siliciclastic Jauf Formation is very poor in these phosphatic microfossils and a correlation to the orthochronological scale of the Early Devonian cannot be provided as yet (Lelièvre *et al.*, in press). In the same time, the climatic conditions and erosional environment of the Al Huj region prevent from finding good spore assemblages (S. Al Hajri, pers. comm., 1994).

VIET NAM: A new phlyctaeniid arthrodire has been collected in the presumably Middle Devonian Ly Hoa Sandstone, Quang Binh Province, Central Viet Nam. It represents the first discovery of a determinable vertebrate in the Devonian of Central Viet Nam, in terrigenous sediments associated to the Indochina (Kontum) block. It displays anatomical features suggestive of *Gemuendenaspis* from the Emsian of Germany, and, at a first glance, does not share affinities with the Chinese faunas. However this first record from the Indochina block is still too weak to allow wide palaebiogeographical comparisons to be made (Tong Dzuy & Janvier, in press; Tong Dzuy *et al.*, in press).

CHINA: Several biostratigraphical syntheses of the Early Devonian ichthyofaunas of South China have already been published. However recent new

discoveries of vertebrates in the classical Qujing region, Yunnan lead to a redefinition of the fish assemblages within the Xishancun, Xitun, Guijiatun and Xujiachong Formations, which also yield bivalves, ostracodes and plants. Four fish assemblages are defined and used for correlation through South China (Zhu Min *et al.*, 1994).

DEVONIAN / CARBONIFEROUS

BELGIUM - FRANCE: The Middle Devonian to Upper Carboniferous sequence of the Boulonnais-Ardenne area has been sampled for conodonts for several years. Lots of acid leaching residues and new sampling have provided with vertebrate microremains which are the subject of C. Derycke's Ph. D. thesis on *Late Palaeozoic vertebrate microremains between the Channel and the Rhine River (France, Belgium): biodiversity and biostratigraphy*. Sampled localities come from upper Givetian to Namurian levels of the Ferques inlier, Boulonnais, France, and the Ardenne Massif, Belgium. The greatest diversity and abundance of ichthyoliths is encountered in Famennian and Namurian localities, the Tournaisian-Viséan ones being much poorer. The chondrichthyans are the most diversified taxon with Holocephali (few Bradyodonti) and mainly Euselachii (Ctenacanthiformes, rare Xenacanthida, Symmoriida, Eugeneodontida, Orodontida, Petalodontida, rare Neoselachii). Other fishes include Acanthodii (mainly *Acanthodes*), Actinopterygii (*Kentuckia*?, *Moythomasia*, *Elonichthys*?), and Sarcopterygii (rare Dipnoi). Preliminary comparisons are made with equivalent strata of the USA, UK, Spain, Poland and Russia. The Frasnian/Famennian biological event cannot be evidenced as the Frasnian samples are from Boulonnais (with abundant actinops and rare chondrichthyans) while the Famennian ones are from the Ardenne (with mainly chondrichthyans). The chondrichthyan assemblages do not show any major change at the Devonian/Carboniferous boundary.

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IGCP 328 Annual General Meeting

Moscow, July 9, 1994

French Working Group Annual Report 1994

A. BLIECK, with contributions by
R. CLOUTIER, C. DERYCKE, D. GOUJET, P. JANVIER and H. LELIÈVRE

Most of our works focused on Devonian matters since the Gross Symposium, Göttingen, August 1993, however a few Ordovician-Silurian data are also concerned with.

A. Blieck finished to coordinate a paper on new biostratigraphical data on the Ordovician and Silurian of Bolivia, after samples collected with P.Y. Gagnier in 1991. We attempted to date as precisely as possible the *Sacabambaspis*-bearing localities of the Anzaldo Formation, and come to the conclusion that they are most probably Caradoc in age, better than Llanvirn after proposals from other authors. Some localities from the supposed underlying Capinota Formation of central Bolivia, where *Andinaspis suarezorum* Gagnier 1991 is supposed to come from, have been dated Devonian on the basis of spores and shelly faunas. A new Devonian vertebrate locality is also described from west of lake Poopo, in a second paper in progress. A collective book on the revision and redefinition of all Early Devonian formations of the Ardenne Massif, Belgium-France, is coordinated by P. Bultynck; it will review the whole classical sections of the "Gedinnian", "Siegenian" and Emsian with biostratigraphical correlations to the standard Lochkovian-Pragian-Emsian stages. Another paper in collaboration has been finished on the general geology of Gondwana, with special emphasis on its Palaeozoic continental drift evolution. Alain is presently mainly involved in writing his part of the *Handbook of Paleoichthyology* volume 1 on agnathans, viz., the Pteraspidomorphi chapter, in collaboration with D.K. Elliott. Nothing else is planned for the weeks and months to come... The only field activities were for short prospections of the Lower Devonian of Artois, France (with the two Belgian colleagues P. Steemans and P. Gerrienne, for paleopalynology and paleobotany respectively), and of the Lower Devonian of the Ardenne, France (with structural and sedimentologist geologists F. Meilliez *et al.*). Next year should concentrate on the SDS thematic volume for the *Courier Forschungsinstitut Senckenberg* on Devonian correlation charts, and on the biostratigraphical synthesis of Early Devonian ichthyofaunas of the Old Red Continent for the Paris 1995 Early Vertebrates Meeting (IGCP 328/SDS joint symposium), as well as on related matters.

R. Cloutier continued to work chiefly on the Early Frasnian ichthyofauna of Miguasha: he has nearly completed with H.P. Schultze the editing of *Paleontology and Geology of the Upper Devonian Escuminac Formation from Québec, Canada*, and finished to write his own eight or so chapters for this book (on *Cheirolepis*, dipnoans, *Eusthenopteron*, *Miguashaia*, porolepiforms, faunal comparisons, distribution and taphonomy). He is presently in the field in Miguasha until next September to finish the process of a bed-by-bed sampling of the formation in order to more precisely assess its paleoenvironmental conditions of deposition (geochemistry, sedimentological analysis, spores, acritarchs, ichnofossils, taphonomy of fishes). He is also working for papers on sarcopterygians (dipnoans, actinistians, salamanders), on theoretical phylogenetic problems (homology and phylogeny, use of basal taxa), and on computer image analysis.

C. Derycke is presently mainly involved in writing her Ph. D. thesis on *Late Palaeozoic vertebrate microremains between the Channel and the Rhine River (France, Belgium): biodiversity and biostratigraphy*. Sampled localities come from upper Givetian to Namurian levels of the Ferques inlier, Boulonnais, France, and the Ardenne Massif, Belgium. The greatest diversity and abundance of ichthyoliths is encountered in Famennian and Namurian localities, the Tournaisian-Viséan ones being much poorer. The chondrichthyans are the most diversified taxon with Holocephali (few Bradyodonti) and mainly Euselachii (Ctenacanthiformes, rare Xenacanthida, Symmoriida, Eugeneodontida, Orodontida, Petalodontida, rare Neoselachii). Other fishes include Acanthodii (mainly *Acanthodes*), Actinopterygii (*Kentuckia*?, *Moythomasia*, *Elonichthys*?), and Sarcopterygii (rare Dipnoi). Preliminary comparisons are made with equivalent strata of the USA, UK, Spain, Poland and Russia. The Frasnian/Famennian biological event cannot be evidenced as the Frasnian samples are from Boulonnais (with abundant actinops and rare chondrichthyans) while the Famennian ones are from the Ardenne (with mainly chondrichthyans). The chondrichthyan assemblages do not show any major change at the Devonian/Carboniferous boundary. Claire also spent a lot of time in teaching geological matters at both the Catholic University of Lille and the newly opened Artois University, Lens, Pas-de-Calais. She went to the field in Boulonnais to try tracing a Famennian? oolitic marker bed of the Ferques inlier sequence.

D. Goujet prepared part of the samples collected in the Early Devonian Jauf Formation of Saudi Arabia. Acanthothoracid placoderm microremains are abundant and occur together with acanthodian and chondrichthyan scales. Numerous skull elements, and in particular complete endocrania of a new acanthothoracid have been extracted (see H. Lelièvre here below). Daniel also studied isolated acanthothoracid remains (among which several skull and pectoral girdle bones) from boreholes in the Timan-Pechora region of Russia, in collaboration with V. Karatajute-Talimaa and E. Mark-Kurik.

P. Janvier achieved his writing of a handbook on early vertebrates for Oxford University Press as well as his chapters for the *Handbook of Paleoichtyology* volume 1 on agnathans (Osteostraci, Galeaspida, Pituriaspida, Anaspida, lampreys, myxinoids). He has completed a revision of the osteostracans of Miguasha with M. Arsenault, for the book edited by H.P. Schultze, R. Cloutier and D. Vézina. He also participated to the preliminary description of the Early Devonian ichthyofaunas of Saoudi Arabia that he collected with H. Lelièvre. Philippe went to the field in Vietnam in November 1993 where he collected Early Devonian galeaspids and youngolepids in Trang Xa, Thai Nguyên Province, and the first Middle Devonian placoderms of central Vietnam. The latter come from the Indochina block, contrary to the previously collected Vietnamese Devonian ichthyofaunas which are from the southern South China block. They should provide us with new interesting biogeographical comparisons. Philippe is planning a monograph on Devonian vertebrates of Khush-Yeilagh, Iran, with a possible field trip to this country next October. He is also organizing a field expedition to the Upper Devonian vertebrate-bearing localities of Antalya, Turkey, with the French geologist J. Marcoux, next September. He will perhaps go back to central Vietnam next November or December, in conjunction with his participation to the IGCP 306 meeting on stratigraphical correlations in South East Asia.

H. Lelièvre has spent lot of time in preparing the Early Devonian fishes collected in Saoudi Arabia in 1992 together with P. Janvier. The fauna is extremely diverse and often very well preserved. Twelve horizons have been sampled in the Jauf Formation of the Al Huj region. The first conodonts have been extracted from the Hammamiyat Member. But the formation mainly yielded chondrichthyans, acanthodians, placoderms, and rare sarcopterygians. Placoderms are represented by acanthothoracids, rhenanids, ptyctodonts, petalichtyids, and arthrodires (actinolepids, phlyctaeniids, and primitive eubrachythoracids). One of the assemblages, within the Hammamiyat Member of the formation, is compared to the Khush-Yeilagh fauna of Iran. Hervé is also writing his second doctorate thesis (called "thèse d'habilitation" in French) on placoderms; it will be mainly concerned with detailed anatomical descriptions of the species collected in the Devonian of Morocco and with phylogenetic analyses. However biostratigraphical results will also come as lots of Moroccan Devonian vertebrate-bearing localities have yielded a well-known marine invertebrate fauna (brachiopods, trilobites, goniatites, conodonts, ostracodes).

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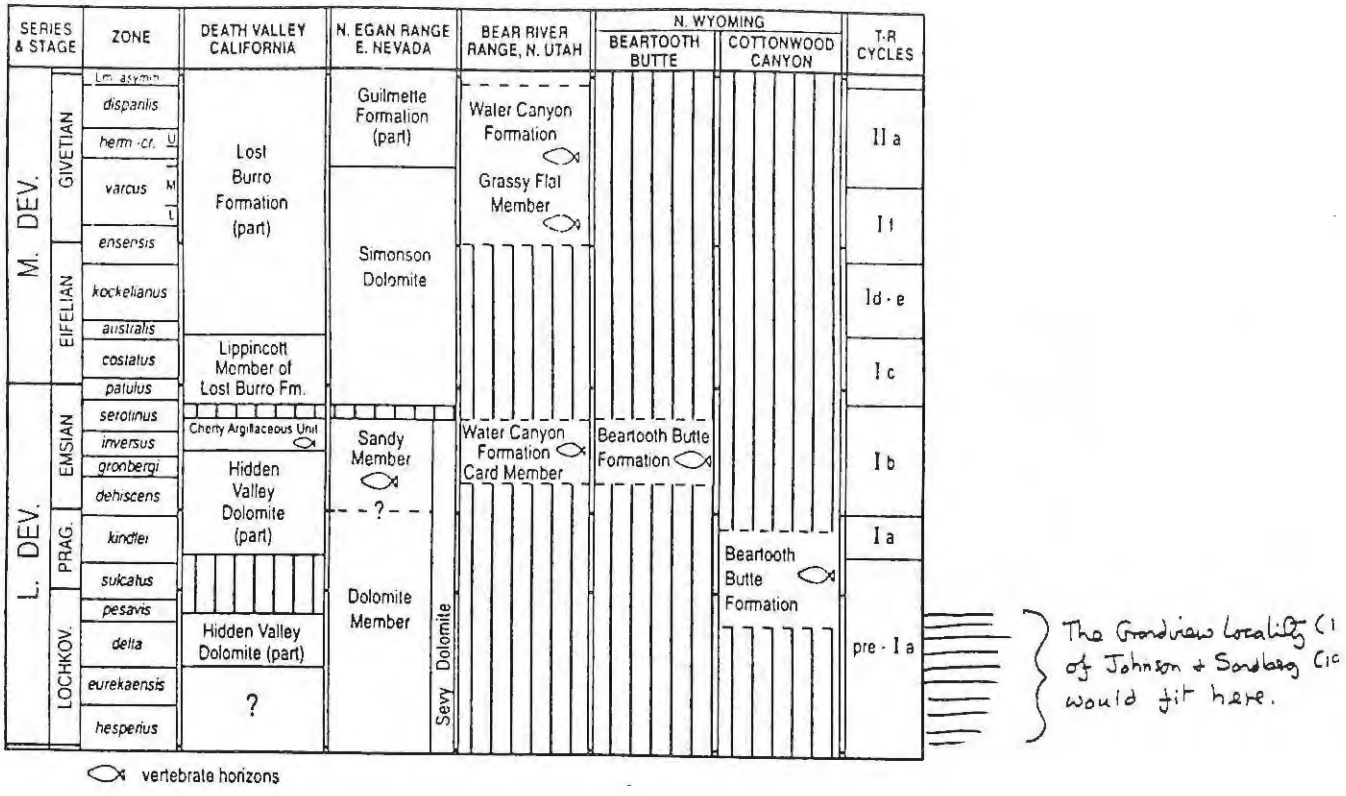
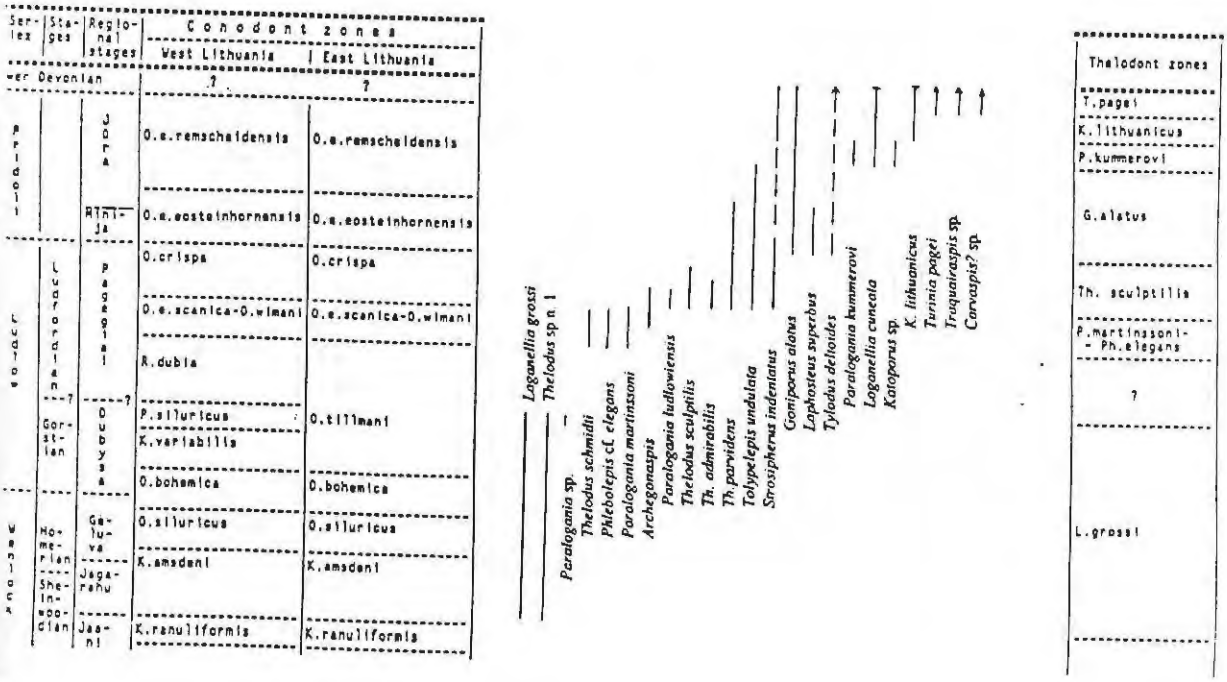
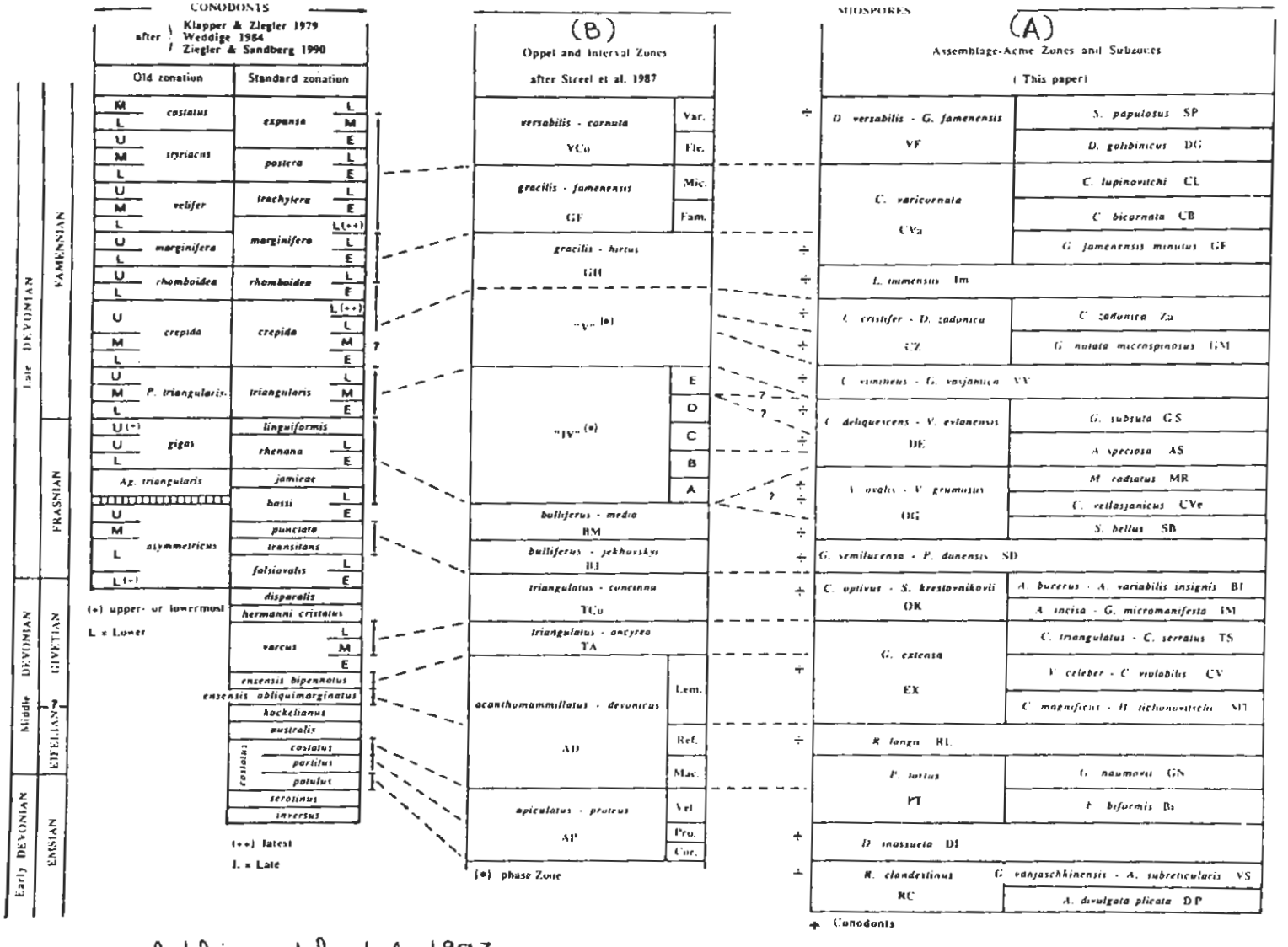
Elliott & Ilyes, in press



Karatajūtė-Talimaa & Burzanskas, in press





Avkhimovitch etal., 1993

FIGURE 4

Middle and Late Devonian biostratigraphical (Conodonts and miospores) relations between the East European Platform and the Ardenne-Rhine regions, modified after Streel & Loboziak in press

(A) (B)

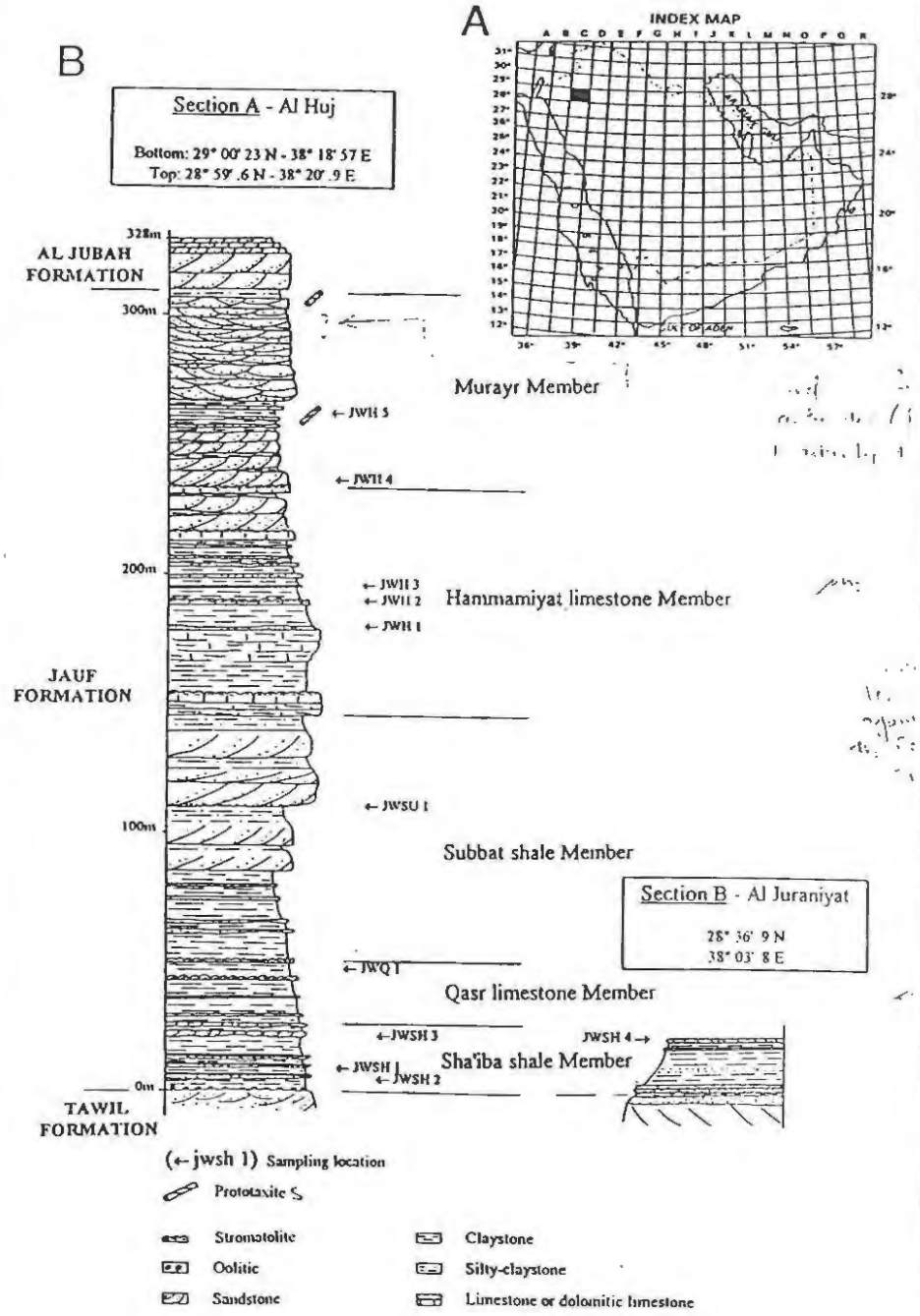
Berrienne, 1994

ETAGES	LOCHKOVIEN					PRAGUIEN ?					EMSIEN						EIF.
BIOZONES (Streel *et al.*, 1987; Steemans, 1989)	MN					BZ		PoW				AB	FD			AP	
	N	R	M	Si	G	Z	E	Po	W	Pa	Su		Fow	Pra	Min	Cor	Pro	Vel
Taeniocrada decheniana	18																	
Zosterophyllum fertile	18																	
Pachytheca sp.	18					14A	14B	2	3	12	17	19	25	8B	15	23		
Hostinella sp.	18														8A	20		
Psilophytites gileppensis						14A												
Gosslingia breconensis						14A							25					
Gen. nov. indéterminé								24										
Prototaxites sp.						14A	14B	2	3	17	19	24	25	15				
Dawsonites arcuatus								24					25	4	6	16A		
cf. *Psilophyton princeps*								24					4	6	7	22		
Sporogonites exuberans								24					4	6	7	22		
Drepanophycus spinaeformis								2	24				4	6	7	8A	8B	16C 22
Taeniocrada sp.									1	12			7			16C	22	
Dawsonites magnus												5						
Taeniocrada dubia												25	22					
Aphyllopteris sp.												25				21		
Dreponophycus sp.												25				11	13	20
Psilophytites sp.												1	16A			9	11	
Anisophyton cf. *gothanii*													7					
Estinnophyton gracile													6					
Foozia minuta													7					
Forgesia curvata													16A					
Krithodeophyton sp.													16A					
Psilophyton cf. *crenulatum*													16A					
Psilophyton forbesii													16A					
Psilophyton sp. nov. 1													16A					
Psilophyton sp. nov. 2													16A					
Rebuchia (?) *pendula*													6					
cf. *Sawdonia ornata*													16A					
Sciadophyton laxum													6					
Urpicalis steemansii													7					
Zosterophyllum deciduum													16A					
Zosterophyllum cf. *fertile*													16A					
Dawsonites sp.														9	11	13	16C	
Drepanophycus (?) *crepinii*															9			
Drepanophycus gaspianus													4	7		20	23	
"*Psilophyton*" *burnotense*												4	6	7	16A	8A	16B	16C 20 22 23
Stockmansella langii													4	6			21	
Sartilmania jabachensis																	21	

Fig 2 - Répartition stratigraphique des végétaux éodévoniens de Belgique

— = datation par la palynologie
= datation par corrélation lithostratigraphiques
Les localités (1 à 25) sont indiquées pour chaque taxon (voir tableau 1)

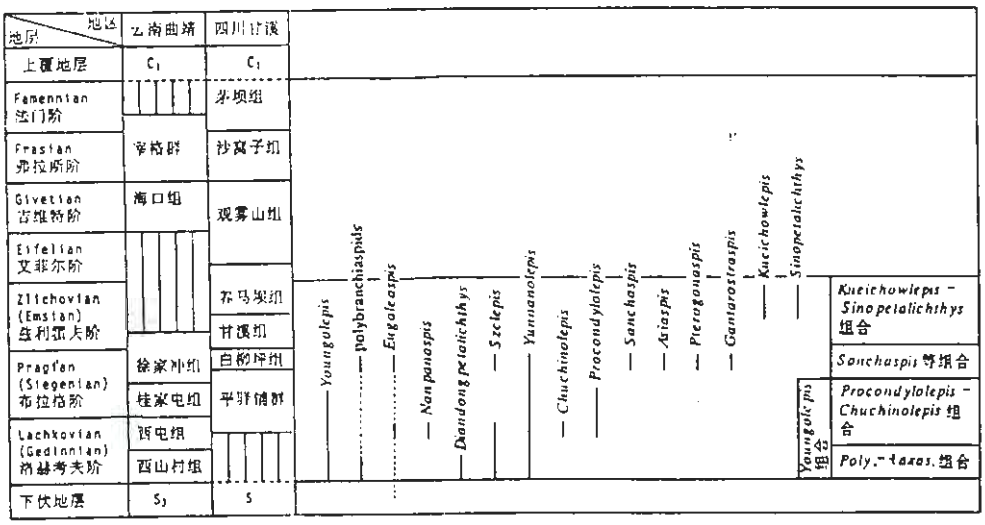
Lelièvre et al., in press



ZHU Min et al., 1994

表 2 华南早泥盆世脊椎动物化石的地层分布及组合

Table 2 Assemblage and stratigraphical distribution of the vertebrate species in early Devonian of southern China



REPORT ON IGCP PROJECT 335 MEETING "BIOTIC RECOVERY FROM MASS EXTINCTION EVENTS" BASED AT PLYMOUTH, ENGLAND, SEPTEMBER 3-10, 1994

There were 61 registrants for this IGCP meeting which is the successor programme to the successful IGCP Project 216 on "Global Biological Events in Earth History" led by Otto Walliser. The meeting was held at the University of Plymouth, Devon. The meeting was well attended by Devonian Subcommission members. The following SDS members gave contributions; Jindrich Hladil and Petr Cejchan (Prague, Czechia) spoke on "Are we able to find any patterns of colonization and survivorship? Lower Frasnian to Lower Famennian marine benthic dwellers"; John Talent, with G.A. Wilson & R. Mawson spoke on "Faunal dynamics through the end- *pesavis* Event (Early Devonian: Lochkovian - Pragian boundary); and Michael House spoke on "Goniatite survival strategies following Devonian extinction events". Malcolm Hart (Plymouth University), the organisor of the whole meeting, was unable to lead the final excursion to the Mesozoic of the Dorset coast and his place as leader was taken by Michael House.

Other papers of SDS interest included; J. Kalvoda (Brno, Czechia), on "Trends in the late Devonian - Early Carboniferous conodont evolution"; C.G. Maples, J.A. Waters (USA), N.G. Lane, Hou Hong-Fei, S.A. Marcus & W. Jin-Xing (U.S.A. and Beijing, PRC), on "Famennian echinoderm recovery from Late Devonian mass extinction events: evidence from the People's Republic of China". J.A. Waters on "Echinoderm rebound from Late Devonian Extinctions"; George R. McGhee Jr (U.S.A.) on "Recovery and reorganisation of marine ecosystems of New York State (U.S.A.) following the Givetian extinctions (Middle/Late Devonian). Publication of papers is planned in the special volume series of the Geological society of London.

M.R. House

NEW INTAS RESEARCH PROGRAMME

In 1993, with funding from the European Community, an association was established to foster cooperation between European Community member states and the independent states of the former Soviet Union under the acronym INTAS< in abbreviation of "The International Association for the Promotion of Cooperation with Scientists from the Independent States of the former Soviet Union for Joint Scientific Research and Networking Projects". This was advertised in Nature, v. 365, 16 September 1993.

A successful application for funding was made by Michael House (Southampton) on behalf of a cooperating group including: RT. Becker (Berlin), P. Bultynck (Brussels), R. Feist (Montpellier), A. Kusmin (Moscow), V. Minner (Moscow), N. Ovnatanova (Moscow) and S.V. Yatskov (Moscow), with associates G. Klapper (Iowa) and J.E.A. Marshall (Southampton). Details of the title and objectives are given below:

Title: Mid-Palaeozoic greenhouse anoxic and eustatic events in the Timan, Urals and western European regions.

Objectives: To establish detailed biostratigraphic successions for the late Devonian rock sequences of the Timan, Polar Urals and Urals. The initial phase currently funded will concentrate on the Timan and Petchora Basin. Primary methods will use conodont and ammonoid international high-resolution zonations as precise scale against which lithological changes in Timan and Pechora Basin sequences can be related. Lithological and faunal characteristics of the sequences will be documented. Results will be integrated to model sea level changes for the succession. International correlations will be used to establish contemporaneity or otherwise of transgressive/regressive events; this will be used in comparison with models established for North America, Western Europe, Australia and North Africa to separate local epeirogenic sea-level change signatures from those which are world wide and eustatic.

Most of the cooperating group met in Moscow in July 1994 to initiate the programme and to deal with organizational matters. Most members of the group joined the SDS field excursion to the Timan in July to familiarize western participants with the local problems. The initial phase of the study will deal with the Petchora Basin and later extend to the Polar Urals. Later phases are planned to extend to the northern, central and southern Urals. In 1995 joint work will continue in the area, and most Russian participants will join a field excursion to Frasnian sequences in Belgium, France and Germany in September 1995.

Michael House
September 1994

by G Klapper, R Feist, R T Becker and M R House

Definition of the Frasnian/Famennian Stage boundary

The boundary for the Frasnian/Famennian Stage Global Stratotype Section and Point (GSSP) has been ratified by ICS and IUGS and is drawn in a section exposed near the Upper Coumiac Quarry in the southeastern Montagne Noire, France. The position of the boundary was selected by the Subcommission on Devonian Stratigraphy in 1991 to coincide with the lower boundary of the Lower Palmatolepis triangularis *Zone in the conodont biostratigraphy. The revised definition of the lower boundary of the zone, proposed herein, excludes the extremely rare occurrences of* Palmatolepis triangularis *a few centimetres lower, within the uppermost conodont zone. The GSSP also coincides with the boundary between the* Crickites holzapfeli *Zone and the* Phoenixites frechi *Zone in the goniatite scale. The position of the GSSP is immediately above a major horizon of extinction within the Devonian and is stratigraphically somewhat lower than formerly used boundary levels for the base of the Famennian.*

Introduction

Historically, several different levels have been used to define the base of the Famennian. In the type area for the naming of the stages in southern Belgium, precise documentation in recent years has been given to a new reference section replacing the now-infilled classic section in the Senzeilles railway cutting (Bultynck and others, 1988). Largely resulting from work in the first quarter of this century in Germany, another boundary was used that was based on the entry of the goniatite *Cheiloceras* in the pelagic realm. In the latter half of this century the considerable growth of conodont studies has led to much refinement of the biostratigraphy. However, the level taken as the base of the Famennian has varied between a level at the base of the *crepida* Zone down to the base of the Lower *triangularis* Zone. The need for an international definition has become urgent. The Subcom-

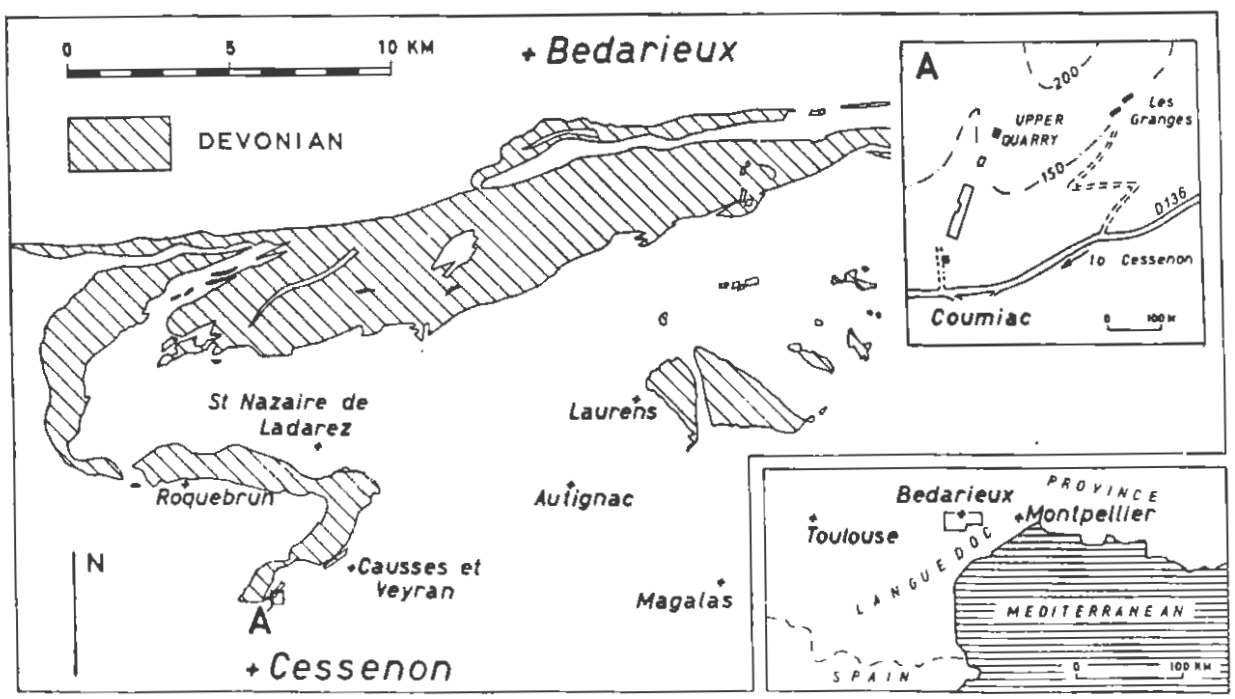


Figure 1 Maps showing the position of the Montagne Noire in southeastern France and of the Upper Coumiac Quarry near Cessenon, the site of the Global Stratotype Section and Point (GSSP) for the definition of the base of the Famennian Stage (inset map A). Modified from Becker and others (1989).

mission on Devonian Stratigraphy (SDS) has given careful consideration to which level is most appropriate for international correlation and it decided, at a meeting in Washington in 1989, that a GSSP should be sought in relation to the base of the Lower *triangularis* conodont Zone. Final ballots and ratification by ICS and IUGS (in January 1993) led to a level in a section at Coumiac, southern France being designated as the Global Stratotype Section and Point (GSSP). A brief review of the documentation leading to this decision is given here. The conodont and goniatite biostratigraphic divisions are shown in figures 5 and 6.

It has been recognised by the Subcommission that, in general, Devonian sections in pelagic realm facies are more likely to be complete than those in the neritic facies. The pelagic facies forms a better basis for the biostratigraphical precision needed for international correlation. In particular the conodont and goniatite records are better in those facies. That is not to imply that there are not facies rich in other groups, for example spores and brachiopods, which are very important for correlation, but it is normally easier to correlate into such sections secondarily from primary sections in the pelagic facies. In the last resort the Subcommission concentrated on two such sections, one at Steinbruch Schmidt in the Rhenish Slate Mountains, Germany (Sandberg and others, 1990; Schindler, 1990) and the other at Coumiac in the Montagne Noire (Feist, 1990). The latter was finally selected because of the better documentation of macrofossil groups.

Recommended stratotype

The recommended boundary GSSP between the Frasnian and Famennian Stages (Devonian) is above the Upper Coumiac Quarry, near Cessenon, Montagne Noire, France (figure 1). The section is situated in the southeastern Montagne Noire, Département Hérault, District of Cessenon (topographic sheet 1:25 000, No. 2544 E, Murviel-lès-Béziers; Lambert's coordinates: x = 130 375, y = 658 55). It is adjacent to the southeastern border of the disused upper marble quarry (UQ) of Coumiac, 175 m WSW of the Les Granges farmhouse, about 1.5 km NE of Cessenon village and 2100 m SW of Causses et Veyran. It can be reached easily by a path up the hill from near the track to Les Granges farmhouse from the road D136 between Cessenon and St Nazaire-de-Ladarez. The ground is owned by the commune of Cessenon and is already protected as part of a water supply area. Conservation and protection of the section has been assured by communal and department officials. Free access for scientists is confirmed.

The sequence is one of pelagic calcilutites, mostly red tinted and well bedded, with bedding probably controlled by Milankovitch-Band climatic oscillations during sedimentation. The sequence has been described in published accounts (House and others, 1985; Klapper, 1989; Becker and others, 1989; Schindler 1990; Becker 1993a) and is depicted in figure 2. The boundary is drawn between Beds 31g and 32a as shown in figures 2 and 3. Distinctive is Bed 31g which is correlated with the Upper Kellwasser Limestone of Germany and which is a hypoxic dark grey calcilutite to calcarenite above which is the most marked faunal boundary. Both Beds 31g and 32a are characterized by pelagic faunas.

The sequence chosen shows a complete succession through the early Frasnian to late Famennian. It is unfaulted and has no tectonic problems. The beds are approximately vertical. Equivalent sections can be found elsewhere in the area. The rocks are of low-grade metamorphism and thermal maturity (CAI 2-3) and comprise an homogeneous pelagic calcilutite sequence without marly or shaly interbeds. There is a complete zonal succession with a rich fossil content, especially of the biostratigraphically significant groups of conodonts, ammonoids, trilobites, tentaculites and ostracods. Detailed documentation has been provided of this (Feist, 1990). Geochemical work across the boundary at Coumiac has also been published (Goodfellow and others, 1989; Grandjean and others, 1989; Grandjean-Lécuyer and others, 1993; Joachimski and Buggisch, 1993; Girard and others, 1993) and currently other investigations are being

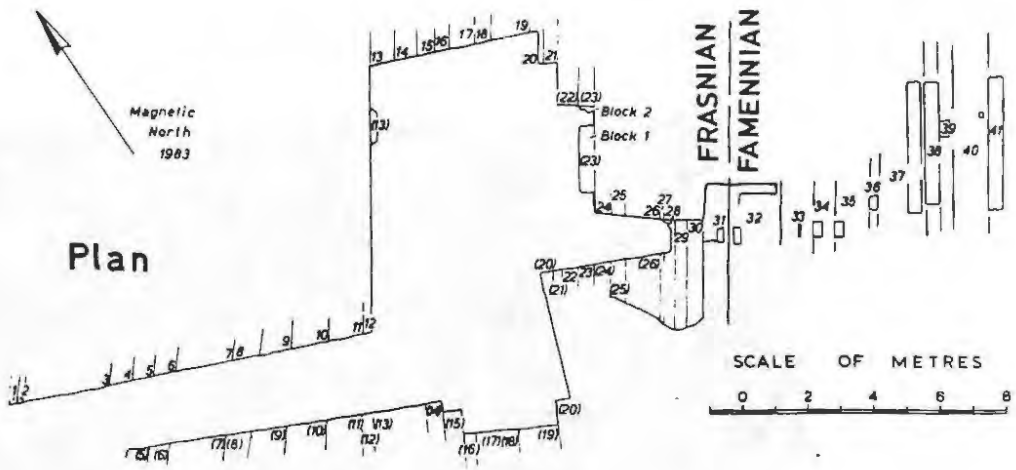


Figure 2 Detailed map of the Upper Quarry at Coumiac, near Cessenon, showing the bed numbering and the position of the GSSP defining the base of the Famennian between Beds 31 and 32. Modified from House and others (1985).

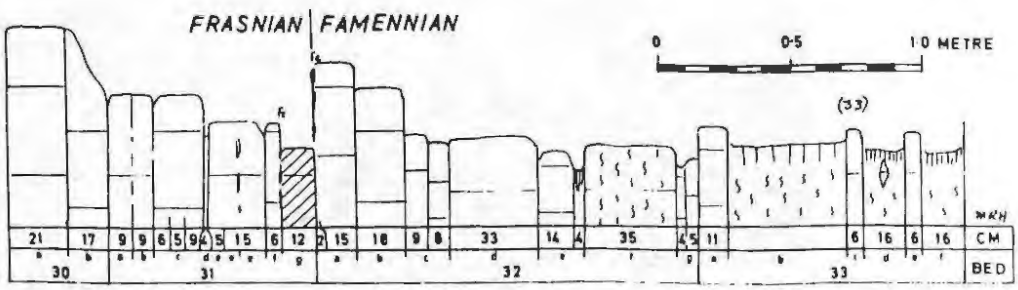


Figure 3 The detailed succession of beds around the GSSP level between beds 31g and 32a above the Upper Coumiac Quarry near Cessenon.

undertaken. Magnetostratigraphic work indicates that the area was remagnetized during the Permian

Correlation of the proposed boundary level

The boundary level proposed represents perhaps the best correlated horizon in the Devonian. A review of more than 30 international sections has been presented by Sandberg and others (1988) including localities in North America and Europe. Further correlation is established in North Africa (Becker and others, 1988), China (Ji, 1989) and Australia (Becker and others, 1991). The boundary corresponds to the extinction of all species of the conodonts *Ancyrodella* and *Ozarkodina* and the loss of all but a few species of *Palmatolepis*, *Polygnathus*, and *Ancyrognathus*, according to Sandberg and others (1988, pp. 293–294). There is a well-known extinction among goniatites of the Gephuroceratidae and Beloceratidae and the record for both conodonts and goniatites at Coumiac demonstrates this well. The last of the brachiopod Atrypidae occurs just below the boundary level (Becker and others, 1991). Among trilobites the Dalmanitidae, Odontopleuridae, Harpetidae and Aulacopleurinae all disappear at the base of the end-Frasnian Upper Kellwasser Limestone level of Bed 31g. Others have documented the global extinction of coral (Sorauf and Pedder, 1986; Scrutton, 1988), stromatoporoid (Stearn, 1987) and acritarch (Vanguestaine and others, 1983) groups and there has been much recent local documentation in many areas. A changeover of benthonic ostracod faunas across the boundary at Coumiac has been published (Lethiers and Feist, 1991).

Conodont record

The conodont sequence at the Upper Coumiac Quarry extends from within the middle part of the Frasnian across the Frasnian/Famennian boundary and into the lower Famennian (as high as the Upper *crepida* Zone in the current sampling up to Bed 44). Upper Coumiac is a key sequence for the thirteen fold Montagne Noire Frasnian zonation (Klapper 1989) substantial parts of which have been replicated at various sections in North America, Western Australia, and European Russia (Klapper and Foster 1993, figure 2). The sequence at Upper Coumiac extends from Frasnian Zone 5 to the top of Zone 13 (= top of the Frasnian), but only the higher part of the Frasnian sequence is of concern here.

Bed 24a, the Lower Kellwasser Limestone, has the lowest occurrence of *Ancyrognathus asymmetricus*, which is the defining species for the lower boundary of the Upper *gigas* Zone in the zonation of Ziegler (1962, p.23, 1971). The conodont fauna of Bed 24a is interpreted as the highest sampled level of Montagne Noire Zone 12 (Klapper, 1989, p. 456, figure 4). However, due to the facies of the Lower Kellwasser at Coumiac, which apparently resulted in the extreme rarity of *Palmatolepis* in Bed 24a, a higher zonal identification cannot be excluded. Nonetheless, the lower boundary of Zone 13 is necessarily taken at the lowest occurrence of *Palmatolepis bogartensis* in Bed 24e (figure 5), as well as at the coincident lowest occurrence of *Pa. hassi* s.s. The lowest occurrence of *Pa. rhenana* sensu Klapper and Foster (1993, p. 24, figure 2) is high within Zone 13 in Bed 30b, coincident with the lowest *Pa. boogaardi* (figure 5).

It is noteworthy that species characteristic of the higher part of the Frasnian at Upper Coumiac, *Palmatolepis bogartensis*, *Pa. winchelli*, *Pa. rhenana*, *Pa. boogaardi*, *Ancyrognathus asymmetricus*, and *Ancyrodella curvata* all terminate in either Beds 31f or 31g. The conodont fauna of Bed 31g, the Upper Kellwasser Limestone, has all but two of the foregoing species (figure 5) and is dominated in terms of its *Palmatolepis* component, by *Pa. bogartensis* and *Pa. winchelli*. On evidence of the lowest (and only) occurrence of *Ancyrognathus ubiquitus* in Bed 31g, the fauna is apparently correlative with the upper part of the *linguiformis* Zone (Ziegler and Sandberg, 1990, p. 21), despite the absence of *Pa. linguiformis*. In the Montagne Noire Frasnian zonation, Bed 31g represents the highest part of Zone 13. *Ancyrognathus ubiquitus* also occurs in faunas of the Upper Kellwasser Limestone at three other nearby Montagne Noire localities: Causses et Veyran North and South, and Lower Coumiac (Feist, 1990, pp. 19, 24, 30). All these faunas are correlative with the *linguiformis* Zone, but lack the nominal species (Becker and others, 1989, pp. 262, 265).

Figure 4
Photograph of the succession above the Upper Coumiac Quarry. The GSSP lies between Bed 31g and 32a. For scale compare with the profile of the beds given in figure 3.

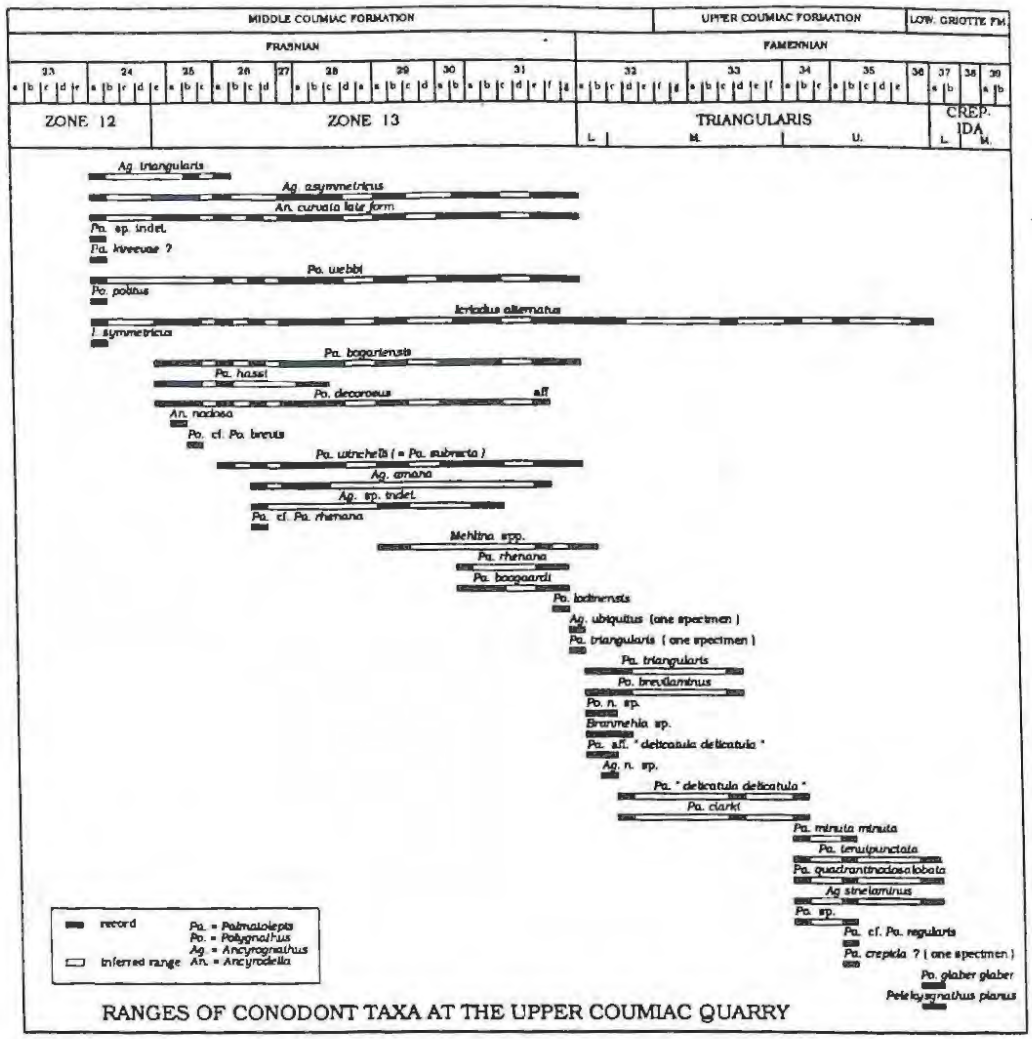


Figure 5 Range chart of conodont species across the Frasnian/Famennin boundary at Upper Coumiac Quarry. The GSSP for the base of the Famennian is at the base of Bed 32a. Position of the upper part of Frasnian Zone 12, Frasnian Zone 13 (Klapper, 1989), the Lower, Middle and Upper triangularis *Zones, and the Lower and Middle* crepida *Zones is indicated. Recognition of the Lower, Middle and Upper* crepida *Zones is cited in the text, but species ranges are not shown above Bed 36.*

Upper Coumiac Bed 31g is also noteworthy in having one confidently identified specimen of *Palmatolepis triangularis* (and one questionable specimen of the same species, the former listed in Feist, 1990, p. 36) among the many examples of *Pa. bogartensis* and *Pa. winchelli*. Although one cannot completely exclude the possibility of stratigraphical leak from the overlying Famennian, extremely rare occurrences of *Palmatolepis triangularis* in the uppermost Frasnian are probably not unique to the Upper Coumiac Quarry. The report of 27 unfigured specimens identified as *Pa. praetriangularis* from three samples within Bed 16 of the Upper Kellwasser Limestone at Steinbruch Schmidt (Sandberg and others, 1988, Table 1) may represent another Frasnian occurrence of *Pa. triangularis*. This inference is based on Klapper's study in 1990 of the holotype and two paratypes of *Pa. praetriangularis* Ziegler and Sandberg (in Sandberg and others, 1988, p. 304, pl. 1, figures 1, 3, 4), all from the highest bed of the *linguiformis* Zone at Hamar Laghdad, southern Morocco. These three types (Pa elements) have an arched outer-posterior platform, which gently rises from the lobe to just before the tip, then arches downward. This is exactly the same as in many specimens of *Pa. triangularis* in the Lower and Middle *triangularis* Zones; however, in the holotype (Sannemann, 1955, pl. 24, figure 3) the outer posterior platform rises more steeply from the lobe to just before the tip, then arches downward. Consequently, the view is favoured here that *Palmatolepis triangularis* and *Pa. praetriangularis* are synonyms. A slightly different view perhaps could be supported in which the latter is treated as an intraspecific morphotype, which is apparently a common form of *Pa. triangularis* in the Lower *triangularis* Zone. Forms like the holotype of Sannemann seem to be relatively rare in this zone at least in the Montagne Noire. Clearly the *praetriangularis* morphotype crosses the Frasnian/Famennian boundary at Schmidt Quarry, as was well documented by Sandberg and others (1988, Table 1). [The 27 specimens listed as *Pa. praetriangularis* in Bed 16 at Schmidt Quarry occur with 3380 listed as *Pa. subrecta* (a junior synonym of *Pa. winchelli*, see Klapper and Foster, 1993, but specimens of *Pa. bogartensis* may have been included in this count)]. Thus, extremely rare *Pa. triangularis* as this species is delimited here may occur slightly below the level of the lower boundary of the Lower *triangularis* Zone at both Coumiac and Schmidt quarries (up to 12 and 10 cm below the boundary, respectively). In both instances, this is within the context of the dominant upper Frasnian fauna of the Upper Kellwasser Limestone. *Palmatolepis triangularis* does not occur in the beds equivalent to Bed 31g at the other Montagne Noire localities cited previously.

It follows, from the foregoing discussion, that there should be modification of the definition of the lower boundary of the Lower *triangularis* Zone (Ziegler, 1962, p. 25; Ziegler and Sandberg, 1990, p. 22) for which the sole criterion is the first occurrence of the nominal taxon. Instead it is proposed here to use for definition the

abundant or flood occurrence of *Palmatolepis triangularis*, to the virtual exclusion of other species of the genus, stratigraphically *above* the fauna dominated by the characteristic upper Frasnian species. These include *Palmatolepis winchelli*, *Pa. bogartensis*, *Pa. rhenana*, *Pa. hoogaardi*, *Ancyrognathus asymmetricus*, *Ancyrodella curvata* (late form), and in some areas, *Pa. linguiformis* and *Pa. juntianensis*. Thus, in the three sampling intervals within Bed 32a at Upper Coumiac (Feist, 1990, p. 36) and Bed 32b, *Pa. triangularis* is the only *Palmatolepis* species with the exception of transitional specimens here termed *Pa.* aff. '*delicatula delicatula*'. None of the species in Beds 31 and lower at Upper Coumiac (figure 5) ranges above the GSSP positioned at the lower boundary of Bed 32a, except *Icriodus alternatus*, which is well known to cross the Frasnian/Famennian boundary elsewhere [the designation *Mehlina* spp. represents several species whose demarcation is unclear]. The new species of *Ancyrognathus* in Bed 32b is part of the Famennian lineage including *Ag. sinelaminus* and *Ag. cryptus* and is morphologically distinct from the main Frasnian Ancyrognathus lineages that include *Ag. asymmetricus* and *Ag. ubiquitus*. Characteristic upper Frasnian species of *Polygnathus*, such as *Po. webbi* and *Po. decorosus*, do not range above the GSSP and are replaced by *Po. brevilaminus* and *Po.* n. sp. above the boundary at Coumiac.

The lower boundary of the Middle *triangularis* Zone, defined by the lowest occurrence of *Palmatolepis clarki* and *Pa. delicatula delicatula* (Ziegler, 1962, p. 26; 1971, chart 5), is at the base of Upper Coumiac Bed 32c. The former species is perfectly useable for defining the base of the zone and that part of the original definition is followed here. But use of the latter taxon is clouded by a taxonomic problem. That is, *Pa. delicatula delicatula* in the sense of most authors since 1962, and *Pa. delicatula* platys of Ziegler and Sandberg (1990), are characterized by platform outlines of the Pa element distinctly different from that of the lectotype of *Pa. delicatula* Branson and Mehl (1934, pl. 18, figure 4; a new photograph in a non-oblique view is available from GK on request). As the solution of this problem cannot be treated fully in this paper, the name of specimens corresponding to *Pa. delicatula delicatula* (sensu auct.) in Upper Coumiac Beds 32c, 33c, and 34a is written in quotation marks.

Recognition of the Upper *triangularis* Zone (Beds 34a, 35a, 36), the Lower *crepida* Zone (Bed 37, on the unquestioned occurrence of the nominal species), and Middle *crepida* Zone (Beds 41–44) is straightforward, but not especially pertinent to the description of the GSSP.

Goniatite record

Coumiac is one of the few known places with a continuous goniatite succession from the Middle Frasnian to the Middle Famennian. Ammonoids occur both in the latest Frasnian (Bed 31g) and basalmost Famennian (Bed 32a). Preservation, however, is in many cases relatively poor, extraction tedious, and species-level determination is often difficult. The faunal record (figure 6) has gradually been built up over the past several years and certainly can be further extended. Bed-by-bed investigations were first conducted by House and others (1985) and updates of faunal lists were supplied in consecutive years to SDS and later summarised (in Feist, 1990). A detailed description of the Famennian part is provided in Becker (1993a).

The boundary itself is clearly marked by the disappearance of the gephuroceratids and beloceratids with the immediate subsequent bloom of the tornoceratid *Phoenixites frechi* in the haematite-enriched base of Bed 32a, but the species is known to occur in late Frasnian beds elsewhere (Becker, 1993a). The *frechi* (partial range) Zone or *Phoenixites* Genozone (do II-A) is followed in Bed 35c by the entry of first *Falcitornoceras* and questionable cross-sections of *Cheiloceras*. Both genera are defining forms of the do II-B. Undoubted *Cheiloceras* specimens have not been collected below Bed 39 and earliest falcitornoceratids (especially those found in Bed 36) are still somewhat intermediate to *Phoenixites*.

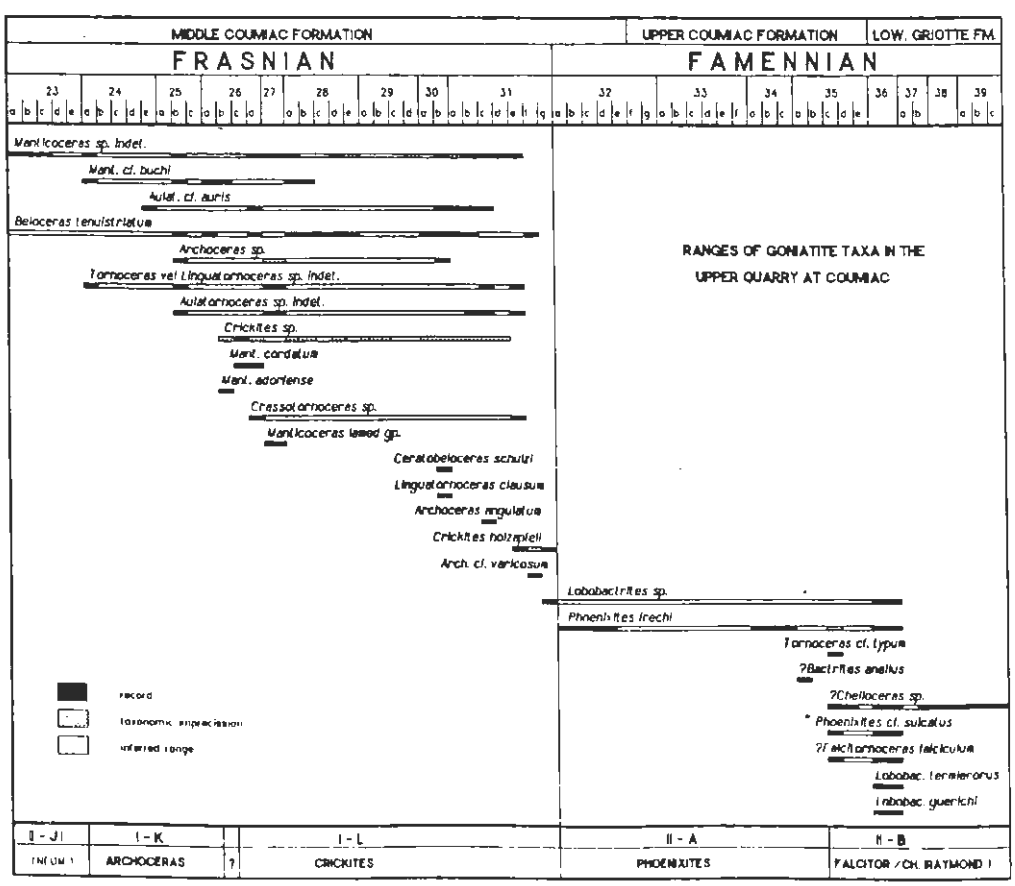


***Figure 6** Range chart of succession of goniatites so far recorded from Bed 23 to Bed 39 in the section around the GSSP above the Upper Coumiac Quarry, with the assignment of ammonoid zones. For correlation with the conodont zonation, see figure 5.*

The Coumiac goniatite sequence generally matches faunal successions described from classical sections of the Rhenish Slate Mountains and Thuringia. Correlation with the new international zonation based on the appearance and spread of genera (House and Kirchgasser, 1993; Becker and others, 1993; Becker, 1993b) is straightforward, although there are regional features mirroring local facies developments. For example, international marker genera such as *Trimanticoceras, Carinoceras, Neomanticoceras* and *Playfordites* are still lacking in the Montagne Noire area. Late Middle Frasnian beds at Coumiac, below the equivalent of the Lower Kellwasser Limestone (Bed 24a), contain *Beloceras*, various manticoceratids and somewhat ambiguous *Costamanticoceras* (House and others, 1985; pl. 2, figure 11–12). The latter is a marker for the *Playfordites* and *Neomanticoceras* Genozones (do I-I and I-J), or for the *cordatum* Zone (do Iß/γ) of the classical goniatite zonation. Index species for Divisions I-K so far have only been found above the Lower Kellwasser level in Bed 25b (*Archoceras* sp.) and Bed 26b (*Manticoceras adorfense*). The first evidence for the latest Frasnian *Crickites* Genozone (do I-L) comes from Bed 26c. At Coumiac and neighbouring sections of the Mont Peyroux Nappe a succession of *Crickites* species can possibly be established. All early, often somewhat doubtful members of the lineage have whorl forms similar to *Manticoceras cordatum* and may be related to the Canadian *Crick. cordiforme* (Miller). *Crick. holzapfeli*, the index species of the classical *holzapfeli* Zone, enters in great profusion in the lower part of Bed 31e and continues to Bed 31g and to the end of the Frasnian. The apparent patchiness of the Upper Frasnian goniatite record is only to a limited extent a consequence of sampling bias. Clearly two different goniatite assemblages alternate with each other. The first is characterized by great abundance of *Beloceras tenuistriatum* (e.g. in Beds 26d and 31a) and rarity of gephuroceratids and tornoceratids. Other beds have rich *Manticoceras* or *Crickites* faunas accompanied by more abundant tornoceratids, and *Buchiola*. Due to the lack of lithological differences between beds containing the two faunal types it is inferred that changing assemblages mirror fluctuations in the trophic structure. Especially the Upper Kellwasser Limestone equivalents with their rich *Crickites* and pelecypod faunas associated with unusually large ostracods but without *Beloceras* may have been deposited under eutrophic ecological conditions. This suggests that beloceratids thrived during oligotrophic periods.

The chosen stratotype has one of the best known goniatite records around the Frasnian/Famennian boundary and is the best known anywhere for index species occurring in beds exactly at the boundary. However, it is far from being an ideal ammonoid locality due to aspects of preservation and difficult recovery of large faunas. This misfortune can partly be balanced by the wide range of other goniatite-bearing and easily correlatable localities nearby in the Montagne Noire, which supply additional information on stratigraphical ranges and occurrences in slightly different facies settings. These will be documented elsewhere (Becker and House, 1994 in press).

Trilobites

Among bottom-living biotas, trilobites are most frequent and diversified in the Late Frasnian strata at Coumiac. Of eight families

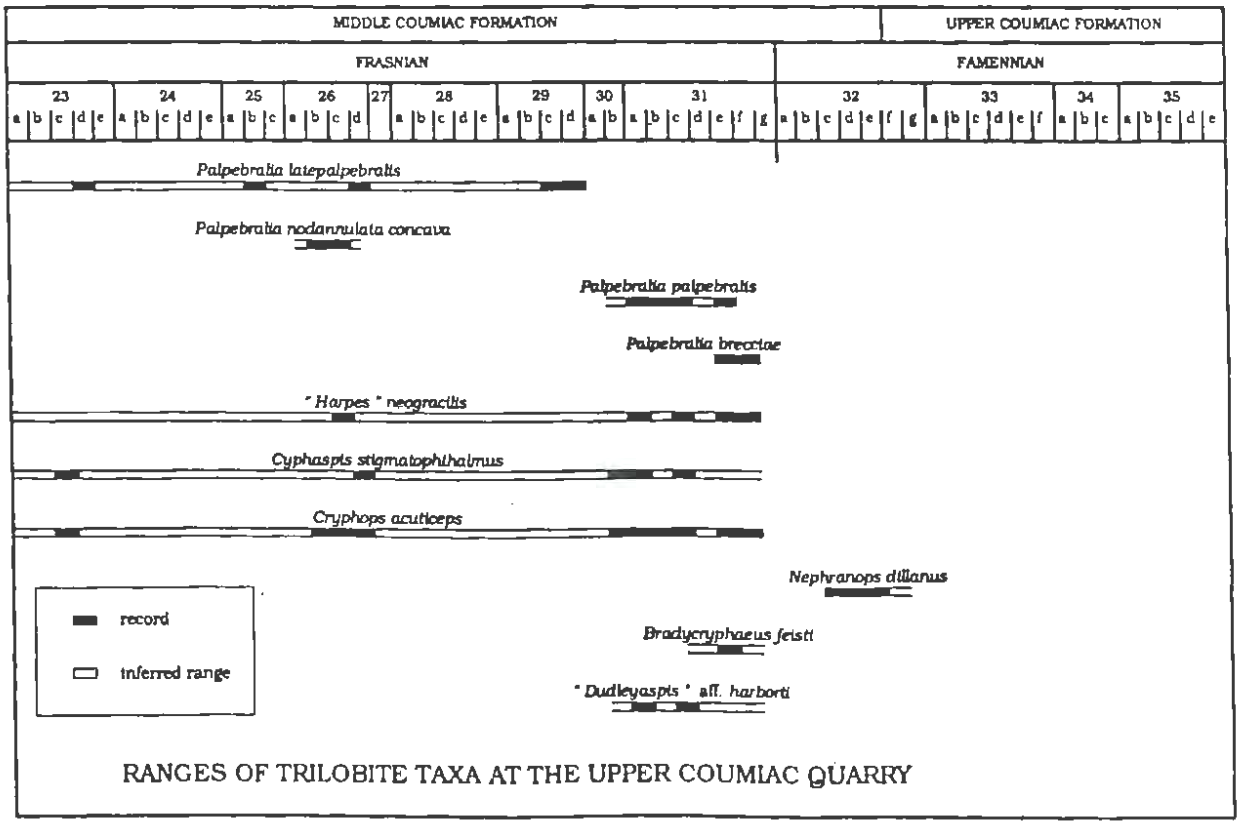


Figure 7 Range chart showing the trilobite record from Bed 23 to Bed 39 around the GSSP in the section at the Upper Quarry at Coumiac. Modified from data of R Feist (in *Feist, 1990*).

known globally to be present at the Upper Kellwasser extinction event (Feist, 1990; 1991), six occur in the stratotype section (Proetidae, Aulacopleuridae, Odontopleuridae, Harpetidae, Dalmanitidae and Phacopidae) and of a total of 13 species known globally, nine are represented at Coumiac (see figure 7). All but three families and all species disappear within Zone 13, or at the base of the Upper Kellwasser Limestone equivalent (Bed 31g). The latter does not yield any trilobites, nor do the succeeding beds of the Lower *triangularis* Zone (Bed 32a–b), a fact which has been observed in all known Frasnian/ Famennian boundary sections world wide. Recovery does not take place earlier than from the Middle *triangularis* Zone onwards when solely phacopids of the genus *Nephranops* occur (Beds 32c–e). Thus the defined basal Famennian at the base of the Lower *triangularis* Zone, cannot be precisely recognised using trilobites. By contrast, the base of the topmost Frasnian Kellwasser Limestone level can be located with considerable precision by the major extinction affecting trilobites at that level (Feist and Schindler, 1994).

Fine-scale intrazonal subdivision and biostratigraphical correlation of the latest Frasnian at Coumiac is provided by evolutionary species of the proetid *Palpebralia* which are characterized by a trend in reduction of the palpebral lobe and in the straightening of the facial sutures. The ancestral form, *Pal. latepalpebralis* being already present below the Lower Kellwasser Limestone equivalent (Bed 24a), has been recovered as high as in the middle of Zone 13 (Bed 29d). It gave rise to *Pal. palpebralis* which is abundant in Beds 31a to 31e and is also known from latest Frasnian sections in the Rhenish Schiefergebirge and Harz (Feist and Schindler, 1994) and may occur in the Canning Basin of Western Australia (K McNamara, oral communication) The last representative of the lineage is *Pal. brecciae* which enters the stratotype section in Bed 31e and f, thus marking precisely the last oxygenated level-bottom environment prior to the hypoxic overturn of the Upper Kellwasser Limestone. This species is at least of moderate value for long distance correlation as it has been recovered in the Rhenish Schiefergebirge (at Steinbruch Schmidt) and in the Harz (Aeke Valley) in an equivalent position and associated there with *Palmatolepis linguiformis* (Schindler, 1990). Consequently *Pal. brecciae* appears to be limited to the lower part of the *linguiformis* Zone. This supports the results obtained by graphic correlation, which indicated the presence of *linguiformis* Zone equivalents at Coumiac in Beds 31f and g (Klapper in Becker and others, 1989, p. 262).

Concomitantly with the *Palpebralia* line, another evolutionary trend is seen in succeeding populations of *Cryphops acuticeps* and this trend is of biostratigraphical significance. This group, which is rather common in Beds 31a to 31f, exhibits a spectacular reduction in the mean number of its eye lenses which drop from ten lenses in Bed 31a to only three lenses in Bed 31f before its final extinction (Feist, 1991). This evolution may represent a further potential for fine-scale biostratigraphical subdivisions and correlation during a period of world-wide biotic crisis.

Other fossil groups

Palynomorphs have been obtained from the Upper Kellwasser level (Bed 31g) but are too badly preserved for precise identification: further work is required here. The stratigraphically important entomozoaceans are a rather minor faunal element; detailed work is currently being carried out by F Lethiers. Solitary rugose corals, gastropods, orthoconic and breviconic nautiloids, crinoids and rare fish scales represent further accessory fossil groups still to be investigated in detail. Brachiopoda and bivalve records of C Babin and P R Racheboeuf have been presented (*in* Feist, 1990). Rich homoctenid faunas have been determined by M Truyols-Massoni (*in* Feist, 1990); the *Homoctenus ultimus* Zone is first recognized in Bed 26c and therefore seems to correlate with the *Crickites* Genozone. Ostracod data of F Lethiers have been listed (*in* Feist, 1990), and more than 30 different species are recognised in the topmost beds of the Frasnian; among the benthonic forms, the Frasnian/Famennian boundary is characterized by a major extinction since 65 per cent of all recorded taxa disappear there (Lethiers and Feist, 1991). Thus, the Coumiac stratotype bears evidence of an extraordinary breadth of faunal representation enabling correlation into regimes with better spore and acritarch records. The SDS views this documentation as the best of any of the levels it has recommended for boundary stratotypes in the Devonian.

Chemostratigraphy

As yet geochemical methods do not provide an unambiguous guide to correlation internationally, although there is great potential especially with strontium isotope chemostratigraphy applied within the framework of conodont biostratigraphy (e.g. Ruppel and others, 1993). Geochemical methods do, however, provide an important clue to environmental interpretation. The stratotype section at Coumiac has been investigated for $\delta\,^{13}C/^{12}C$ values by Joachimski and Buggisch (1993) where a positive shift of $\sigma^{13}C$ was noted at the boundary. Rare-earth elements (REE) have been investigated by Grandjean-Lécuyer and others (1993) using individual Devonian conodonts, but no anomaly at the boundary was noted although the REE patterns did not conform with those of modern sea water. The pursuit of iridium anomalies has not been successful at Coumiac (Girard and others, 1993), nor at Steinbruch Schmidt (McGhee and others, 1984). Those claimed at the boundary in the Canning Basin have proved to be from a much higher stratigraphic level (Becker and others, 1991; Nicoll and Playford, 1993) although there is a weak iridium anomaly apparently at the correct level at Xiangtian (Wang and others, 1991) and other element anomalies, but the cause is uncertain. There has been no link of microtektites with the boundary stratotype and records elsewhere are higher in the Famennian (high within the Lower *triangularis* Zone at Senzeilles in Belgium: Claeys and others, 1992, figure 1; Lower *crepida* Zone in south China: Wang, 1992).

Relationship to the Upper Kellwasser Event

The main sedimentary marker of the GSSP is the top of the distinctive level known in Germany as the Upper Kellwasser Limestone (Walliser and others (1989). This dark hypoxic limestone appears to represent an acme in the spread of a distinctive facies which in many sections globally is precisely constrained by conodont biostratigraphy. In parallel with the work of the SDS in recent years has been the recognition of an important extinction event near the Frasnian/Famennian boundary. Some of these extinctions were listed in the previous sections. The recommendation of the Subcommission for a GSSP falls at a level immediately above the acme of extinctions, that is at the base of the Lower *triangularis* Zone. The most precise documentation for this (Becker and others, 1989) has been followed by data assembled for the Subcommission and illustrated here (figures 5–7). Following especially the work of Sandberg and others (1988) this level has been widely traced internationally.

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

Four main groups of hypotheses have been invoked to explain the faunal and sedimentary changes around the base of the Lower *triangularis* Zone. Firstly, causes related to a bolide impact or impacts (Sandberg and others 1988, McLaren and Goodfellow 1990). Secondly, a spread of anoxic conditions on continental shelves associated with possible tectonic events and ocean overturn (Wilde and

Berry, 1984; Buggisch, 1991) with a transgression followed by quick regression at the upper boundary (Sandberg and others, 1988). Thirdly, these second events but associated with a peak of cold climatic conditions, resulting in a rise of the pycnocline (Copper, 1986). Fourthly, the same, but with the Upper Kellwasser Limestone representing a peak of hot climatic conditions, resulting also in a rise of the pycnocline and probable disruption of the trophic tiering, particularly that of the plankton (Becker and House, 1994); this latter theory was first invoked for Devonian anoxic events by Becker (1992). Related hypotheses involving climatic warming have been suggested by Thompson and Newton (1989) and Ormiston and Klapper (1992). It is generally recognised that the collapse of stromatoporoid reef systems near the end of the Frasnian led to extinctions of associated faunas. House (1985) has drawn attention to the many similar events at other levels in the Devonian suggesting that an interpretation enabling a common hypothesis is to be preferred.

Whatever the cause(s) of this sedimentary perturbation may be, the SDS took the view that the hypoxic perturbations below the base of the Lower *triangularis* Zone resulted in a considerable faunal changeover and an horizon which may be correlated internationally with perhaps more precision than any other in the Devonian. It is in the light of this view that Coumiac was recommended for the GSSP to define the base of the Famennian Stage.

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Consolidated report about activities of ICS Subcommission.

by Jürgen REMANE, Chairman of ICS

* *

1. Introduction

1993 was the first year when ICS bodies were asked to give their annual report earlier than in the preceding years (Nov. 1st instead of Nov. 30) and also using a new format. Not surprinsingly, the first run of the new procedure was not absolutely perfect, but when the Chairman and Secretary General of ICS met at Neuchâtel from Nov. 15-17, 1993, nearly all annual reports were at hand.
About half of them had been organized according to the new rules. The following comments are intended to provide a background information which may be helpful for non-stratigraphers, analyzing the reports of individual ICS bodies.

2. Comments on annual reports of individual subcommissions

2.1. Precambrian SC

According to the new administrative structure of ICS, the Working Group on the Terminal Proterozoic System is incorporated in the Precambrian SC, but for 1993 we still received separate reports.
As to the Precambrian SC s. str., it should be stressed that a new subdivision of the Archean is being proposed. It follows the same scheme as the subdivision of the Proterozoic (ratified by IUGS in 1990), i.e. chronostratigraphic boundaries defined in terms of absolute ages and not by GSSPs. Interestingly the notion of a Hadean era corresponding to the period from which no rocks are preserved, has not been retained by the SC, which is certainly a good thing.
The work program of the SC shows that a very extensive discussion of the proposed new Archean subdivision is planned. The submission of a final project to ICS can be expected for 1995, after the South Africa meeting.

WG on the Terminal Proterozoic System

The base of this system (which has still to be named) was fixed at 650 Ma B.P. together with the Proterozoic subdivision adopted by IUGS in 1990. But this system offers better possibilities for correlation than the rest of the Precambrian, thanks to acritarchs, Ediacara type assemblages and trace fossils. Research in this field seems to have made good progress, and the definition of the system's lower boundary through a GSSP is envisaged.
Very active group cooperating closely with relevant IGCP projects, especially Project 320, with a very informative common newsletter.

2.2. Cambrian SC

For the Cambrian, the subdivision on stage level is not as well settled as e.g. in the Devonian. The SC now concentrates its work on this task, focusing on the lowermost stage : This is a new problem, because the newly defined base of the Cambrian lies deeper than the classical boundary at the base of the Tommotian. Discussion about the lower boundary of the Cambrian seems still to go on, but it has to be stressed that the GSSP defining the boundary at Fortune Head, Newfoundland, has been voted in due form and ratified by IUGS.

2.3. Ordovician SC

The reorganization of the Cambrian-Ordovician Boundary Working Group (COBWG) is now completed and a new chairman has been elected. The COBWG will reexamine the failed GSSP candidate at Dayangcha (China) in the light of new data and hopefully come to a conclusion in 1994. The first vote on Dayangcha had been between 50% and 60% in favour.
The classical European subdivisions of the Ordovician as Tremadoc Arenig etc., are often difficult to correlate around the world, due to strong paleogeographic provincialism. The SC has therefore chosen a different approach, searching for correlatable biohorizons which may provide a base for solid boundary definitions. This research has obviously made good progress and should now lead to the establishment of formal units on series/stage level.
The completion of the Ordovician correlation charts, the last of which are now ready for publication should be highlighted here.

2.4. Silurian SC

All Silurian stage boundaries have been defined by GSSPs already in 1985, resulting in a very detailed subdivision with 8 stages for only 28Ma. the SC now concentrates on the mutual calibration of zonal schemes based on different fossil groups in order to obtain a common denominator for correlation charts. This seems to be problematic and will certainly also provide an interesting test for the worldwide practicability of Silurian stages.

2.5. Devonian SC

Very active SC, only two of the six internal stage boundaries are not yet formally defined by a GSSP. But one of them (base of the Givetian) has already been voted by ICS and awaits ratification through IUGS, and the last one will soon be submitted to ICS.

2.6. Carboniferous SC

After the decision to have only one system, the Carboniferous, in the global standard scale and not two (as Mississippian and Pennsylvanian or Dinantian and Silesian) the Mid Carboniferous boundary was the first problem to be solved, in order to arrive at a globally applicable subdivision of the Carboniferous into two subsystems. Good progress has been made in this direction.
Another problem is that the classical W-European subdivision of the Upper Carboniferous was derived from the coal measures. This has to be replaced by a marine standard, but so far no clear image of the subdivision to be used has emerged.

2.7. Gondvana SC

The interregional correlation of terrestrial Gondwana successions and their correlation with the marine standard is a most important and interesting task. It would be fine to have more detailed information about the existing (or envisaged) terrestrial scheme(s) and the possibilities of correlation with marine series (which ones ? and where ?)
The reorganization, viz. thorough discussion of the SGS strategy was already mentioned in the 1992 report and seems to continue.

2.8. Permian SC

Very active SC, has obviously made good progress towards defining the Carboniferous-Permian boundary, cooperates closely with the Triassic SC on the Permian-Triassic boundary. It should perhaps be mentioned here that during the Permian global correlations are difficult.

2.9. Triassic SC

The long dispute over the subdivision of the Scythian at the base and whether the Rhaetian stage should be maintained at the top of the Triassic has been ended in 1992, so that the SC now turns to a precise definition of stage boundaries.
With the election of a new Chairman the Permian-Triassic Boundary Working Group has been reactivated.
A precise definition of this boundary has so far been difficult although it falls into a period of major faunal turnover. This is mainly due to a strong biogeographic provincialism with separate Tethyan and Boreal ammonite faunas. Looks like as if conodonts will bring a solution.

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2.10. Jurassic SC

The subdivision of the Jurassic system into series and stages is agreed upon since long years. Most of the traditional boundaries as expressed in ammonite zones allow far reaching correlations.
But none of the boundaries has so far been defined by a GSSP and there seems to be no hope for 1994. Hopefully, the International Symposium in Argentina 1994 will accelerate procedures.

2.11. Cretaceous SC

No formal report received, only accounts for 1993 and budget for 1994. According to Newsl. 1993/1 from Aug. 30, 1993 and personal discussions of the Chairman of ICS with the Secretary of the Cretaceous SC the reorganization of the SC in Working Groups for individual stages makes further progress.
The reneved activity of the SC merits to be supported.

2.12. Paleogene SC

Working Groups for nearly all open stage boundaries within the Paleogene have been established (the Eocene/Oligocene boundary has already a GSSP).
The open-endedness of this kind of WGs criticized in the report is indeed a problem and may unduly delay agreement on a GSSP. On the other hand, the comparison with IGCP projects is not quite correct : the latter can be terminated even when they have not attained the anticipated goal, boundary WGs not, they can only be reorganized (as in the case of the Cambrian-Ordovician BWG). And some boundary problems are more difficult than others, this can best be judged by the respective SC. So the question is, if SCs shall be encouraged or obliged to set deadlines for their BWGs.

2.13. Neogene SC

No formal report. According to documents forwarded to the Chairman of ICS, the Pliocene Symposium at Baton Rouge (USA) was one of the main activites. There a new magneto-chrono-bio-cyclostratigraphic scheme was developped.

2.14. Quaternary SC

The sudden retirement of the Chairman caused some organizational problems, the Vice-Chairman was thus obliged to provide the annual report within a very brief delay.
The base of the Quaternary was defined in 1985 by a GSSP at Vrica (Italy). There seems to be a strong tendency among Quaternary stratigraphers to move the boundary farther down to a more "natural" level. Therefore the Pliocene-Pleistocene BWG, with T. Partridge as Chairman was established on the Kyoto IGC, in order to examine if a new boundary level have a higher correlation potential. In such a case, a formal BWG would have to be elected with the task to propose a new GSSP. It should, however, be remembered that the Vrica boundary remains valid until a new boundary + GSSP has been voted by ICS and ratified by IUGS.

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2.14. ISSC

As other SCs, ISSC is going to discuss sequence stratigraphy. The project to produce an abreged version of the International Stratigraphic Guide is maintained.

2.15. Subcommission on Geochronology

Very active and successful SC, the report is very informative in this respect and there is nothing to add here.
The calibration of chronostratigraphic boundaries by radiometric dating is indeed a very important task.

Neuchâtel, 30.11.93

DEVONIAN STRATIGRAPHY
PALAEOZOIC MICROVERTEBRATES
PROJECT 328
JOINT
MEETING

DEVONIAN COMMISSION
OF THE RUSSIAN
INTERDEPARTMENTAL
STRATIGRAPHIC
COMMITTEE

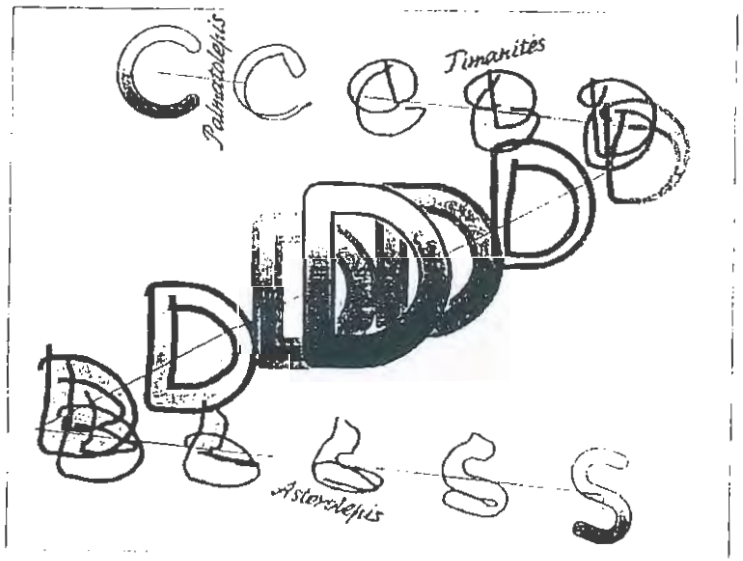
July, 9–22 1994

Symposium

Devonian Eustatic Changes of the World Ocean Level

MOSCOW AND UKHTA

PALAEONTOLOGICAL INSTITUTE OF RAS, PROFSOYUZNAYA ST. 123, MOSCOW, RUSSIA
TIMAN–PECHORA BRANCH OF VNIGRI, PUSHKIN ST. 2, UKHTA
KOMI REPUBLIC, RUSSIA



JOINT SUBCOMMISSION ON THE DEVONIAN STRATIGRAPHY, DEVONIAN COMMISSION OF THE INTERDEPARTMENTAL STRATIGRAPHIC COMMITTEE OF RUSSIA AND IGCP "PALAEOZOIC MICROVERTEBRATE BIOCHRONOLOGY AND GLOBAL MARINE–NON–MARINE CORRELATION" PROJECT No. 328 Meeting

SPONSORED BY Palaeontological Institute of the Russian Academy of Sciences, National Committee of the Geologists of Russia, "Reserve" Insurance Co.

MOSCOW MEETING, 1994

Report on the SDS/IGCP 238 meetings, Moscow and Ukhta, 9-22 July 1994, and the Symposium "Devonian Eustatic Changes of the World Ocean Level"

MOSCOW MEETINGS

The Moscow meeting was held at the Palaeontological Institute, Russian Academy of Sciences through the kindness of Prof. Alexei Rozanov, Director. Organisational matters in Russia were under the chairmanship of Prof. Maria Rhonsnitskaya, and it was with great sadness for the meeting that Prof. Rhonsnitskaya was unable to attend for health reasons; a message of thanks and good wishes were sent to her. The local arrangements were in the hands of Dr. Oleg Lebedev, who organised matters with great skill: the success of the meeting was largely due to him. Dr S. Yatskov also acted as local secretary. The help of the Russian National Committee of Geologists, and Executive Secretary Dr. R.I. Volkov was especially appreciated. The meeting was saddened to learn of the death of Jes Johnson, shortly before the symposium on Devonian sea level changes, a problem on which he had contributed so significantly.

The timing of the SDS/IGCP meeting was especially welcomed by Muscovites since it brought with it the first brilliant sunshine of the summer, and in the fields and woods behind the institute, local citizens sunbathed and gradually tanned themselves, evolving from lily white to lobster red during the course of the meeting. The lushness of the scenery, flowers, attractive woodlands and lakes between the Academy Hotel ("Uskoye") and the Institute were especially appreciated by western visitors.

The SDS meetings were preceded by meetings of IGCP 328, under the leadership of Sue Turner and Alain Blieck, and they report separately on their project meeting which was held on July 9th with associated poster sessions.

On Sunday 10 July, Dr. A.S. Alekseev of Moscow University led a field excursion to the environs of Moskow, especially to the Domodedova Quarry, 38 km SSE of central Moscow. A field guide was provided written by Dr Alekseev entitled "Moscovian and basal Kasimovian (Upper Carboniferous) of the Moscow Basin" (with stratigraphic logs and faunal lists, for the vertebrates by Oleg Lebedev, and for cephalopods by Andrew Shkolin). Impressive evidence of the Jurassic Callovian transgression was given by the unconformable Callovian and Oxfordian silty clays forming an overburden to the quarry. Next isolated sections along the left bank of the Pakhtra River, near Novoye Syanov Village were examined, and packed lunch was taken overlooking the river with many local inhabitants enjoying the sunshine and swimming or boating on the river. After lunch the party moved towards Novlinskoe Village to see old adit entrances to extensive galleries, over 30 km in length, where, in the Middle Ages, underground stone of the Novlinskoye Formation was mined and used for all ancient Russian cathedrals as well as the famous "white-stoned" Moscow public buildings and the walls and towers of the Kremlin.

Monday 11th July was dedicated to museum collections, both at the new Palaeontological Institute on Profsoyuznaya Street, with its exceptionally fine museum, and the older building on Leninsky Prospect. In the evening there was a splendid reception and boat tour which left from Gorky Park Pier and cruised, during the reception, below the

Kremlin walls to views of the gold domes of The Cathedral of St Basil the Blessed on Red Square, and then turned, retracing the route past the Kremlin and on to the Olympic stadia, Moscow University, and upstream as far as the "White House" before returning. Oleg Lebedev and helpers are greatly to be thanked for their work to make this social "ice-breaker" such a success.

Tuesday 12th and Wednesday 13th July were dedicated to the Plenary Sessions of the symposium on "Devonian Eustatic Changes of the World Ocean level". There were 86 registrants for the symposium but, with guests and students, numbers at times exceeded one hundred. All was greatly enhance by the extremely high quality of the simultaneous translations. The program is appended, but this was a little altered by some withdrawn papers and newly added contributions. With the exception of the Americas, there was a good international cover, and especially so for the area of the former Soviet Union. Many manuscripts were submitted to form part of the symposium volume planned to be published in *Modern Geology*. The Business Meeting of SDS was held in the late afternoon of July 13th and the minutes of these will be available.

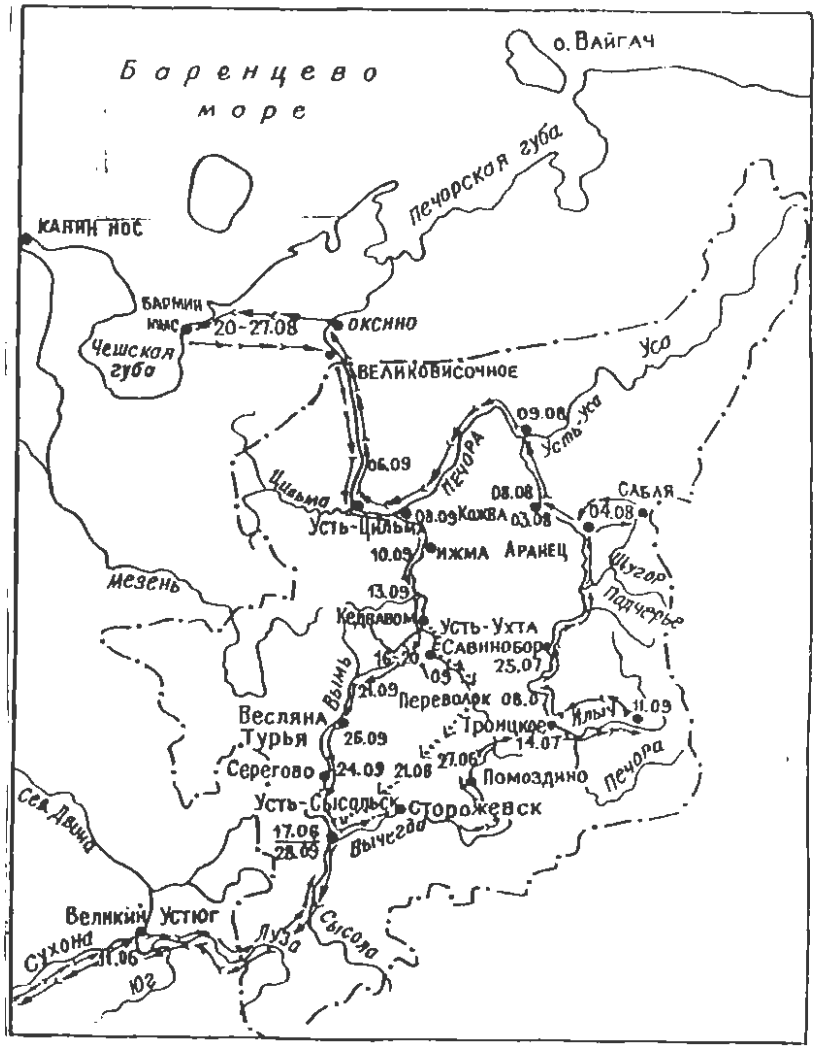
Thursday 14th July was dedicated to the examination of collections in the two institutes and, again, visitors greatly appreciated the help given by their hosts. Some took the opportunity to visit central Moscow, others the time-consuming task of changing traveller's cheques. In the evening the Symposium Dinner was held in the Cheryomushky Restaurant, attended by thirty participants including Dr Ruslan Volkov of the Russian National Committee of Geologists.

Copies of the Abstract Volume of the Moscow meeting, giving all the abstracts of contributions to the symposium "Devonian eustatic changes to the World Ocean Level", compiled by O. Lebedev (51pp) and published by the Palaeontological Institute of the RAS, are available, price US$ 12 (notes only please) from:

Dr Oleg Lebedev
Palaeontological Institute
Profsoyuznaya St. 123
MOSCOW 117647

TIMAN EXCURSION

On Friday 15th July participants for the Ukhta excursion left Moscow Sheremetyevo 1 airport at 8.55 for the flight to Ukhta where they were accommodated in the Timan Hotel. The party comprised 10 western participants, and five Russian colleagues. It was in 1843 when Aleksander Keyserling led his famous "Reise in Das Petschora-Land" the full account of which was published in St Petersburg 1846 although the preliminary account was published in 1844, 150 years before the arrival of the SDS party in 1994. Keyserling was only aged 27 at the start of his extensive journeys (see accompanying



ROUTE OF THE 1843 EXPEDTION TO THE PETCHORA LAND OF A.A. KEYSERLING

map) which made known to the geological world the Ukhta oil-bearing area and the rich fossil faunas, mostly of Frasnian area. This represented a major step in the development of Devonian studies world-wide. The SDS/IGCP group was welcomed in Ukhta by Dr V.I. Bogatsky and Dr. G.J. Andreev, Director and Deputy Director respectively of the Timan-Petchora affiliate of VNIGRI. The help throughout of Mrs Bogatsky and Natasha as translators was greatly appreciated.

The Timan Excursion was under the leadership of Dr. Yu. A. Yudina and Dr. M.N. Moskalenko who had produced a fine introductory volume "Frasnian key sections of the South Timan (44 pp), published by TPO-VNIGRI. On the afternoon of the 15th, introductory talks on the Timan were given covering history, general geology and important fossil groups. The nature of the successive reef complexes in the Frasnian was explained. On the 16th orientation continued, including the opportunity to see the cores through the lower part of the Timan Formation (I-B) borehole and the volcanics in the early part of the succession. During the next four days work concentrated on the Frasnian succession west and east of Ukhta, especially along or near the Ukhta River. Sections were often in 20-30 metre high cliffs beside the rivers and subject to landslips. However, the ease with which the succession could be established, and the high quality of the fossil material were soon apparent. The late Frasnian faunas, particularly of brachiopods and corals, in quarries around Syrachoy Mountain were quite outstanding and some members compared their excellence with those of Iowa. Sue Turner and Vladimir Menner took a separate trip to see the bone beds near the Frasnian/Famennian boundary near Sosnogorsk. The excursion ended on July 20 with a superb evening buffet hosted by the Director, Dr Bogatsky, with representatives of the Leningrad VNIGRI. The warmest thanks were given by the Chairman of SDS to all those who had played such a role in making the trip so successful, and especially to the leaders Drs Yudina and Moskalenko.

VEZHA VOZH EXCURSION

On Thursday July 21 fewer members joined the field trip by helicopter to the Vezha-Vozh River, 45 km south of Ukhta for the last two days (which the writer did not attend). Participants were amazed at the black cloud of mosquitoes which descended on them as soon as the helicopter left. However, the late Frasnian sections and faunas were particularly superb and a plentiful supply of wine and vodka enabled the night in tents to be survived memorably. The party returned to Ukhta in the late afternoon of Friday July 22nd filled with the greatest admiration of the intrepid exploration of Keyserling, 151 years before.

Michael House
Chairman

A.A. KEYSERLING (1815-1891)

DECWOL PROGRAM

IGCP 328 PROJECT SESSION

Saturday July 9

10.00 Opening words.
10.05 GINTER M. Ichthyoliths and late Devonian events in Poland.
10.35 VALIUKEVICIUS J., TALIMAA V.N., KRUCHEK S.A. Microvertebrate assemblages and correlation of the terrigenous Devonian deposits of Byelarus and adjacent territories.
11.05 AVKHIMOVICH V.I., GOLUBTSOV V.K., ESIN D.N., PETUKHOVA L.A., LEBEDEV O.A. Upper Devonian and Lower Carboniferous fish microremains from Pripyat depression (Byelarus).
11.35 Coffea.
11.40 TURNER S. Devonian and D/C microvertebrate correlation in Australia
12.10 MERTINIENE R. Elasmobranch teeth and spines from the Moscovian (Upper Carboniferous) of the Moscow area.
12.40 General discussion.
13.00 Lunch.
14.30 IVANOV A.O. Vertebrates of the Devonian/Carboniferous boundary from South Urals.
15.00 LUKSEVICS E. Ichthyofauna and Famennian zonation of the Main Devonian field (north-west Russian platform).
15.30 Poster session.
16.45 Tea.
17.00 IGCP 328 project business meeting.

POSTERS:

IVANOV A.O. Ichthyofauna of South Timan sections.

KOLESNIK L.S., IVANOV A.O. Famennian conodonts and ichthyofauna from two facial zones of the Polar Urals.

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

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

VOROBYEVA E.I., PANTELEYEV N.V. SEM and histological studies of the *Laccognathus* (Porolepiformes, Pisces) dermal skeleton components.

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

Sunday July 10 one-day field excursion to Domodedovo Upper Carboniferous quarry in the suburbs of Moscow (excursion B). Field leader - Dr. A.S. Alekseev (Moscow University).

9.00 Bus will start from "Uzkoye" Russian Academy of Sciences hotel via Palaeontological Institute building (departure at 9.15). Approximate travel time - 6 hours. Payment for lunches will be accepted during the registration.

Excursion day may be changed to Monday 11 depending on weather conditions!

Wednesday July 13

9.00 KARAULOV V.B., GRETSCHISCHNIKOVA I.A. Devonian eustatic fluctuations in Northern Eurasia.
9.25 YOLKIN E.A., GRATSIANOVA R.T., BAKHAREV N.K., IZOKH N.G., YAZIKOV A.YU. Devonian sea-level fluctuations on the south-western margin of the Siberian continent.
9.50 MENNER V.V., SHUVALOVA G.A., OVNATANOVA N.S., KUZMIN A.V., AVKHIMOVICH V.I., OBUKHOVSKAYA T.G., MOSKALENKO M.N. Late Devonian eustatic events in the north-eastern part of the Russian platform.
10.15 MASLOV V.A. TCHIBRIKOVA E.V. ABRAMOVA A.N., ARTYUSHKOVA O.V., BARYSHEV V.N., PAZUKHIN V.N., KULAGINA E.I. Reflection of eustatic fluctuations in the Devonian of the eastern part of Russian platform and South Urals.
10.40 CHERKESOVA S.V., SOBOLEV N.N. Devonian transgressive-regressive cyclicity in Novaya Zemlya Islands.
11.05 Coffee.
11.20 NEKHOROSHEVA L.V., PATRUNOV D.K., SHURYGINA M.V. Eustatic event on the Silurian-Devonian boundary in Vaigach - Novaya Zemlya region: facies zones and their biostratigraphic implication.
11.45 BOGOYAVLENSKAYA O.V., GLEBOV A.R., LOBANOV YE.YU., SNIGIREVA M.P. Eustatic fluctuations of the Devonian sea-level on the eastern slope of northern Urals.
12.10 CHERKESOVA S.V. Early Devonian events on Taimyr Peninsula on the information from Tareya Lower Devonian base section.
12.35 GAGIEV M.KH. Evolution of sedimentogenesis and fluctuations of sea level in the Devonian of the north-east Asia.
13.00 Lunch.
14.30 ORMISTON A.R. Paleoclimatology and controls on Late Devonian transgressions.
14.55 MARSHALL J.E.A. Marine influences in the Orcadian Basin, Scotland.
15.20 PEDDER A.E.H. Coral responses to Early and Middle Devonian eustatic fluctuations in paleo-Pacific regions of Australia and North America.
15.45 RICHARDSON R.B. Cryptospores, miospores, interfacies correlation in the Devonian.
16.10 DORODNOVA I.V., KLISHEVICH V.L. Tentaculitid3dacrioconarid assemblages succession as an indicator of the sea-level changes during the Devonian.
16.25 Tea.
16.40 General discussion.
17.30 SDS business meeting.

Thursday July 14 Examination of collections.

10.00 Palaeontological Institute in Profsoyuznaya St. 123 building and Leninsky Prosp. 33 building.
13.00 Lunch.
14.30 Poster session.
18.15 Bus departure for the Symposium dinner.
19.00 Symposium dinner at "Cheryomushky" restaurant.

Monday July 11

10.00 Fish collections examination in the Palaeontological Institute of RAS. Micro- and macroichthyological collections available (agnathans, acanthodians, placoderms, chondrichthyans, dipnoans, porolepiforms, osteolepiforms, actinopterygians etc.).

18.30 Bus departure for the evening reception and river excursion at the Palaeontological Museum of RAS (see above).
21.00 Bus departs from the Gorky Park pier to "Uzkoye" hotel.

DECWOL SDS SESSION

Tuesday July 12 Plenary session "Devonian Eustatic Changes of the World Ocean Level"

9.00 Opening words.
9.20 RZHONSNITSKAYA M.A., KULIKOVA V.F., SOKIRAN E.V. The most important transgressive-regressive cycles and biotic events in the Devonian of Russia.
9.45 TIKHOMIROV S.V. On the study of eustatic fluctuations of the world ocean level at the Russian Platform.
10.10 BARSKOV I.S., ALEKSEEV A.S., KARTSEVA O.A., KONONOVA L.I., NAZAROVA V.M., REIMERS A.N., VENGERTSEV V.V. Conodont biofacies and eustatic sea-level changes in the Late Devonian of the Russian plate.
10.35 BECKER R.T. The onset of the global Famennian regression and its evolutionary consequences.
11.00 Coffee.
11.15 RACKI G. Devonian eustatic events in Poland.
11.40 PUSHKIN V.I. Early Famennian eustatic sea-level fluctuations in Pripyat depression (Byelarus).
12.05 TSIEN H.H. Sea level fluctuations in Central Armorican and Ardenno-Rhenish basins.
12.30 HOUSE M.R., MARSHALL J.E.A. Devonian sea level changes in the British area.
12.55 Lunch.
14.30 BRETT C.E., BAIRD G.C. Middle Devonian sedimentary sequences and eustatic sea-level cycles in the northern Appalachian basin.
14.55 WOODROW D.L., SEVON W.D., RICHARDSON J.B. AVKHIMOVICH V.I. A major Appalachian Late Devonian event.
15.20 KRUCHEK S.A., BOUMENGEL K. Devonian transgressions and regressions of the Sakhara and western part of the East-European platforms.
15.45 BECKER R.T., HOUSE M.R., PLAYFORD P.E. Sea level changes in the Upper Devonian of the Canning Basin, Western Australia.
16.10 TURNER S., YOUNG G.C. Devonian vertebrate faunal response to eustatic sea level changes in east Gondwana.
16.35 Tea.
16.50 TSIEN H.H., FONG C.C.K. Sea level fluctuations in South China.
17.15 DARSTANPOUR M. Sea Level changes in the Upper Devonian of central Iran.
17.40 General discussion.

POSTERS

ABRAMOVA A.N., BARYSHEV V.N. Upper Devonian Mendym and Askyn regional stages of the western slope of south Urals (biostratigraphic boundary substantiation).

AFANASYEVA M.S., MIKHAILOVA M.V. Radiolarians as bioindicators of eustatic fluctuations of ths Domanik basin (Ukhta part of the Timan-Pechora basin).

ARISTOV V.A. Rhythmical alternation of conodont biofacies in a sequence as indicator of environmental changes (Upper Devonian of the Russian Platform).

AVKHIMOVICH V.I., OBUKHOVSKAYA T.G. Zonal subdivision of the South Timan Famennian deposits by miospores.

BISKE G.S. Devonian to Visean events on the northern margin of Tarim palaeocontinent.

CHIBRIKOVA E.V. Correlation of the Upper Devonian deposits of the east of the Russian platform, South Urals and Kuznetsk basin margins by miospores.

KIRCHGASSER W.T. Ammonoid and conodont distributions in the Genesee formation and equivalents in the Appalachian Basin (Eastern United States): evidence for a global transgressive pulse in the Early Frasnian.

KOCHETKOVA N.M., YUNUSOVA G.M. Development and succession of ostracod associations at the D/C boundary (Urals and the eastern part of the Russian platform).

ORLOV A.N. Late Devonian pelagic ostracods of Timan-Pechora province.

PATRUNOV D.K. Drastic Devonian sea-level sinking events in the south of Novaya Zemlya Islands.

RODIONOVA G.D., UMNOVA V.T., OVNATANOVA N.S., KONONOVA L.I. Devonian sea-level fluctuations in the Moscow basin.

SOROKIN V.S. Regularity in the development of the of the northern part of the East-European platform during the Late Devonian.

TSYGANKO V.S., YUDINA A.B. Late Devonian sea-level fluctuations on the Pechora plate.

UDODOV V.P., MEZENTSEVA O.P., GUMEROVA N.V. Devonian transgressions on the territory of Gorny Altay (Siberia).

VEIMARN A.B., KUZMIN A.V., KONONOVA L.I., BARYSHEV V.N., VORONTZOVA T.N. Geological events at the Frasnian/Famennian boundary on the territory of Kazakhstan, Urals and adjacent regions of the Russian plate.

VISHNEVSKAYA V.S. Siliceous plankton and benthos of the Ukhta Domanik Formation and the model of the basin sedimentation.

YUNUSOV M.A., MASAGUTOV R.KH., ARKHIPOVA V.V., YUNUSOVA G.M. Changes of Devonian sea-level in the platform region of Bashkortostan.

FIRST CIRCULAR
FIRST AUSTRALIAN CONODONT SYMPOSIUM (AUSCOS-1)
and conjoined
PALAEONTOLOGICAL SYMPOSIUM
IN HONOUR OF PROFESSOR A.J. BOUCOT
18-21 July 1995

Macquarie University, Sydney, Australia

Sponsored by the Association of Australasian Palaeontologists (AAP) and the Pander Society (the International Association of Conodont Workers), and hosted by the Macquarie University Centre for Ecostratigraphy and Palaeobiology (MUCEP)

Outline

In view of the success of the Australian Palaeontologic Convention-94 (APC-94), and in response to a request from the Pander Society that an international conodont symposium might usefully be mounted in Australia, the Macquarie University Centre for Ecostratigraphy and Palaeobiology (MUCEP) has undertaken to organise and host conjoined symposia. Guest of honour will be Professor Arthur J. Boucot (Oregon), long-time friend of many Australian palaeontologists and biostratigraphers, who has contributed mightily to palaeontology, palaeoecology, palaeobiogeography and in particular to Middle Palaeozoic brachiopods and biostratigraphy. There will be two strands to the conference, one devoted to oral and poster presentations on conodont biostratigraphy, palaeobiology and related matters, the other, especially to honour Art, on select aspects of ecostratigraphy, palaeoecology, palaeobiogeography and palaeobiology.

It is anticipated that the first three days of the conference (18-20 July) will be devoted to oral and poster presentations (with some concurrent sessions), the fourth day will be devoted to specialist workshops and discussion groups, a harbour cruise, and/or visits to other institutions. Pre and post conference excursions will be offered (see below). Spouses and friends will be very welcome and are encouraged to join in all activities, including excursions.

Call for papers and posters on the following topics:

AUSCOS-1 SYMPOSIUM

- High resolution stratigraphic correlation
- Calibration of conodont zonation with assemblage zones based on other biota
- Colour alteration indices and their application
- The conodont animal and palaeobiologic implications
- Biofacies interpretation
- Conodont systematics

BOUCOT SYMPOSIUM

- Global bioevents (including extinctions) and their interpretation
- Palaeoclimates and palaeoclimatic indicators
- Origin and early evolution of terrestrial ecosystems
- Fossil lagerstätte and 'smothered' assemblages
- Palaeoecology including taphonomy and trophic analysis
- Functional morphology
- Reef dynamics (living and fossil)
- Palaeobotany (macro & micro)
- Palaeobiogeography (vertebrate, invertebrate or plant)
- Brachiopod studies

Venue

The conference will be held in the new Science and Technology Building on the campus of Macquarie University, situated some 18 km north-west of Sydney's central business district and 29km north of Kingsford-Smith International Airport and adjacent to the Macquarie Centre shopping mall. Facilities for oral presentations include two 35mm projectors (laser control), two overhead projectors and a VHS video-tape recorder.

Conference Registration

Registration is **A$95.00 (A$35.00 for full-time students)** payable before May 1, 1995.

Late registration after May 1, 1995 is accepted for **A$130.00 (A$50.00 for full-time students)**.

Registration will include access to all scientific sessions, a copy of the abstract and programme volume, sumptuous morning and afternoon teas, and copies of the relevant publications emanating from each symposium.

Publications

Negotiations are in the final stages with two publishers for separate proceedings volumes based on each symposium to be published. Editorial requirements will be sent to all who respond to the enclosed 'Notification of Interest' form.

Accommodation

The following lists nearby college/hotel/motel accommodation as an approximate guide to accommodation costs. Bookings for Dunmore Lang College will be made on your behalf if you select this option on the accompanying Notification of Interest form. Bookings for other establishments must be made directly by delegates. Prices quoted are as of July 1994.

Dunmore Lang College, Macquarie University.

Full accommodation (all meals included) is available at Dunmore Lang College at Macquarie University for A$55.00 per night for a single room. A limited number of double units are also available on a first come first serve basis. In addition, low-budget accommodation will be available for *bona fide* full-time students with financial difficulties. Credit cards not excepted.

El-Rancho Hotel/Motel

Middle of the range (2 1/2-star) hotel situated one block from Macquarie University. Single: A$85.00 per night, Double: A$95.00 per night, Triple: A$112.00 per night. Includes full cooked breakfast. Tel: 61-2-887 2411, FAX: 61-2-888 9145. Credit card option.

Ramada Hotel North Ryde

Four-star hotel situated 1km west of Macquarie University. Special Government rate of A$154.00 applies to all single, double and twin share accommodation. If booking ensure you make it known you will be attending a conference at Macquarie University. Price includes full buffet meal each night. Tel: 61-2-888 1077, FAX: 61-2-805 0655. Credit card option.

Conference Dinner

The Conference Dinner is to be held at Dunmore Lang College on the evening of 20 July. Cost A$32 per head or A$22 per head for those booked to stay at the college.

Excursions

Three excursions are planned. Two of these (one pre-sessional, the other post-sessional) are designed to provide a survey of virtually all important mid-Palaeozoic sequences in eastern Australia, from Tyers-Boola and Buchan (Vic.) to the Broken River (N Qld). Prices may change if there should be major foreign currency fluctuations and consequent significant changes in airfares.

1. **Ordovician-Devonian of southeastern Australia**, 9-17 July (pre-meeting) [10 days total]. Leaders: Ruth Mawson and John Talent. Cost: **A$900** (transport by car from Melbourne, accommodation budget motels/shared, including night of day 1 in Melbourne). **The excursion begins in Melbourne and ends in Sydney. Overseas and interstate participants are advised to fly directly into Melbourne to avoid an extra airfare from Sydney to Melbourne.**

   Melbourne (Ordovician), Tyers\Boola (Pragian limestones), Waratah Bay (Early Ordovician; Pragian), Buchan (Emsian), Taemas (latest Pragian-Emsian), Yass (Late Silurian-early Lochkovian), Cliefden (Late Ordovician), Borenore and Bridge Creek (Llandovery-Wenlock), Wellington (late Lochkovian-Pragian), Nubrigyn and Mudgee (allochthonous blocks and debris-flow megabreccias; Late Silurian-early Middle Devonian).

2. **Late Devonian-Early Carboniferous and Ordovician (Arenig) of Canning Basin, north-western Australia, and Ordovician of Amadeus Basin, central Australia**, 5-17 July (pre-meeting). Leader: Bob Nicoll. Cost: **A$ 3,750** (transport by plane and 4-wheel drive, accommodation - mostly camping, some budget motels/shared, including night of day 1 in Sydney; all meals (except for the nights of arrival and termination in Sydney).

   Fly Sydney-Derby; Late Devonian reef complexes Windjana Gorge, Oscar Range, Geikie Gorge, McWhae Ridge; Early Ordovician (Emmanuel Limestone); fly Derby-Alice Springs then 4-wheel drive to Gosses Bluff, Ross River, etc.: Pacoota Sandstone, Horn Valley Siltstone, Stairway Sandstone, Stokes Siltstone; fly Alice Springs-Sydney.

3. **Ordovician-Early Carboniferous of north-eastern Australia** (post-meeting) and conjoined **Induction into reef dynamics at the Heron Island Research Station**, 22 July-3 August. Leaders: Ruth Mawson and John Talent. Cost: **A$ 2025** (transport by air, 4-wheel drive vehicles, accommodation 5 nights under canvas, budget motels/shared in Townsville and Gladstone and final night in Sydney, shared accommodation on Heron Island, airfares Townsville-Gladstone-Sydney, hydrofoil Gladstone-Heron Island return, all meals (except 2 evening meals, Townsville and Sydney).

   Days 1-6: fly Sydney-Townsville followed by formal excursion: Late Ordovician at Greenvale and Silurian-Carboniferous (late Llandovery-Tournaisian) of the Broken River [4 nights camping]; Devonian-Early Carboniferous (late Emsian-Tournaisian) of Mt Podge; Middle Devonian of the Burdekin Basin. Day 7: fly to Gladstone followed by 5 nights at the Heron Island Research Station; return to Gladstone and flight to Sydney.

   Excursion 3 falls naturally into two parts:

   3A. Costs for anyone wishing to participate in **only** the Ordovician-Early Carboniferous portion, including airfares Townsville-Sydney return [22-28 July] = **A$1200**

   3B. Costs for anyone wishing to participate in **only** the Heron Island portion would be approximately = **A$825** (NOTE: THIS DOES NOT INCLUDE COSTS INVOLVED IN GETTING FROM SYDNEY OR WHEREVER TO GLADSTONE ON 28 JULY AND BACK AGAIN)

Additional time on Heron Island

We realise that for many people a visit to the Barrier Reef maybe a once in a lifetime opportunity so, for anyone intending to take part in the Heron Island section of Excursion 3 [i.e 3B] it is possible to extend your stay for an additional 5 days at an extra cost of A$450. Please indicate on the enclosed 'Notification of Interest' form if you would be interested in an additional 5 days on Heron Island...

For more details...

If you are interested in participating in the conference and would like to receive further circulars with details of abstract, manuscript and poster requirements, etc., please complete and return the following Notification of Interest form by **1 DECEMBER 1994** at the latest.

NOTIFICATION OF INTEREST IN THE AUSCOS-1/BOUCOT CONFERENCE

Preference foraccommodation: Dunmore Lang College / El-Rancho Hotel / Ramada Hotel / other arrangements (circle one)

	Definite	Possible	no possibility
Pre-conference excursions			
1 (Southeastern Australia - A$900)			
2 (Canning and Amadeus basins - A$3750)			
Participation in the conference			
Participation in the conference dinner			
(please indicate if partner will be attending the conference dinner by 'x 2')			

Post-conference excursion

3A (Broken River - A$1200)

3B (Heron Island - A$825)

Both parts - A$2025

I would like to present a paper poster at the conference. (circle one or both)

Provisional title of presentation(s

.....

.....

Potential post-conference option (dependent on responses)

If you intend to participate in excursion 3B, would you be interested in staying an additional 5 days with us at the Heron Island Research Station, taking advantage of the facilities available there (maximum cost $450)?

Yes No (circle one)

Would a letter of invitation addressed to you personally be helpful in seeking funding towards participation in the conference? Yes No (circle one)

Name: .....

Address for Correspondence:.....

.....

Phone..... Fax: ..... E-mail: .....

Please xerox or tear out and return by post or fax to:

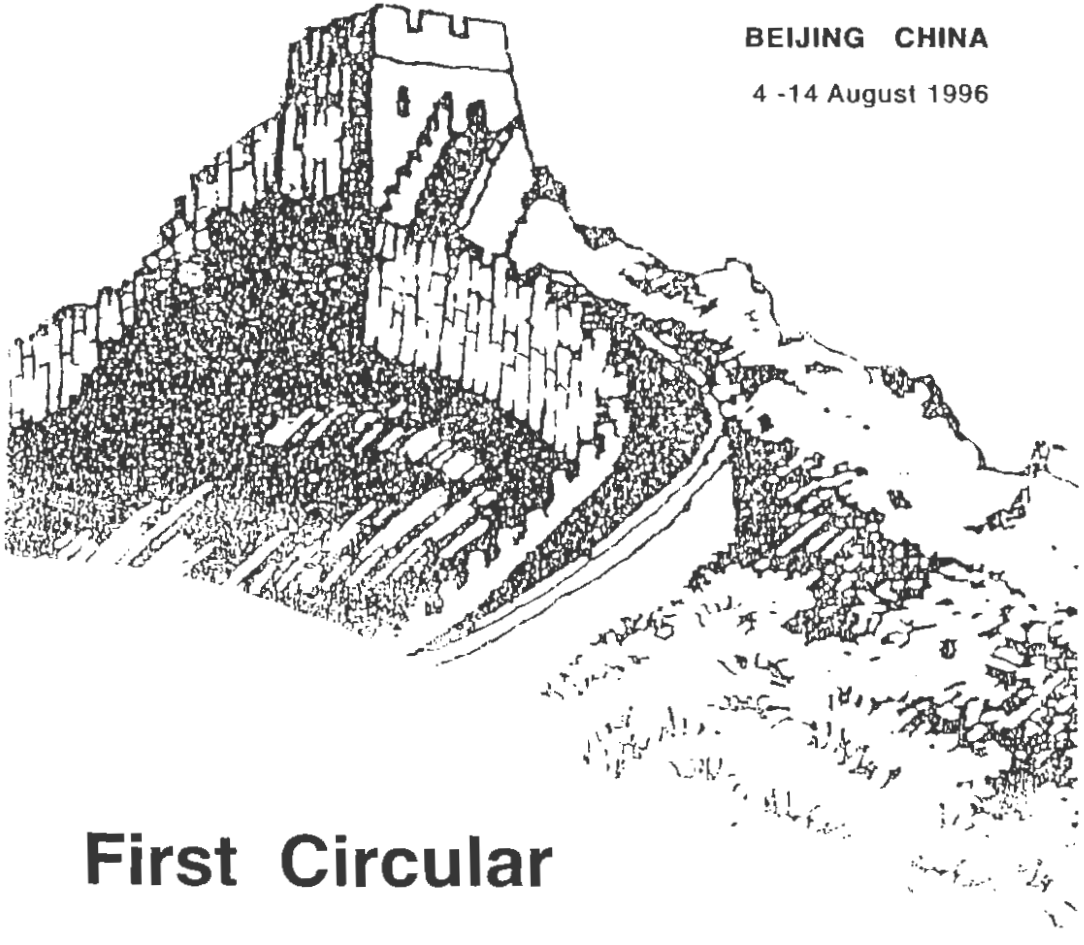
Ruth Mawson or Glenn A. Brock, Centre for Ecostratigraphy and Palaeobiology, School of Earth Sciences, Macquarie University, NSW 2109, AUSTRALIA.

Tel.: (02) 850 8336 or 850 7484; Fax: (02) 850 8428; E-mail: rmawson@laurel.ocs.mq.edu.au

30th INTERNATIONAL GEOLOGICAL CONGRESS

BEIJING CHINA

4 -14 August 1996



First Circular

The 30th Session of the International Geological Congress (IGC) will be held in the People's Republic of China from 4 to 14 August 1996, in collaboration with, and under sponsorship of, the International Union of Geological Sciences (IUGS). The 30th IGC is co-hosted by the Geological Society of China, the Ministry of Geology and Mineral Resources, and the relevant Chinese governmental agencies, scientific institutions and industrial organizations.

Send the Preliminary Questionnaire contained in this First Circular to:
Secretariat Bureau
30th International Geological Congress
P.O. Box 823
Beijing 100037
P.R. China

Please return the Questionnaire by 31 October 1994.

Tentative Schedule

Second Circular distributed	March 1995
Abstract submission deadline	1 November 1995
Return of Registration Form of the Second Circular	1 December 1995
Field Trips, Short Courses and Workshops deposit due	1 December 1995
Preregistration payment due	1 February 1996
Third Circular distributed	February 1996
Field Trips, Short Courses and Workshops full payment due	1 May 1996

Notes: * Nothing in this First Circular should be considered as final. Some parts of the Scientific Programme may be changed, and some Field Trips may be added or deleted. Please feel free to send your requests, opinions and suggestions to the following address:

Prof. Zhao Xun
Deputy Secretary General
30th International Geological Congress
P.O. Box 823
Beijing 100037
P.R. China
Telephone: 86-1-8327772
Telex: 222721 CAGS CN
Fax: 86-1-8328928

** Photocopies of the Questionnaire are acceptable with original signatures.

Issued in April 1994

SELECTED SESSIONS - see main circular for others

K. Progress of International Geoscience Projects

K1. International Lithosphere Project (ILP)
K2. International Geosphere-Biosphere Programme: A Study of Global Changes (IGBP)
K3. International Decade for Natural Disaster Reduction (IDNDR)
K4 International Geological Correlation Programme (IGCP)
K5. Ocean Drilling Programme (ODP)
K6. Circum-Pacific Map Project
K7. Earth Processes and Global Changes/Climates of the Past (EPGC/CLIP)
K8. Global Sedimentary Geology Programme (GSGP)

Symposia

1. Stratigraphy

1-1. Recent approaches to stratigraphic nomenclature and classification and the geological time scale
1-2. Global events and stratigraphic correlation
1-3. Sedimentary stratigraphy and palaeontology of deep-water facies
1-4. Biostratigraphy (Poster Session only)
1-5. New advances in quantitative stratigraphy
1-6. Sequence stratigraphy and sea-level changes
1-7. Time limit, subdivision, and global correlation of the terminal Proterozoic (Sinian, Vendian, Ediacaran, etc.)
1-8. Correlation and subdivision of Mesozoic non-marine strata

2. Palaeontology and Historical Geology

2-1. Palaeobiogeography and reconstruction of palaeo-continents
2-2. Global mass extinction and biotic recovery through geological history
2-3. Palaeocommunities through geological history
2-4. Taphonomy, trace fossils, and extraordinarily preserved fossil groups
2-5. Evolution of marine vertebrates

3. Sedimentology

3-1. Modern and ancient marine sedimentary environments
3-2. Modern and ancient continental sedimentary environments
3-3. Lacustrine sediments: records of ancient environments
3-4. Reservoir sedimentology and diagenesis
3-5. Sedimentary geochemistry and the role of organic matter
3-6. Continental margin sediments
3-7. Sedimentation in intracratonic basins
3-8. Reefal carbonate and carbonate platform sediments

4. Marine Geology and Palaeoceanography

4-1. Impact of continental environments on ocean records and marine-continent interaction
4-2. Formation and evolution of marginal-sea basins
4-3. Processes of evolution of mid-ocean ridge and deep-sea mineralization
4-4. Marine geological environments

FIELD TRIP

T348 Devonian and Carboniferous stratigraphy, sedimentary facies and palaeontology of Guangxi (PA, SG, SD)

Various kinds of sedimentary facies, biotic and sedimentary events of Devonian and Carboniferous, and the reference sections of Frasnian/Famennian, Devonian/Carboniferous and mid-Carboniferous boundaries can be examined along Guilin-Liuzhou-Nanning, southern-central Guangxi .

Trip begins in Guilin and ends in Nanning, Guangxi Zhuang Autonomous Region. 6 days. $705

STRATIGRAPHIC ADVANCES

IN THE OFFSHORE

DEVONIAN & CARBONIFEROUS

UKCS AND SURROUNDING AREAS

A ONE DAY MEETING AT THE GEOLOGICAL SOCIETY, LONDON

THURSDAY 19th JANUARY 1995

Organised by the Stratigraphy Committee of the Geological Society & the PESGB

For further details, titles and abstracts, contact the convenors:
JEA Marshall (Dept of Geology, University of Southampton, Southampton, SO17 1BJ. Tel: 0703 592015. Fax: 0703 593052)
NJ Riley (BGS, Keyworth, Notts, NG12 5GG. Tel: 0602 363100. Fax: 0602 363200)
CC Ebdon (Amoco (UK) Exploration Company, West Gate, Ealing, London, W5 1XL. Tel: 081 849 7381. Fax: 081 849 7020)

19 January 1995

STRATIGRAPHIC ADVANCES IN THE OFFSHORE DEVONIAN/CARBONIFEROUS ROCKS, UKCS AND SURROUNDING OFFSHORE AREAS

at Burlington House

Joint with the Stratigraphy Committee and PESGB

The following contributions have been offered (some provisionally):

A cyclostratigraphy for the offshore Devonian? Astin, T.R. & Marshall, J.E.A.

Stratigraphy of late Carboniferous red beds in the Southern North Sea and adjoining land areas. Besley, B.M.

Stratigraphy of the Trent Field. Bowler, M., Cristopher, R. & Riley, N. J.

New early Namurian marine bands from northern Britain; implications for correlation and sequence stratigraphy. Brandon, A., Riley, N. & Ellison, R.

The Carboniferous stratigraphy of the Irish Sector of the Irish Sea Basins. Burnett, R.D. & Clayton, G.

The tectonostratigraphic development of the southern margin of the Mid North Sea High. Corfield, S. & Gawthorpe, R.

New evidence for evaporitic Middle Devonian lacustrine sediments with hydrocarbon source potential on the East Shetland Platform, North Sea. Duncan, W.I. & Buxton, N.W.K.

Application of sequence stratigraphy to the Upper Carboniferous Millstone Grit of the onshore U.K.: implications for the southern North Sea.
Hampson, G.J., Elliott, T., Flint, S.S. & Davies, S.J.

Discovery of Carboniferous deposits in Q12, Inner Moray Firth Basin, Scotland. Hewitt, A.J., Owens, B. & Gueinn, K.J.

Kerr-McKee well 12/29-2, a complete Devonian sequence penetrated offshore. Hewitt, A. J. & Marshall, J.E.A.

Hierarchial stratigraphic cycles in the non-marine Clair Group (Devonian) U.K.C.S. McKay, T. & Garden, I.R.

A palynostratigraphic classification of the Westphalian of the Southern North Sea Carboniferous Basin. McLean, D.

Stratigraphic refinement of Westphalian C & D units using chemostratigraphy Pearce, T.

MEMBERSHIP NEWS

G. Alberti (Hamburg)

Recent monograph on tentaculitids

Alberti, G.K.B., 1993, Dacryoconaride und homoctenide Tentaculiten des Unter- und Mittle-Devons I. Cour. Forsch.-Inst. Senckenberg, 158: 1-229, 50 Abb., 2 Tab., 46 Taf.

S. L. Bai (Beijing)

Bai, S.L., Bai, Z.Q., Ma, X.P., Wang, D.R. & Sun, Y.L. (1994): Devonian Events and biostratigraphy of South China. 303 ps., 45 pls., Peking University Press, Beijing. (In English). (To be published December 1994)

In this report, the value of conodont studies is emphasized for biostratigraphy. From the base of the Emsian (Lower Devonian) to the Lower Carboniferous, 53 conodont zones are recognized, which coincide with those of the international conodont zonation. Stage boundaries are defined by conodont-markers which had been ratified elsewhere by the International Commission on Stratigraphy or recommended by the Subcommission on Devonian Stratigraphy, International Commission on Stratigraphy. This zonation and definition fulfil the requirements of current international usage.

Chemo-biostratigraphic method in particular is proved to be a practical tool for correlation and timing. Detailed correlation of stage boundaries between the basinal and platform facies of South China is given. This method could also have potential for intercontinental correlation. Milankovitch cyclicity with a recurrent interval of 0.1 Ma is recognized, the time spans of conodont zones are given based on this cyclicity. Eustatic cyclicity with a recurrent interval of 1.4 Ma is also recognized. From the Emsian to the top of the Famennian six nickel-episodes are distinguished; each of them has a duration of around 0.5 Ma.

Systematic chemo-biostratigraphic methods are advocated and have proven value. As a result, knowledge on Devonian events, including the bio-crises, nickel-events, paleosalinity, paleoredox and eustasy is improved. The relation between events and their mechanism are preliminarily discussed. It is postulated that asteroids larger than about 1 km in diameter struck the Earth with a collision rate of $(5.0 \pm 1.3) \times 10^{-6} yr^{-1}$. These impacts triggered the global or vast regional intensification of rifting, hydrothermal activities, and other earth-bound and long-lasting processes. The main excess of nickel and iridium might have a hydrothermal origin.

R. Th. Becker (Berlin)

Good news arrived in March when the Deutsche Forschungsgemeinschaft approved a two years habilitation project on "Global facies changes and evolutionary ecology in Upper Devonian outer shelf basins". Work will concentrate on ammonoids but comparison with the evolution of trilobites and conodonts will be made. There is already firm evidence that eustatic fluctuations not only determined global diversity changes and paleobiogeography but also sequences of morphotype spectra. Joint field work with Michael House has been conducted in spring in Hercynian Morocco and in the Anti-Atlas. This time much progress has been made to establish regional ammonoid successions and zonations in the Pharciceras-Stufe, in the Frasnian, and in the Middle and Upper Famennian. With the help of M. Zahraoui (Rabat) we collected an unique hematitic fauna from the middle part of the Wocklumeria-Stufe in the western Moroccan Meseta, close to Ben Slimane. During the Moscow meeting papers were given on sealevel changes in the Canning Basin (jointly with M.R. House, P.E. Playford) and on the onset of the global Famennian regression (see abstracts). A list of new publications since the last newsletter is given below. New future research topics include: a coral shale from the late Givetian Lower Bänderschiefer Formation of the Northern Rhenish Slate Mountains (jointly with A. May), the first blind phacopids from the German Middle Devonian, and an update of the faunal succession in the Hasselbachtal D-C-boundary parastratotype.

Publication list 1994

Becker, R.T. & House, M.R.: International Emsian to Mid-Givetian (Devonian) goniatite zonation with new records from Morocco. - Cour. Forsch.-Inst. Senckenberg, W. ZIEGLER-Festschrift II, **169**: 79-135, 10 Abb., 7 Taf.

Becker, R.T. & House, M.R.: Kellwasser Events and goniatite successions in the Devonian of the Montagne Noire with Comments on possible causations. - Cour. Forsch.-Inst. Senck., W. ZIEGLER-Festschrift II, **169**: 45-77, 17 Abb., 3 Taf.

Becker, R.T. & Schreiber, G.: Zur Trilobiten-Stratigraphie im Letmather Famennium (Nordsauerland). [On trilobite stratigraphy in the Famennian of Letmathe (northern Sauerland)] - Berl. geowiss. Abh., E , **13**: 369-387, 5 Abb., 2 Taf.

Becker, R.T.: The onset of the global Famennian regression and its evolutionary consequences. - Abstr. Internat. Symp. on "Devonian Eustatic Changes of the World Ocean Level", Moscow and Ukhta: 7.

Becker, R.T., House, M.R. & Playford, P.E.: Sea-level changes in the Upper Devonian of the Canning Basin, Western Australia. - Abstr. Internat. Symp. on "Devonian Eustatic Changes of the World Ocean Level", Moscow and Ukhta: 7-8.

Klapper, G., Feist, R., Becker, R.T. & House, M.R.: Definition of the Frasnian-Famennian Stage boundary. - Episodes, **16** (4): 433-441.

Becker, R.T.: Global environmental changes and Upper Devonian ammonoid evolution. - Abstr. Jahrestag. Dt. Paläont. Ges., Budapest, 1 p.

Becker, R.T.: Faunal and sedimentary succession around the Frasnian-Famennian boundary in the eastern Moroccan Meseta. - Abstr. Jahrestag. Dt. Paläont. Ges., Budapest, 1p.

I. Chlupac (Praha)

Work continues on:

1. The Devonian stratigraphy of the Czech Republic, particularly in the Barrandian area.
2. Devonian trilobites-evolution, stratigraphic evaluation (Particularly Lower Devonian to Eifelian).
3. Non trilobite Cambrian to Devonian arthropods (phyllocarids, eurypterids, systematics, evolution, biostratigraphy).

Selected recent papers:

Chlupac I. (1992): Middle Devonian trilobites from Celechovice in Moravia (Czechoslovakia). - Sbor. geol. Ved, Palaeont. 32, 123-161. Praha.

Chlupac I. (1992): The metamorphic Palaeozoic of the of the "Islet Zone" as a connecting link between the Barrándian and the Moldanubicum. - Proc.First Internat. Conference on the Bohemian Massif, Prague, 1988, (Z.Kukal, edit.) P. 49-52. Praha.

Chlupac I. (1992): New aristozoid crustaceans from the Lower Devonian of Bohemia. - Cas.Mineral.Geol., 37, 4, 289-296. Praha.

Chlupac I. (1992): Trilobites from the Givetian and Frasnian of the Holy Cross Mountains. - Acta Palaeont. Polonica, 37, 2-4, 395-406. Warszawa.

Chlupac I., Havlicek V., Kriz J., Kukal Z., Storch P. (1992): Paleozoikum Barrandienu (kambrium-devon). Palaeozoic of the Barrandia, Cambrian to Devonian). - Cesky geologicky ustav, Praha. 292 p.

Chlupac I. (1993): Geology of the Barrandian - a field trip guide. Seckenberg-Buch 69, 163 p. Frankfurt a.M.

Chlupac I. (1993): Stratigraphic evaluation of some metamorphic units in the N Part of the Bohemian Massif - Neues Jahrbuch f. Geol. u. Palaont. 188, 3, 363-388. Stuttgart.

Brauckmann C., Chlupac I., Feist R. (1993). Trilobites at the Devonian - Carboniferous boundary. - Annales Soc. geol. Belgique, 115, 2, 507-518. Bruxelles.

Chlupac I. (1994): Facies and biogeographic relationships in Devonian of the Bohemian Massif. - Courier Forsch.- Inst. Senckenberg, 169 (Willi Ziegler Festschrift II), 299-317. Frankfurt a.M.

R. E. Crick (Texas)

The taxonomy, evolution and biostratigraphy of Devonian nautiloids from the Anti-Atlas, Morocco, is nearing completion with coauthor Dr. A. El Hassani (Institut Scientifique, Rabat). Ranges of nautiloid species fall in-between conodont and ammonoid ranges and provide overlap between many zones. Recognized difficulty of identifying nautiloid taxa continues to limit their biostratigraphic utility to nautiloid specialists and then only with careful examination of internal structures.

Work in Morocco with Dr. A. El Hassani (Institut Scientifique, Rabat) and Dr. Brooks Ellwood (UT-Arlington) is now concentrating on *magnetosusceptibility stratigraphy* to develop high-resolution event stratigraphy (see contribution in Report section). Together with Tong-Dzuy Thanh, we are in the process of preliminary sampling of the Eifelain/Givetian sequence near Ha Noi. Future plans are to extend this work to sections in the Devonian of western U.S.A. (Nevada, Utah) and eastern U.S.A. (New York, Pennsylvania). This type of work is very well suited to collaboration, and we welcome anyone wishing to join. Probably the single most attractive advantage of the technique is that it can be applied to all of those left over samples lying about in your sample cases and field bags. As long as you can vouch for the biostratigraphic control of samples, they can be used. Contact me for details if interested.

In the summer of 1993 Michael House, Thomas Becker and Phil Playford (Geol. Surv. West. Aust.) were kind enough to introduce me to the Devonian of the Canning Basin and, together with Gil Klapper, provided the luxury of an existing biostratigraphy for sampling and comparing Givetian-Famennian nautiloids of the region with those of north Africa. The faunas are very different in many cases and the host of new genera and species has slowed work somewhat.

John Talent was kind enough to put me onto a collection of Late Devonian-Early Carboniferous nautiloids from eastern Iran collected by Mehdi Yazdi, now studying at Macquarie University. The nautiloids have strong affinities to those of Morocco, yet a few genera are unique.

Progress on revision of Part K — Mollusca 3 is slow (I was warned) in part by the lack of nautiloid workers. C.H. Holland (Trinity Univ.) has graciously agreed to join the effort as have Ol'ga Bogolepova and Evgeni Sobolev both of Inst. Geology & Geophysics, Novosibirisk.

[see also contribution under Membership Reports — Ed.]

J. Hladil (Praha)

List of my small and bigger published informations (1992-1993):

*Hladil, J., Cejchan, P. & Berousek, P. (1992): Rebuilding of the shallow water dwellers: otomari-Kacak and Kellwasser events. - Global Bioevents, Abstr., Gottingen 1992, 50-51. Gottingen.

___ (1992): Are there turbidites in the Silurian / Devonian Boundary Stratotype ? (Klonk near Suchomasty, Barrandian, Czechoslovakia). - Facies, 26, 35-54. Erlangen.

___ (1992): Svrchnodevonsti konodonti z vrbenske skupiny od Rymarova. [Upper Devonian conodonts from the Vrbno Group at Rymarov]. - Zpr. geol. Vyzk., R. 1990, Ces. geol. Ust., p. 56. Praha.

___ (1992): Celechovicke vapence v deformacnich strukturach na v. okraji Boskovicke brazdy. [Celechovice Limestone within the deformation structures of the eastern margin of the Boskovice Furrow]. - Zpr. geol. Vyzk. R. 1990, Ces. geol. Ust., p. 55. Praha.

*___, Krejci, Z., Kalvoda, J., Ginter, M., Galle, A. & Berousek, P. (1992): Carbonate ramp environment of Kellwasser time-interval (Lesni lom, Moravia, Czechoslovakia). - Bull. Soc. belg. Geol., 100/1-2 [1991], 57-119. Bruxelles.

___ (1992): Zonality in the Devonian Carbonate Sediments in Moravia. - Proceedings of the 1st International Conference on the Bohemian Massif, Prague, 1988, 121-126. Praha.

___ & *Chlupac, I. (1992): New Devonian occurrences in the Jested Mts., North Bohemia. - Cas. Mineral. Geol., 37(3), 185-191. Praha.

*___ & Berousek, P. (1992): Taphonomy and primary biotic associations of the Silurian-Devonian boundary stratotype (Klonk, Central Bohemia). - Scripta, Geology (Univ. Brno), 22, 87-96. Brno.

___ (1993): Posloupnost diagenetickych zmen ve vapencich na hranicnim stratotypu silur/devon, Klonk u Suchomast. [Sequence of diagenetic changes in the limestones of the Silurian/Devonian boundary stratotype, Klonk near Suchomasty]. - Zpr. geol. Vyzk. v r. 1991, 51-53. Praha.

*___, Berousek, P. & Lukes, P. (1993): Temne vapencove vrstvy pri stropu akantopygovych vapencu u Koneprus - otomari-Kacak event. [Dark limestone layers at the roof of the Acanthopyge limestone near Koneprusy - Otomari-Kacak event]. - Zpr. geol. Vyzk. v r. 1991, 53-55. Praha.

___ (1993): Tabulatomorphs and stromatoporoids below and above the upper boundary of the Acanthopyge Limestone (Eifelian/Givetian transitional in-

terval, Central Bohemia). - Vest. Ces. geol. ust., 68(2), 27-42. Praha.

___ (1993): Strange squamulate coral from the Eifelian Acanthopyge Limestone (Koneprusy, Central Bohemia). - Vest. Ces. geol. ust., 68(2), 43-44. Praha.

*___ & Kalvoda,J. (1993): Devonian boundary intervals of Bohemia and Moravia. - In: M.Narkiewicz, ed., Global Boundary Events, Excursion Guidebook, 29-50. Kielce.

___ & *Hladikova,J. (1993): Facies against the global isotope control. - Global Boundary Events, Kielce 1993; Abstracts, p. 21. Kielce.

*___ & Kalvoda,J. (1993): Life strategies during the extinction and recovery at Eifelian-Givetian and Frasnian-Famennian boundaries in Bohemia and Moravia. - Global Boundary Events, Kielce 1993; Abstracts, p.22. Kielce.

(*) the senior (first) author of the publication

[ ] Translated headline when the paper is written in Czech

Selected publications of colleagues (1992-1993):

Chlupac, I. (1992): Middle Devonian trilobites from Celechovice in Moravia (Czechoslovakia). - Sbor. geol. Ved, Paleontologie, 32, 123-161. Praha.

Galle, A. (1993): Middle Devonian Rugosa from Horni Benesov (Moravia, Czech Republic). - Journal of the Czech Geological Society, 38(1-2), 59-70. Praha.

Kalvoda, J. (1992): The youngest conodont fauna of the Barrandian. - Scripta, Geology, 22, 61-63. Brno.

What was done here since the last newsletter:

1. It seems that both the Kacak event and Upper Kellwasser event are accompanied by strong sea-level falls at their bases. First common reactions of biota are observed and compared in the bio-events. Crisis development depends on systagenesis (sensu O.Walliser), selected life strategies of organisms as well as on a complicated interplay of many other factors including small random imputs. The biological reasons may affect the medium-long-term changes of biota much more than usually considered on the background of still favourized terrestrial or extraterrestrial catastrophes of physical nature (J. Hladil & J. Kalvoda).
2. Data on Eifelian-Givetian interval were collected from individual terranes within and around the Bohemian Massif. Summary and interpretation of the data is prepared to be published (A. Galle, J. Hladil & P. Isaacson).

Which projects are started now or newly proposed for 1993/1994:

1. Block configuration before the coming Variscan Orogeny (Emsian-Eifelian fauna of Bohemia and Moravia). Grant Agency of Czech Republic, 1993-1995, J. Hladil, A. Galle, I. Chlupac, V. Havlicek, J. Kalvoda ...
2. More intensive search of any clue to the biological crisis scenarios. State, academician and private grant agencies apply more sofisticated and utilizable approaches (see attached pleading of Grant Agency Vltava-Recovery). P. BerouÁek, J. Hladil, P. ¨ejchan ...

Summary of Devonian work in Geological Institute of Academy of Science

Devonian publications 1994 from Geological Institute, Academy of Science, Prague:

Galle,A. (1994): Rugose corals of the Acanthopyge Limestone of Koneprusy (Middle Devonian, Barrandian, Czech Republic). - Vestnik Ceskeho geologickeho ustavu, 69(1), 41-58. Praha.

Hladil,J. (1994): Ostracodes swallowed by Palaeozoic corals? - Lethaia, 26, 313-317. Oslo.

Hladil,J. (1994): Mikrofacie devonskych vapencu na Morave (Cast I. - Klasifikacni pristupy), [Microfacies of Devonian Limestones in Moravia (Part I. - Approaches in Classification)]. - Zemni Plyn Nafta, 38(4), 291-335. Hodonin.

Hladil,J., Helesicova,K., Hrubanova,J., Muller,P. & Ures,M. (1994): Devonian Island Elevations under the Scope: Central Europe, Basement of the Carpathian Mountains in Moravia. - Jb. Geol. B.-A., 136(4) [Dec.1993], 741-750. Wien.

Hladil,J., Cejchan,P. & Sedlak,R. (1994): Former Structures of Rocks Discernible by Image Analysis. - Jb. Geol. B.-A., 136(4) [Dec.1993], 751-755, 8 photo-pls. Wien.

Hladil,J. (1994): Mikrofacie devonskych vapencu na Morave (Cast II. - Prehled mikrofacii), [Microfacies of Devonian Limestones in Moravia (Part II. - Review of Discerned Microfacies)]. - Zemny Plyn Nafta, 39(1), 19-70. Hodonin-Gbely.

Hladil,J. (1994): Moravian Middle and Late Devonian Buildups: evolution in time and space with respect to Laurussian shelf. - Cour. Forsch.-Inst. Senckenberg, 172, 111-125, 9 figs, 4 tabs in append. Frankfurt a.M.

Cejchan,P. & Hladil,J. (1994): First Czech National Meeting to the IGCP Project 335 "Recoveries after mass extinctions": aims and outlines. - Geolines, 1, p.2, Occasional Papers in Earth Sciences, Academy of Science. Praha.

Hladil,J. (1994): Refugia in ecology: a question of their existence and their basic attributes. - Geolines, 1, 5-10, Occasional Papers in Earth Sciences, Academy of Science. Praha.

Hladil,J. (1994): High specialized organisms have ticket to death but some exceptions are allowed. - Geolines, 1, 10-11, Occasional Papers in Earth Sciences, Academy of Science. Praha.

Hladil,J. (1994): Intraspecific variability reduced before or during the extinction? - Geolines, 1, 11-12, Occasional Papers in Earth Sciences, Academy of Science. Praha.

Hladil,J. & Cejchan,P. (1994): Metamorfovane karbonaty silezika u Velkeho Vrbna: prekrasne klamne fosilie a velmi nejasne zbytky skutecnych fosilii. [Metamorphosed carbonates of Silesicum near Velke Vrbno: wonderfull misleading fossils and very unclear remnants of real fossils]. - Geologicke vyzkumy na Morave a ve Slezsku, 1, 37-40. Masaryk. Univ. Brno / Ces. geol. ust. Brno.

Hladil,J., Galle,A. & Ures,M. (1994): Nalez stareho sbirkoveho vzorku s napisem Eichhorn Bittischka : eifel vychodniho okraje boskovicke brazdy. [Rediscovery of an old museum sample with an inscription Eichhorn Bittischka : Eifelian of the eastern margin of the Boskovice Furrow]. - Geologicke vyzkumy na Morave a ve Slezsku, 1, 41-43. Masaryk. Univ. Brno / Ces. geol. ust. Brno.

May,A. (1994): Ideas about an interaction between sea-level changings, biogeographic patterns, global extinction events, and recovery - exemplified by the Devonian. - Geolines, 1, 18-19. Praha.

Mikulas,R. (1994): Sponge borings in stromatoporoids and tabulate corals from the Devonian of Moravia (Czech Republic). - Vestnik Ceskeho geologickeho ustavu, 69(1), 69-73. Praha.

Mikulas,R. (1994): Using of semi-fossil sources of energy: a successful strategy

in crises of biota? - Geolines, 1, 19-21. Praha.

Otava,J., Hladil,J. & Galle,A. (1994): Stari andelskohorskeho souvrstvi: nova fakta a jejich mozna interpretace. [The age of the Andelska Hora Formation: new facts and their possible interpretation]. - Geologicke vyzkumy na Morave a ve Slezsku, 1, 52-56. Masaryk. Univ. Brno / Ces. geol. ust. Brno.

Works in progress

Miroslav Krs, Marta Krsova & Petr Pruner evaluate new large collections of paleomagnetic data derived from rocks of the Bohemian and Moravian Devonian. Advanced methods and equipment help to recognize the individual magnetization events during the Variscan deformation. Strong shifts among the block positions and predominantly clockwise rotation appears to be confirmed in Moravian terranes. Final structure of results will be available at the end of 1995 (publications in 1996).

Jindrich Hladil, Arnost Galle, Miroslav Kruta & Petr Cejchan (supported by Ivo Chlupac, Vladimir Havlicek, Jiri Kalvoda, Martin Ures, Peter Isaacson, Yves Plusquellec, Jean LeMenn, Andreas May) investigate the Emsian-Eifelian situation between Bohemian and Moravian terranes. Main goal of the study is evaluation of faunal dispersals. An interplay among the basinal tectonoformations, climate ... and paleontological data is in the background of the study (including surrounding terranes). Final structure of results will be available at the end of 1995 (publications in 1996).

Arnost Galle continues his studies on rugose coral faunas. He collects the data for PAUP comparation so that another supporting material for Mid-European paleogeography will be completed soon. Special emphasis was devoted to the fauna of Rhenish intrabasinal ridges. Study on Moravian occurrence of Breviphrentis with respect to very distant occurrences in the world will be submitted for printing. Arnost Galle & Vladimir Marek finished and submitted to printing also new studies on Hyostragulum.

Vaclav Suchy & Jindrich Hladil (supported by Ivo Chlupac, Pavel Lukes, Pavel Bosak, Rudolf Prokop, Vladimir Havlicek, Jiri Vanek, Jiri Kalvoda, Martin Ures, Pavel Berousek) document large Koneprusy quarries that cut the Lower Devonian (Pragian) skeletal accumulations. Crinoid-bryozoan beds covered a Lochkovian submarine elevation that arose along the dextral strike-slip under compression. Proper reef occupied only the highest part of the accumulation when the structure was in the touch with sea level. The dimensions of the structure were significantly larger than dimension of the recent erosion relict (southernly from Ockov Thrust). Current data on individual sedimentary bodies and variety of documentations are continuously completed (to map sheets).

Milada Vavrdova & Peter E. Issacson (University of Moscow, Idaho) evaluate the Devonian/Carboniferous palynomorphs and facies from Bolivia. The study continues the previous investigations in Mexico (already published in 1993).

Petr Cejchan & Jindrich Hladil study the Devonian faunal successions in view of extinction-recovery processes. Petr Cejchan is close to complete the algorithm that enables the reconstruction of the gradients (based on quantitative faunal data). The approach of the authors is based on graph theory and solving of the Traveling Salesman Problem . One of the case studies was performed at Plymouth Recovery Meeting, September 1994. The study will be published in 1995 (Geological Society Publications, London).

Martin Ures (Czech Geological Survey, cooperating with Academy of Science) continues his study on crinoid columnals from Celechovice locality (Middle Devonian, Moravia). The study will be published in 1995 (Vestnik Ceskeho geologickeho ustavu).

Radek Mikulas enlarged his ichnofossil investigations towards the Devonian. Givetian Srbsko Formation (the topmost part of the Barrandian Paleozoic sequence, siliciclastics) is investigated by him. Hardground borings in Lower Devonian limestones are close to be published.

Vladimir Havlicek & Jiri Vanek (cooperating with Academy of Science) have finished manuscript of a monographic study on brachiopod faunas, trilobite faunas and bio-/litofacies from Pragian stage in Central Bohemia. The monograph will be submitted for publication soon.

Continued studies

Miroslav Kruta & Ondrej Slechta are investigating Emsian, Eifelian and Givetian ostracode fauna from Central Bohemia.

Petr Cejchan continues the previous studies on Eifelian and Givetian radiolarians (mainly albailellids). Quantitative approaches are further developed to be applied in paleoecological studies.

Jiri Bek started his first investigations of Devonian miospores (his subjects have been higher in stratigraphical columns, in Carboniferous), Jindrich Hladil continues investigation of Bohemian and Moravian tabulate corals, stromatoporoids, (with excursions to other groups, e.g. conodonts, infusorians ...). Stratigraphy and sedimentology of the Devonian are touched too (from time to time).

Vladimir Marek continues exclusive studies on hyolithids. Pavel Lukes (cooperating with Academy of Science) works on tentaculite stratigraphy and systematics of the Bohemian and Moravian Devonian.

Vaclav Suchy & Jan Krhovsky study the very common subject of sedimentological studies - cephalopod accumulations of Barrandian. The study can provide other approaches in comparison with the well known studies of Petranek & Komarkova or Kriz & Ferreti (or in comparison with study on tentaculite preferential orientations, Hladil & Cejchan).

Frantisek Patocka (cooperating with Jiri Fiala, Arnost Galle, Jindrich Hladil, Vaclav Suchy ... solves the volcanism, metamorphism, geochemistry, deformation and other aspects of the Devonian history and consequent fate of the Devonian segments in our terranes.

"VLTAVA" (Recovery)

VLTAVA is established: aim is an activated scientific research of biotic recovery during or after the mass extinction of organisms

Call for the projects and opinions

Are you feeling that some of your projects which aim to solve the causes of biotic crises have insufficient financial sources? We are feeling the same. Our suggestion is to pursue sponsorship by private companies directly, i.e. without the common state-budget filter, so that some promising topics among recovery studies may be initiated and accomplished faster than they are now.

The Private Czech Grant Agency "RECOVERY" is only born. The first steps have been made but the real face of the Agency will be formed during the next months. Three activities have to proceed simultaneously: Sponsor activation, Agency-supported management activation and activation of scientific contacts as well as relevant creative suggestions. The Agency aims to form a small body within prevailingly but not only Mid-European regions. We hope that the Agency may contribute in a new way to the general effort of the International Geological Correlation Program No.335 "BIOTIC RECOVERIES FROM MASS EXTINCTIONS".

As generally accepted, the interplay of human activities and the rebuilding of contemporaneous biota represents one of the main problems of human civilization. Although this problem seems to be hidden in the noise of other problems such as wars, nutrition of the population, displacement or activation of capital, it must be realized that this problem can have fatal consequences of first order significance.

Contemporaneous ecological activities, as seen from all possible angles, look like chaotic interventions by firemen or like an insufficiently decelerated process which leads to collapse. Many times it is difficult to say whether individual intervention which looks good is really good or not.

Environmental pollution, biotope changes and extinctions have be come threatening processes. We assume that these changes develop more quickly than we can understand them. There are several puzzling but essential questions: Which parts of the biota are activated when other parts of the biota are extinct? What is "still natural or acceptable" rebuilding and what is the "uninvited" fatal collapse? Can we deal with new situations or are the new situations triggered by so many random factors that they can hardly be controlled?

Serious recent evaluations by many experts speak about a lack of any clues how the biota can be activated under extreme pressure. Our strategies should be dictated by moral values and economic considerations.

The Czech Private Grant Agency "RECOVERY" calls for new as well as brain-storming projects. New directions as well as those they have been the objectives of IGCP 216 "GLOBAL BIO-EVENTS" and IGCP 293 "GEOCHEMICAL EVENT MARKERS" are welcome.

Basic orientation of projects

A. Suggested studies will be devoted to major crises in Earth history, or they will be devoted to behavior of organisms in terms of the recent crisis.

B. The preference should be given to strong and clear approaches, i.e. to advanced interpretative studies as well as to primary studies are based on new and strong hypotheses. These studies must appeal to private sponsorship. A sponsor knows that science is complicated but he needs at the same time some guarantees or indications that the study or project has sound and realizable objectives.

C. There is a priority on projects addressing changes of the ecosystem and their causes. Please, note that possible detailed case studies should possess some reasonable chance how can results be generally utilized.

Examples of possible investigations

1. Framework of life strategies and crisis conditions.
2. Small refugia, absorbing and releasing of organisms.
3. Lazarus populations and clades.
4. Effective detection and protection of refuges: their capacity and prospect.
5. Perspectives and limiting factors: clades in steady state (a "stasis"), in radiation, in survival.
6. Phylogenetic evolution of individual groups (a "systagenesis") and internal anticipation; non-adequate reactions in the same conditions.
7. Ultra-small populations, Adam & Eve starting points.
8. Guild reactions; possible structures; their stabilization and decay.
9. Internal oscillations of ecological systems and chaotic inputs: an interplay.
10. Alternative models and documentation of multiple interference of "biotic" and "non-biotic" inputs; the interfering pattern; probability of fatal drops.
11. Inertia of crisis; internal and external factors; perspectives of rare survivors; temporal versus successful salvage excursions.
12. Types of intraclade variability and their significance as evolution markers.
13. More sophisticated, multi-parameter models of geochemical and physical environments.
14. Theoretical system analysis; stable and labil configurations.
15. Any other field of investigation you have in mind. There is only the restriction that they should roughly correspond with the major ideas of the working group.

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G. Klapper (Iowa)

Research is continuing on all aspects of Frasnian conodonts, with special current emphasis on graphic correlation of conodont and ammonoid-bearing sequences in Australia, North America, and Europe. This research is being carried out jointly with John Baesemann (Amoco, Houston) and Bill Kirchgasser (SUNY, Potsdam). A discussion of the methods involved in developing a Frasnian Composite was presented at the symposium on graphic correlation at the Northeastern GSA in March, 1993.

Klapper, G., and Foster, C. T., Jr., Shape Analysis of Frasnian species of the Late Devonian conodont genus *Palmatolepis*. The Paleontological Society Memoir 32 (Journal of Paleontology, v. 67, no. 3, suppl.), 35 p., 21 figures.

Florentin Paris (Rennes)

My work dealing with Devonian material is mainly concentrated on the preparation of a global biozonation of Devonian chitinozoans. Other chitinozoans workers are involved in this project: Dr Theresa WINCHESTER-SEETO (Macquarie University, Australia), Dr Kheira BOUMENDJEL (SONATRACH, Algeria) and Dr Yngve GRAHN (Museum of Natural History, Stockholm, Sweden). Data are available from the main palaeocontinents. However, the density and the quality of the information is highly variable depending on the investigated time interval. We have adopted a similar approach as in the global biozonation proposed recently for Silurian chitinozoans by Verniers et al (in press). A special attention is paid to the chronostratigraphic calibration of late Devonian chitinozoan assemblages. Investigations are carried out on the Frasnian-Famennian material from section C' of La Serre where an indendant stratigraphical control is given by the conodonts. The most striking result is the tremendous amount of chitinozoans recorded in the basal Famennian bed of this section which yielded up to 19 000 chitinozoan per gram of rock (Paris, Girard and Feist 1994). This very unusual chitinozoan abundance is possibly related to the latest Frasnian Event. Late Devonian material from the subsurface of the Algerian Sahara, with abundant spores and chitinozoans, is also under study (joint-project with Dr K. BOUMENDJEL, Algeria).

Recent Publications on the Devonian

Paris, F., 1993. Evolution paleogeographique de l'Europe au Paleozoique inferieur : le test des chitinozoaires. Comptes Rendus de l'Academie des Sciences de Paris, 316: 273-280.

Paris, F., Ta Hoa, P., Baudu, V., 1993. Decouverte de chitinozoaires et de Scolecodontes dans l'Emsien du Viet Nam (coupe de Dong Van-Nho Que, Province de Ha Giang). Neues Jahrbuchs fur Geologie und Palaontologie Monatshefte, 10, 596-606.

Racheboeuf, P., Le HÈrisse, A., Paris, F., Babin, C., Guillocheau, F., Truyols-Massoni, M., Suarez-Soruco, R., 1993. Le Devonien de Bolivie: biostratigraphie et chronostratigraphie. Comptes rendus de l'Academie des Sciences, Paris, II, 317, 795-802.

Paris, F., 1994. Chitinozoan biostratigraphy and Paleogeography. In: J. Jansonius and D. C. McGregor (Editors), Palynology: principles and applications. American Association of Stratigraphic Palynologists Fondation, Vol. 1 (in press).

Paris, F., Le Pochat Gilbert, 1994. The Aquitaine Basin. in: J. D. Keppie (Editor), Pre-Mesozoic Geology in France and related areas. Springer-Verlag, Berlin, Heidelberg, pp. 405-415.

Paris, F., Robardet, M., 1994. The Variscan Orogeny in the Armorican Massif. Stratigraphy and Paleontology. Paleogeographic synthesis. in: J. D. Keppie (Editor), Pre-Mesozoic Geology in France and related areas. Springer-Verlag, Berlin, Heidelberg, pp. 172-176.

Paris, F. Girard, C. Feist, R. 1994. Anomalous chitinozoan abundance in the lowermost Famennian of La Serre section (Montagne Noire, Southern France): relationships with the Frasnian-Famennian bio event. In Dorning, K.J. et al. eds. CIMP Symposium on Palynology, Palaeoenvironments and stratigraphy. Sheffield 6-10 September 1994, Abstracts, p. 33.

Verniers, J. Nestor, V., Paris, F., Dufka, P., Sutherland, S. Van Grootel, G. (in press). Aglobal chitinozoan biozoantion for the Silurian. (Submitted to Geological Magazine).

G. Racki (Sosnowiec)

[see contribution under *Membership Reports* — Ed.]

John A. Talent (N.S.W.)

Macquarie University Purchases the J. Granville ("Jess") Johnson Library as Core for a Paleo Library-Research Facility

Jess Johnson's remarkable career is detailed elsewhere in this issue of the Devonian Newsletter. Readers of that item will appreciate why Jess could not make use of a conventional university library; he was unable to lift heavy tomes and had very limited mobility. He was therefore driven to purchase or request copies of everything that might be helpful in his research. As a consequence he built up a formidable professional library, specialized in things mid-Palaeozoic and especially brachiopods, conodonts, stratigraphy and sedimentary tectonics.

The Macquarie University Library has now purchased Jess Johnson's library and will make this the core of a primarily palaeontologic library-research facility. To it will be added the specialist palaeontologic journals to which Macquarie subscribes, as well as the complete or nearly complete sets of many of the classic series of palaeontologic monographs purchased since Macquarie University came into being in 1967. Also included will be a large collection of reprints on sedimentology from Karl Wolf, and, ultimately, Ruth Mawson's and John Talent's professional libraries, including some 700 volumes of Russian palaeontologic and biostratigraphic literature. The J. Granville Johnson library-research-facility will be provided with binocular microscopes and computers with on-line access to computer databases and library holdings globally. Access to the facility will be freely available, 7 days a week, to all interested parties, including itinerant overseas palaeontologists!

John A. Talent & Ruth Mawson (N.S.W.)

On February 7-9 the Macquarie University Centre for Ecostratigraphy and Palaeobiology (MUCEP) hosted the first Australian Palaeontological Convention (APC-94). Many of the 90 papers presented were on Devonian themes. Workshops run at the conference included one by Margaret Anderson *et al.* (Sodium polytungstate separations), Ian Stewart (Dealing with microfossils preserved in cherts and other siliceous lithologies), and Sue Turner & Gavin Young (Workshop on microvertebrates).

In July 1995 the MUCEP troupe will host an international venture, the First Australian Conodont Symposium (AUSCOS-1) and, with it, a conjoined Palaeontological Convention of a general nature with chief guest, an old friend of numerous Australian fans of things Palaeozoic, Art Boucot of the Zoology Department, State University of Oregon. Excursions are being offered that will take in the most important Ordovician-Early Carboniferous sections in Australia but there is, understandably, a Devonian bias to the excursions. These will be pitched so that everyone, whether conodontophiles or not, will gain much from the excursions and fellowship. For further information see the separate invitation and notification of interest published elsewhere in this issue.

We (JAT & RM) have continued our quest, with CSIRO (Commonwealth Scientific and Industrial Research Organization) colleagues, for isotopic signatures of global extinction events in the mid-Palaeozoic. Recent results from Australian sequences indicate sustained carbon anomalies associated with the Ireviken (basal Wenlock), end-*siluricus* Zone (late Ludlow) and latest Pridoli-earliest Lochkovian events (all seemingly anoxic). A paper on changes in ocean chemistry associated with the Hangenberg Event (latest Devonian) was presented at the final meeting of IGCP Project 293 (Geochemical markers of global events) in Erlangen, Germany, 26-28 September. Analyses have been completed on C, O and Sr isotopes for two Hangenberg sequences in the Montagne Noire (La Serre E, and Puech de la Suque), one in Germany (Drewer Quarry) and one in the Canning Basin, as well as a long Frasnian-Famennian sequence at Coumiac, France, that includes both Kellwasser events. Awaiting machine-time are another Hangenberg sequence from Germany (Muessenberg), and sequences through the Daleje, Kacak and the mid-Devonian Stringocephalid\Taghanic events in the Montagne Noire. Sampling in Europe has involved collaboration with Raimund Feist and Catherine Girard (Montagne Noire), Lennart Jeppsson (Gotland), and Willi Ziegler (Drewer); samples from Muessenberg were collected by Dieter Korn. The European sections have been (and are being) analysed isotopically as counterparts to Australian sections through the same events in order to determine if similar isotopic excursions occur on both sides of the globe. Incidental to the above has been establishing improved chronologic control by conodonts (several hundred samples) through the Taemas sequence (*pireneae* to *serotinus* zones, NSW) preparatory to isotopic analysis through the Daleje Event.

Works on the conodont faunas and inferred chronology of T/R events in the Emsian-Givetian of the Burdekin Basin (Townsville hinterland) of N Queensland was completed and published earlier this year. Late Devonian-Early Carboniferous faunas from the same general area are presently being written up. Sampling of allochthonous blocks and debris-flows in the Camel Ck area and Burges Submarine Valley (N Qld) was completed; a manuscript on ages and implications is being prepared. Writing-up of emplacement mechanisms and dating (*pesavis* to *serotinus* zones) of olistostromes and debris-flow megabreccias on the western flank of the Hill End Trough (NSW) continues. Acid-leaching of limestones, cherts and jaspers from the Mount Morgan-Rockhampton-Gladstone area for conodonts, radiolarians and chitinozoans is nearing completion. Results continue to be interesting, with surprisingly good conodonts from sheared, metamorphosed, and otherwise uninviting carbonates. Samples from the Lilydale Limestone (Vic.) from Raia Wall (Latrobe U.) have demonstrated this stratigraphically pivotal unit to extend higher in the column than previously assumed, i.e. into the *pireneae* Zone of the late Pragian. Samples from the Silverwood Group of southeast Queensland submitted by Kendrick van Noord (Queensland University of Technology) have produced conodonts confirming an early Emsian age for at least some of the limestones, i.e. rather younger than the alignment with the Garra Limestone (Pragian and late Lochkovian) formerly suggested. Samples submitted by Paul Blake (Geological Survey of Queensland) have expanded the spectrum of marine horizons in the Clermont district of central Queensland; they have produced conodonts indicative of late *dehiscens*-early *perbonus*, and *serotinus* zones (Emsian) and *crepida* Zone (Famennian).

A multi-disciplinary investigation, funded by the Australian Research Council, into the tectonics, biochronology and sedimentation of the c. 400 km Tamworth Belt in northern NSW, is being pursued with colleagues from University of Sydney (Jonathon Aitchison & James Stratford) and University of Technology Sydney (Evan Leitch & Tim Sharp). Our principal roles concern conodonts (RM & JAT), chitinozoans and such-like (T. Winchester-Seeto), and structure and stratigraphy (including biostratigraphy) of various areas including the core Moore Creek-Attunga area (John Klyza), the Nemingha and Loomberah limestones (Terry Furey-Greig), and the Crawney and northernmost Timor limestones (Bob Morgan). Ian Stewart (Monash U.) has sampled the cherts of the Murrawong Creek to Yarrimie formations in a quest of conodonts in autochthonous units of the Tamworth Belt. Initial papers on carbonate petrology (S. Pohler) and conodonts from the Attunga area (RM & JT) has been published; others on conodonts and carbonate petrology of limestone units in the Sulcor-Yarramanbully area are in preparation by the same authors.

Identification of the highly diverse silicified faunas obtained by acid-leaching of a Garra Limestone sequence embracing the *pesavis* Event (Lochkovian-Pragian boundary) at Wellington, NSW, has been completed — more than 10,000 specimens of c. 180 taxa (95 spp. of brachiopods) from 121 beds

(through 540 m of section). This event, initially discriminated on the basis of a cut-back in diversity (and abundance) of conodonts seems to have had little impact on benthic faunas. Results of this enterprise, undertaken intermittently over a number of years by JAT & RM with George Wilson, was presented at the inaugural meeting of IGCP Project 335 (Biotic recovery from global events) in Plymouth, UK, 4-8 September.

We have submitted for radiometric dating a suite of some 24 eastern Australian mid-Palaeozoic acid volcanics, mostly sandwiched by conodont data. Additionally, an extensive suite of eastern Australian Devonian samples has been sent to Philippe Steemans (Liege) who is attempting to obtain chronologically useful palynological data. His work includes yet another attempt to obtain spores from Victorian plant-graptolite horizons.

Glenn Brock and Michael Engelbretsen have a paper in press on elegant Early Devonian inarticulate brachiopods obtained as by-products of acid-leaching samples from various areas in eastern Australia: Tyers-Boola, Buchan, and various areas of Garra Limestone. Glenn continues working on Middle Devonian brachiopods from the Broken River in tandem with working up the diverse late Lochkovian-early Pragian silicified faunas from Eurimbla, NSW.

Alison De Pomeroy is working on Emsian-Givetian microvertebrate faunas obtained as a by-product of acid-leaching for conodonts in the southern part (Dosey-Craigie Platform) of the Broken River region, N Queensland. She is especially interested in fossil shark remains and assessing their potential for inferring precise stratigraphic alignments; she has two manuscripts in press. Her next focus will be on Emsian microvertebrates commencing with those from the Buchan and Bindi areas of eastern Victoria. This will be supplemented by an abundance of microvertebrate material obtained from various coeval sequences in south-eastern Australia, principally from Taemas (RM & JAT, see above), Wee Jasper (Steve Monk & Karen Novotny, RM & JAT) and Ravine (Mario Biasutti), for all of which we now have precise conodont chronologies. Much of the project will form the basis of Alison's PhD; it should help development of a tighter microvertebrate biostratigraphy for the Lochkovian-Emsian (*sulcatus* to *serotinus* zones) for south-eastern Australia.

Years of leaching stratigraphically collected sequences through the Lochkovian, (*delta* Zone)-Pragian (*pireneae* Zone) Garra Limestone between Manildra and Wellington, chasing conodonts and silicified faunas, has produced an abundance of microvertebrate material. This is giving much joy to Mark Hocking. Ross Parkes is well into his study of Ludlow-earliest Devonian (pre-*delta* Zone) microvertebrates from Nevada, tied to conodont biochronology by old friend Mike Murphy (U. Calif. Davis). Ross' work extends down the column from Mike's *delta* Zone microvertebrates surveyed by Sue Turner and Mike in 1988 (J. Paleont. 62). Ross will also look at some Australian faunas of comparable age. Zerina Johanson has commenced a PhD at Macquarie on Late Devonian fish from Canowindra (NSW); this is being done under the wing of Alex Ritchie (Australian Museum).

Theresa Winchester-Seeto, a post-doctoral fellow with us, has been extracting Devonian chitinozoans from material she collected in the Altai region (Asiatic Russia) in 1991, from Canning Basin core material, from Point Hibbs (Tas.) and Lilydale (Vic.), and is now vigorously processing carbonates from the Tamworth Belt for chitinozoans, scolecodonts and foraminiferal linings. A long manuscript on chitinozoans of the Taravale Formation at Buchan has been submitted for publication, and another on biogeography of Devonian chitinozoans is in an advanced state. Theresa (and Ken Bell) recently published a paper on Early Devonian microforaminiferal linings obtained as a by-product of acid-leaching.

Ken Bell is polishing a large monograph on eastern Victorian Emsian foraminifers and continues going through our acid-insoluble residues for Devonian and Silurian foraminifers from other carbonate sequences in eastern Australia. His next target is the Middle Devonian foraminifers from the Tamworth Belt. Gary Dargan successfully completed an MSc on tabulate corals from the Murda and Tullamore synclines of central NSW. Gopal Dongol submitted a PhD thesis on the geology and biochronology of the Pigna Barney and Curricabark watersheds NW of Gloucester and returned to Kathmandu at the end of March. He has a manuscript in press on Early Devonian conodont data from the Pigna Barney area.

Mehdi Yazdi, from Isfahan, is working on conodonts and selected macrofauna from the Givetian-Early Carboniferous of the Shotori Range near Tabas, eastern Iran. Ammonoids and nautiloids from his elegant collections have been sent to Michael House and Rex Crick.

John Farrell is well advanced with his PhD on conodonts from Ludlow-Lochkovian limestones S and SE of Wellington, and The Gap, NW of Molong; the faunas have proved to be more diverse than anticipated. Steve Monk and Karen Novotny are writing up dissertations on conodonts from Wee Jasper. Terry Sloan is looking into shape analysis of Devonian conodonts, and dating (with RM, JAT *et al.*) allochthonous carbonates from the Broken River and Camel Creek Province of north Queensland.

Recent publications or manuscripts in press concerning Devonian matters from the Macquarie group include:

Andrew, A.S., Hamilton, P.J., Mawson, R., Talent, J.A., & Whitford, D.J., 1994. Isotopic correlation tools in the mid-Palaeozoic and their relation to extinction events. *Australian Petroleum Exploration Association (APEA) Jour.* 34 (part I): 268-277.

Brock, G., Engelbretsen, M., & Dean-Jones, G. Acrotretoid brachiopods from the Early Devonian of Victoria and New South Wales. *Mem. Assoc. Australn Palaeontols.* (in press).

Brock, G.A., & Talent, J.A., 1993. Emsian (Early Devonian) brachiopods from the Ukalunda Beds, north Queensland. *Mem. Austral. Assoc. Palaeontols* 15: 225-248.

De Pomeroy, A., in press. Biostratigraphy of Early and Middle Devonian microvertebrates from the Broken River, north Queensland. *Rec. West. Aust. Mus.*

De Pomeroy, A., in press. Mid-Devonian chondrichthyan scales from the Broken River, north Queensland. *Mem. Qld Mus.*

Dongol, G.M.S., in press. Age-diagnostic Early Devonian (Pragian and early Em-

sian) conodonts and other fauna from the eastern end of the Tamworth Terrane, NSW. *Mem. Assoc. Australn Palaeontols.*

Farrell, J.R., 1992. The Garra Formation (Early Devonian: late Lochkovian) between Cumnock and Larras Lee, New South Wales, Australia: stratigraphic and structural setting, faunas and community sequence. *Palaeontographica* 222: 1-41, Taf. 1-7.

Klyza, J., in press. Devonian (Eifelian and earliest Givetian) conodonts from the "Warrawilla limestone", Attunga, NSW. *Mem. Assoc. Australn Palaeontols.*

Mawson, R., 1993. *Bipennatus*, a new genus of mid-Devonian conodonts. *Mem. Austral. Assoc. Palaeontols* 15: 137-140.

Mawson, R., & Talent, J.A., 1994. The Tamworth Group at Attunga, New South Wales: conodont data and inferred ages. *Courier Forsch.-Inst. Senckenberg* 168: 37-59.

Mawson, R., & Talent, J.A., 1994. Age of an Early Devonain carbonate fan and isolated limestone clasts and megaclasts, east-central Victoria. *Proc. Roy. Soc. Victoria* 106: 40pp.

Mawson, R., Talent, J.A., Brock, G.A., & Engelbretsen, M.J., 1992. Conodont data in relation to sequences about the Pragian-Emsian boundary (Early Devonian) in southeastern Australia. *Proc. roy. Soc. Victoria* 104: 23-56.

Pickett, J.W., & Pohler, S., 1993. The Alaskan Devonian sphinctozoan *Hormospongia* (Porifera) in eastern Australia. *Alcheringa* 17: 158.

Pohler, S.M.L., & Herbert, C., 1993. Carbonate sedimentology of the Middle Devonian Wyaralong limestone near Attunga, N.S.W. *Mem. Austral. Assoc. Palaeontols* 15: 255-278.

Powell, C.McA., Baillie, P.W., Conaghan, P.J., & Turner, N.J., 1993. The mid-Palaeozoic turbiditic Mathinna Group, northeast Tasmania. *Austral. J. Earth Sci.*, 40: 169-196.

Talent, J.A., in press [since 1990!]. V.J. Gupta's contributions to the Research Bulletin of Panjab University. *Research Bull. Panjab Univ.*

Talent, J.A., Gratsianova, R.T., & Yolkin, E.A., 1994. Latest Silurian (Pridoli) to Middle Devonian of the Asia-Australia hemisphere: rationalization of brachiopod taxa and faunal lists; correlation charts. *Courier Forsch.-Inst. Senckenberg.* (in press)

Talent, J.A., & Mawson, R., 1994. Conodonts in relation to the age and environmental framework of the Burdekin Basin (mid-Devonian), north-eastern Australia. *Courier Forsch.-Inst. Senckenberg* 168: 61-81.

Talent, J.A., Mawson, R., Andrew, A.S., Hamilton, P.J., & Whitford, D.J., 1993. Middle Palaeozoic extinction events: faunal and isotopic data. *Palaeogeog., Palaeoclimatol., Palaeoecol.*, 104: 139-152.

Talent, J.A., Mawson, R., Andrew, A. A.S., Hamilton, P.J., & Whitford, D.J., 1993. Middle Palaeozoic extinction events: faunal and isotopic data. *Research Report, Centre for Isotope Studies (CSIRO Mineral Research Laboratories), North Ryde*, 98-108.

Webster, G.D., Rexroad, C., & Talent, J.A., 1993. An evaluation of the V.J. Gupta conodont papers. *J. Paleontology* 67: 486-493.

Winchester-Seeto, T., 1993. Lochkovian-Pragian chitinozoans from the Garra Limestone, central New South Wales. *J. Paleontology* 67: 738-757.

Winchester-Seeto, T., 1993. Documentation of Chitinozoan assemblages from the Pragian of eastern Australia. *Proc. roy. Soc. Victoria* 105: 85-112.

Winchester-Seeto, T., 1993. Expanded biostratigraphic perspectives for Devonian Chitinozoa. *Mem. Austral. Assoc. Palaeontols* 15: 249-254.

Winchester-Seeto, T., in review. Emsian (Early Devonian) chitinozoans from the Taravale Formation, south-eastern Australia. Submitted to *Palaeontology.*

Winchester-Seeto, T., & Bell, K.N., 1994. Microforaminiferal linings from the Early Devonian of eastern Australia. *Jour. Paleontology* 68: 200-207.

Tong-Dzuy Thanh (Hanoi)

[see contribution under ***Membership Reports*** — Ed.]

Susan Turner (Queensland)

[see contribution under **IGCP 328 Reports**— Ed.]

Tom Uyeno (Calgary)

[see contribution under ***Membership Reports*** — Ed.]

Evgeny A. Yolkin (Novosibirsk)

The most important topic of my research in the last three years was an investigation the paleontological contents of the Pragian-Emsian transition at the base Emsian GSSP. Some papers for "the Zinzilban book" are completely ready. I am deeply grateful to Bill Oliver for checking the English of coral papers, Jess Johnson for checking the English of a brachiopod paper, and Michael House who agreed to check English of the crinoid paper. Other papers are close to completion.

Quite difficult problems arose from conodont and tentaculate side. In stratotype section for the base Emsian it was discovered diverse tentaculate association that requires the careful investigations. This association is certainly pre-Zlichovian (pre-*N. zlichovensis* Zone). It could be very important for an alignment of the standard Pragian-Emsian stratigraphical succession and Barrandian Pragian-Zlichovian one.

In the Zinzilban section here is whole conodont zonal succession from the *sulcatus* through *pireneae-E. gronbergi* up to *serotinus* Zone (in neighboring Khodzha Kurgan Gorge) with all zonal indices. Zinzilban conodont collection is so abundant and good that we were compelled to decide a set of nomenclature problems. Our great worry referred to a necessity to change the name for the successor of *Polygnathus pireneae* that was considered *P. dehiscens*. However the original description of this species (Philip, 1967) and its holotype illustration didn't leave us any compromise decision. The main features of the *dehiscens* holotype - the shallow basal cavity and crossed ribs on posterior platform surface, are appeared much later than just after *P. pireneae* with entries of *P. nothoperbonus* and *P. perbonus*. In this relation another nomenclature problem is arisen that should be decided using Australian collections. This was a reason for introducing the new species name (*kitabicus*) for the *P. dehiscens sensu* Klapper et Johnson, 1975.

We had tried to represent shortly these results in our paper (Yolkin, Weddige et al., 1994). Complete data with many illustrations will be included in "the Zinzilban book" (its formal name is PRAGIAN-EMSIAN BOUNDARY STRATOTYPE) that should be completed as soon as it will be possible.

This information and my comments I direct to all Devonian friend and especially who will prepare contributions for the Courier Devonian volume.

In the last year other two topics kept my attention: (1) Paleogeographical reconstructions and their geodynamic interpretations (Yolkin, Sennikov et al., 1994) and (2) Global events within Devonian (Yolkin, Izokh et al., 1994). In the first case it was shown that Altai-Sayan folded area represented a shelf of the Siberian continent. This marginal marine basin was open to the Paleoasian ocean. In the second case it was proposed to recognize two new anoxic sedimentary and biologic events: Kyk (*praehercynicus*) Event and Zinzilban (*dehiscens* [=*kitabicus*]) Event.

My current research deals with revision of the Upper Devonian stratigraphy of the Kuznetsk Basin as well as eustatic changes through the Altai - Sayan Devonian. This work is carried out together with Bakharev N.K. (ostracods), Gratsianova R.T. and Yazikov A.Yu. (brachiopods), Izokh N.G. (conodonts) and V'yushkova L.V. (fish microremains). We are now studying also much core material from the subsurface Paleozoic of the Western Siberia.

Gratsianova R.T., Yazikov A.Yu., Yolkin E.A., Izokh N.G. 1993. Istoriya razvitiya strofeodontatsey (brakhiopody) v devonskom baseine zapadnoy chasti Altaye-Sayanskoy oblasti.- Stratigrafiya. Geologicheskaya korrelyatsiya, tom 1, N 4, pp. 33-40.

Yolkin E.A., Izokh N.G., Sennikov N.V., Yazikov A.Yu., Kim A.I., Erina M.V. 1994. Vazhneyshiye global'nye sedimentologicheskiye i biologicheskiye sobytiya devona Yuzhnogo Tyan'-Shanya i Yuga Zapadnoy Sibiri. - Stratigrafiya. Geologicheskaya korrelyatsiya, tom 2, N 3, pp. 24-31.

Yolkin E.A., Sennikov N.V., Buslov M.M., Yazikov A.Yu., Gratsianova R.T., Bakharev N.K. 1994. Paleogeographic reconstruction of the western Altai-Sayan area in the Ordovician, Silurian, and Devonian and their geodinamic interpretation. - Russian Geology and Geophisics (English editon of Geologiya and Geophizika), vol. 35, N 7-8, pp. 118-144

Yolkin E.A., Weddige K., Izokh N.G., Erina M.V. 1994 New Emsian conodont zonation (Lower Devonian). - Courier Forschuginstitut Senckenberg, 168, pp. 139-157.

Karl Zagora (Grimmen)

I am working at the moment on a monograph about subsurface Upper Devonian of NE-Germany, together with Profs. Walliser & Ziegler and Drs. Weyer, Königshof & Blumenstengel.

[see also contribution under *Membership Reports* — Ed.]

MEMBER REPORTS

Integration of Biostratigraphy, Magnetic Susceptibility, & Relative Sea-Level Change: A New Look at High Resolution Correlation

Rex E. Crick, Brooks Ellwood and A. El Hassani

Introduction

Traditional means of regional correlation are at or near their effective limits of resolution. Thus it is appropriate to test and evaluate new and more precise tools for dating and correlation in support of the interpretation of the geologic record. An ideal tool for this task would be one that allows for the establishment of local, regional, and global time lines (chronostratigraphic surfaces or intervals) which could be calibrated to reversal magnetostratigraphy or radiometric geochronology. Unfortunately neither reversal magnetostratigraphy nor radiometric geochronology can, by themselves, provide the levels of stratigraphic resolution we seek. The former is limited by widely spaced intervals between reversals and problems with remagnetization, and the latter by the magnitude of analytical errors. While biostratigraphic resolution is constantly being refined through more precise definition of taxa and temporal changes in populations, and by increases in integration of composite assemblage biozones, *biostratigraphy will ultimately be limited by the evolutionary rates of biozone taxa*. In addition, there is always the inherent lack of isochroneity of biozone boundaries regardless of our tacit assumption of the isochroneity of these boundaries. Seismic and sequence stratigraphy provides a much needed link to sea-level change but time resolution and correlation of sequences on interregional and intercontinental scales is subject to some debate. One of the more promising approaches to the need for greater stratigraphic resolution being actively pursued by several SDS members has been the use of cycle or event stratigraphy that has led to the recognition of abundant, closely spaced, short-term (19 ka to 1.3 Ma) cycles and episodic events in the rock record. These cycles and events are preserved as isochronous to near-isochronous surfaces and thin stratal units, and are widely distributed in most modern and ancient sedimentary basins, especially in hemipelagic and pelagic facies. Deposits representing cycles and events develop from short-term physical events (e.g., meteorite impacts, volcanic ash falls); chemical events (abrupt changes in atmospheric or aquatic chemistry); biological events (e.g., extinctions, mass mortalities); and composite events caused by the interaction of two or more of the aforementioned. There is also a growing body of work suggesting that many 3rd order (0.5 to 5 Ma) and 4th order (0.08 to 0.5 Ma) events are related to glacio- and tectono-eustatic cycles or other related global events (e.g., anoxic events, oceanic advection events, intraplate stresses) with very short boundary transitions. Boundaries of such events comprise valuable high-resolution markers for chronostratigraphic correlation but are typically difficult to correlate especially on the interregional and intercontinental scale.

Aside from all of the arguments centered around the complex mix of sea-

level change, global, regional and local tectonics, the one thing that all net changes in sea-level have in common is a change in base-level (Christie, et al., 1988; Haq, 1991; Vail, et al., 1991). How these net changes were achieved is a matter for debate but the evidence of their existence is preserved in the rock and fossil record and, with varying levels of success, packages of sediment related to short term changes in sea-level are now being correlated over greater distances. Problems associated with the correlation of these events center around difficulties of recognizing such events, distinguishing between autocyclic and allocyclic events, and the correlation of events with fidelity. What has largely been overlooked is the connection between events related to changes in sea-level and the relative fractions of biogenic and lithogenic components in marine sediment. In general, lowering base-level results in an increase in lithogenic fraction relative to the biogenic fraction and raising base level produces the opposite effect. Ferrimagnetic minerals are a common component of all lithogenic fractions and for any given geologic moment the percentage of ferrimagnetic minerals to other lithogenic minerals is reasonably consistent. Determining this relationship then provides a reasonable estimate of the change in proportions of lithogenic and biogenic fractions (while it is acknowledged that both fractions may vary, the lithogenic fraction typically varies at a higher rate than the biogenic fraction). The concentration of ferrimagnetic minerals per sample mass can be easily and rapidly determined by measuring the *susceptibility* of such minerals to *induced* magnetization, a quantity commonly referred to as magnetic susceptibility or simply MS. We stress that what is being measured is **induced magnetization** as opposed to remanent (or fossil) magnetization related to Earth's magnetic field. The latter requires much care in sample orientation and is strongly affected by subsequent thermal overprints the severity of which may render unless the original reversal history.

What we offer here is a method of integrating the proven methods of biostratigraphy, MS of marine sediments, history of sea-level changes, and tie-points of the chronometric time scale to produce a *magnetosusceptibility stratigraphy* (MSS) curve. MSS is similar in nature to the application of MS in some deep-sea studies. The use and application of MS in deep-sea studies is different from what we propose, and no attempt has been made to correlate MS over interregional or intercontinental distances using MS from outcrops or cores. MSS has none of the drawbacks of reversal magnetostratigraphy while providing resolution better than the biostratigraphy used for temporal control. Because of the mechanisms controlling the MS of marine sediments, MSS is capable of intrabasin, interbasin, interregional and intercontinental correlation. While this claim may appear overstated, we feel the success of the method in the Devonian example discussed here is empirical proof in practice.

Magnetosusceptibility stratigraphy or MSS

General. — What is MSS? MSS is the integration of standard biostratigraphic data and the magnetic susceptibility (MS) curve for marine sediments from various stratigraphic sections to develop a composite MS curve that is independent of, but constrained by, standard biozones, and where possible, is related to radiogenically dated tie-points of a chronometric scale (see Fig. 1 for an example). The MS of sediments is the basis for MSS and, because susceptibility varies in proportion to the detrital dominated iron-containing mineral fraction of marine sediment, MS acts as a proxy for changes in sea level (local, regional and eustatic). As such, MS is a viable and independent means for local, regional and global correlation of marine strata with resolutions equivalent to Vail's 4th (0.08-0.5 Ma), 3rd (0.5-3 Ma), and 2nd (3-50 Ma) orders, and *theoretically* on the Milankovitch scale (19, 23, 41, 100, 413 ka), with temporal resolutions decreasing from intrabasin to interbasin to interregional to intercontinental.

Although it is necessary to integrate biostratigraphy and MS for temporal constraint in the development of composite MSS reference sections, once established the facies *independence* of the MSS reference curve allows time lines to be extended through pelagic, hemipelagic and neritic facies. Sampling of marine units at intervals close enough to include changes in the concentration of ferrimagnetic minerals allows the reconstruction of the history of sea level/base level change for a basin, a region, or the Earth. Creation of composite magnetostratigraphic sections for basins or regions provides a powerful correlation tool independent of facies and potentially much more sensitive than most biozone fossils. MS data are amenable to analysis by graphic correlation techniques and where data points become abundant this is perhaps the most expedient method of comparing local sections with the composite.

Rationale. — A common factor in relating cycles and events to global events is that allocyclic pelagic and hemipelagic marine sediments consist of two fractions, biogenic and lithogenic, and the ratio of these fractions varies in proportion to supply (Einsele and Ricken, 1991b). In the context of dilution cycles (as opposed to productivity cycles), the supply of the lithogenic fraction will vary with net changes in base-level regardless of the mechanism. One very important component of the lithogenic fraction is ferrimagnetic and this ferrimagnetic component is both proportional to the volume of the lithogenic fraction as well as iron content of this fraction. The measurement of the ferrimagnetic component as MS is common practice in deep-sea studies where MS is used as proxy for $\delta^{18}O$ and for carbonate content (essentially the inverse of MS/lithogenic fraction). The magnitude of the ferrimagnetic component is easy to measure by assessing its susceptibility to being magnetized and thus in our approach the MS measure of marine strata proxies not only for the volume of lithogenic sediment (relative to the biogenic fraction) but also for the net changes in sea-level responsible for controlling the volume of the lithogenic fraction. *It is necessary to make the point here that our data have greater range (by at least 10^{-1}) than any reported by virtue of a susceptibility instrument optimized for this purpose.*

If this analysis is applied to a stratigraphic sequence with moderately good biostratigraphic control, the result

is an MS curve showing high magnitudes of susceptibility during periods of greater lithogenic contribution (shallowing events) and low magnitudes during periods of less lithogenic contribution (deepening events). Applying this analysis to intrabasin events allows for correlation of specific autocyclic and allocyclic events across the basin. Extending this analysis to adjacent basins allows for distinguishing between autocyclic and allocyclic controls on the lithogenic fraction making it possible to establish interbasin correlation of the event that caused the coeval change in MS. Maxima and minima of MS can be correlated on the basis of relative magnitudes and position within a biozone scheme. Magnitudes are unlikely to agree among basins due to subtleties in transport, etc., but as discussed for the Tafilalt and Ma'der Basins (Anti-Atlas, Morocco), the relative position and intensity of magnitude provides a definable MS signature correlative between basins at resolutions on the order of at least 0.3 to 1 Ma (~4th order) (given our present sampling density). We also show that on the order of 2 to 4 Ma (~3rd order) MS can also resolve intercontinental correlations (see Fig. 3 for an example).

Possible problems and concerns. — The following are legitimate problems and concerns that need some elaboration. The space allotted to each is approximate to the importance of the problem or concern.

1. *Useful sediment and facies types.*— Any that contain trace amounts of ferrimagnetic minerals (marine and non-marine). To effectively correlate between different facies may require the creation of a composite MSS section in the facies with the dominant biostratigraphic control.
2. *Time periods.*— MS is not restricted to any portion of the geologic column although its effectiveness will diminish in the absence of a viable chronostratigraphy.
3. *Resolution.*— The effective resolution in Plio-Pleistocene loess and deep-sea sediments is in the low end of the Milankovitch band (19 ka) over relatively short distances. For older strata, resolutions of this scale may be attainable within basins or between genetically related basins with resolution decreasing to 0.1 to 1.0 Ma over interregional and intercontinental distances.
4. *Effects of diagenesis on ferrimagnetic fraction.*— The extent of iron diagenesis and consequent effects on magnetic properties will depend on the degree to which REDOX conditions are established, as well as the grain sizes of the magnetic species and the availability of iron. For example, under REDOX conditions magnetite and other iron oxide minerals may be dissolved in proportion to the amount of organic matter present in the sediment. Dissolution selectively removes the smaller grain fraction causing a coarsening of the magnetic fraction. The net effect is variable, depending on the volume of the finer-sized fraction, but will almost certainly act to decrease the magnitude of susceptibility, BUT will not destroy the MS signature.
5. *Effects of bioturbation on MS signal.*— It is generally agreed that the effects of bioturbation obscure the MS signal to some degree. Concerns about these effects are normally discussed in the context of polarity and other studies where identification of discrete time boundaries is a concern. In the case of MS, these concerns are less relevant. The extent to which the MS signal will be "blurred" depends on the rate of sediment accumulation, the degree of resolution desired and the intensity of bioturbation. Generally, slow rates of sediment accumulation will not support infaunal burrowers (because of low nutrient levels) and thus the effect of bioturbation is potentially greater in thicker sequences. However there is evidence that bioturbation effects on the magnetic properties of thick units are minimal. Working at resolutions >100 ka tends to smooth out the effects of blurring caused by bioturbation. The intensity of bioturbation is an independent factor and there will be units in which the combination of factors is such that it will be impossible to accurately determine the original MS signature of the unit. However, we believe that these problems can be overcome by creating composite sections.
6. *Effects of biogenic ferrimagnetic minerals.*— The effects of biogenic ferrimagnetic minerals (most notably magnetite of bacterial or algal origin are of concern for studies where grain orientations are important. It is much less important here because we measure whole rock MS and because the iron utilized by magnetotactic life forms came from the existing iron budget of the sediment and formation waters, thus the concentration of whole rock iron has not changed. In this context, the volume contribution and grain size of magnetite from biogenic sources is usually very small and therefore, in most cases, unlikely to significantly effect an MS curve.
7. *Variations in source or provenance of ferrimagnetic minerals.*— While a concern with deep-sea studies and with studies of sedimentary basins proximal to source, it is less so with more distal pelagic and hemipelagic sequences of the type described here. In any event, if the effects were pronounced enough to register in these facies, they would be allocyclic and of the type we wish to record (e.g., local and regional epeirogenics, eustasy, climate).
8. *Sources for variations in the MS curve.*— Variations in MS of any sediment reflect changes in lithology, i.e., fluctuations in the ratio of biogenic to lithogenic components in the sediment. Exceptions to this general statement include disproportionately large volumes of essentially non-magnetic lithogenic minerals (detrital quartz and alkali feldspar) and ferrimagnetic minerals of biogenic origin.

   What are the causal mechanisms for variations in the general case? Recent work with loess deposits and deep-sea sediment have convincingly related variations in MS to orbital forcing mechanisms with Milankovitch scale resolutions of 19, 23, 41, 100 & 413 ka and 1.3 Ma. No one disputes the effect of glacio-eustasy on cycles during periods when glacial conditions persisted. Less clear is the relationship between orbital

forcing, global eustasy, and sedimentological controls during nonglacial times, but there is a growing body of evidence that orbital forcing mechanisms are detectable in sediments at least as old as Cambrian (Einsele and Ricken, 1991a; Fischer, 1991; Goldhammer, et al., 1987; Goldhammer, et al., 1994; Grotzinger, 1986; Koerschner and Read, 1989; Strasser, 1991). The pioneering work of Vail and his colleagues (Vail et al., 1977) has drawn much criticism concerning the regional and global correlation of 3rd order events or sequences (those with 0.5 to 5 Ma duration). While there is no great debate about the rock record containing evidence of 1st (50+ Ma) and 2nd (5-50 Ma) order eustatic sea-level changes, much has been written both for and against the recognition of global 3rd order cycles or eustatic sea-level changes. The central concern of parties on both sides of the argument is how to recognize and validate the preservation of small-scale eustatic changes in the context of local and regional tectonics, basin evolution, and changes in the rate of tectonic subsidence and sediment supply (Christie, et al., 1988; Hallam, 1991; Vail, et al., 1991) cover the spectrum of this controversy). For the most part, all views have some legitimacy and most agree that, while it is not possible to correlate single events on a global scale, it is possible to correlate, *within the limits of biochronostratigraphic schemes*, series of sea level events interpreted from depositional sequences of characteristic systems-tract patterns *with* similar series of events in other areas.

The question of the controlling mechanism for short-term 3rd and 4th order fluctuations in sea-level still remains. We would argue, as have others, (Crick, et al., 1994, Crick, et al, in review; Einsele and Ricken, 1991a; Fischer, 1991; Hansen, et al., 1993; Haq, 1991; Laferriere, et al., 1987; Vail, et al., 1991) that the case for the existence of correlative 3rd order eustatic cycles (whether as orbital or carbonate cycles, or MS curves) has been made in principle by the demonstration of these correlations. We also agree as do most of the above that a great deal of basic work is required to properly demonstrate, *first* the separation of autocyclic and allocyclic sequences within basins, *second* the correlation of allocyclic events and sequences between regionally related basins, and *finally* correlation of sequences among paleogeographically unrelated basins. We feel that such an approach would be most convincing if accomplished within a coherent interval of time such as the Devonian with its wealth of biostratigraphic and chronostratigraphic work completed or in progress and its abundant evidence of yet unexplained global cycles (Becker, et al., 1991; House, 1983; House, 1985; House, 1989a; House, 1989b).

A Devonian Example

General. — A total of 33, limestone and marl beds (196 specimens) were sampled at five localities in the Tafilalt Basin. These beds, mainly Devonian, also included one Late Silurian and two Early Carboniferous units. Units identified as the same age were sampled at different localities to evaluate susceptibility consistency over relatively long distances. To test the susceptibility method within the basin, samples were analyzed from sections overlapping in age and separated over a distance of >30 km. To test the within unit variability of susceptibility, 10 sites were sampled in the same 15 cm thick bed over a distance of approximately 1 km at Bou Tchrafine. Six cores were drilled at each site or unit, and within each bed, samples were drilled from the same stratigraphic level, a process made easier by thin beds and the unselfish sharing by M. R. House and R. Thomas Becker of unpublished section descriptions, etc., as well as their time and experience when field seasons coincided in the Tafilalt. Cores were cut to standard paleomagnetic lengths to avoid surface weathering effects. The thirteen samples from the Ou Dris Est section (ODE) (Zagora Graben, Ma'der Basin) consist of matrix filled living chambers of nautiloid cephalopods collected for evolutionary and biostratigraphy purposes. Nautiloid living chambers filled with sediment upon decay of the animal and serve as a valuable source of biostratigraphic information as well as MS. Limited samples from horizons in the ODE section prevented more than two susceptibility determinations from any one level. MS analysis of 11 samples across the Silurian/Devonian boundary stratotype at Klonk (Czech Republic) provide a *limited* test for intercontinental correlation. Klonk samples were collected by Ellwood during a study of polarity changes across the boundary. These samples are constrained in time by virtue of having been taken from the numbered stratotype limestone beds. The intervening shales have not been sampled nor were they included in the original stratotype definition.

Figure 1 illustrates the MS record from all sites in the two Anti-Atlas basins. However, the following discussion is limited to the Silurian/Devonian boundary interval and the Early Eifelian through Middle Givetian interval (*costatus* through middle *varcus* zones) to take advantage of the most heavily sampled portions of the section and for comparison between basins (Fig. 2) and regions (Fig. 3).

Intra- and Interbasin Comparison. — Data from three Tafilalt sections (Jebel Amelane (JA), Bou Tchrafine (BT), and Jebel Mech Irdane (JMI)) and the Ma'der section [Ou Dris Est (ODE)] provide a high resolution composite MSS record for the interval Early Eifelian through Middle Givetian (*costatus* through middle *varcus* zones) with sample overlap resulting from samples taken from the same biohorizons in different sections (Tafilalt) and basins (Tafilalt & Ma'der) (Fig. 2). The MS curve for the interval document several fluctuations about a moderate stand of sea level with three deepening events of low magnitude and two shallowing events of high magnitude. Several changes in MS of smaller magnitude also occur, and the records for the two basins are virtually identical, differing only in magnitude. Like the records from other regions (columnar data of Fig. 1), the data describe a deepening episode through the beginning of T-R cycle Id with a small shallowing event near the *australis/kockelianus* zone boundary and close in time to shallow-

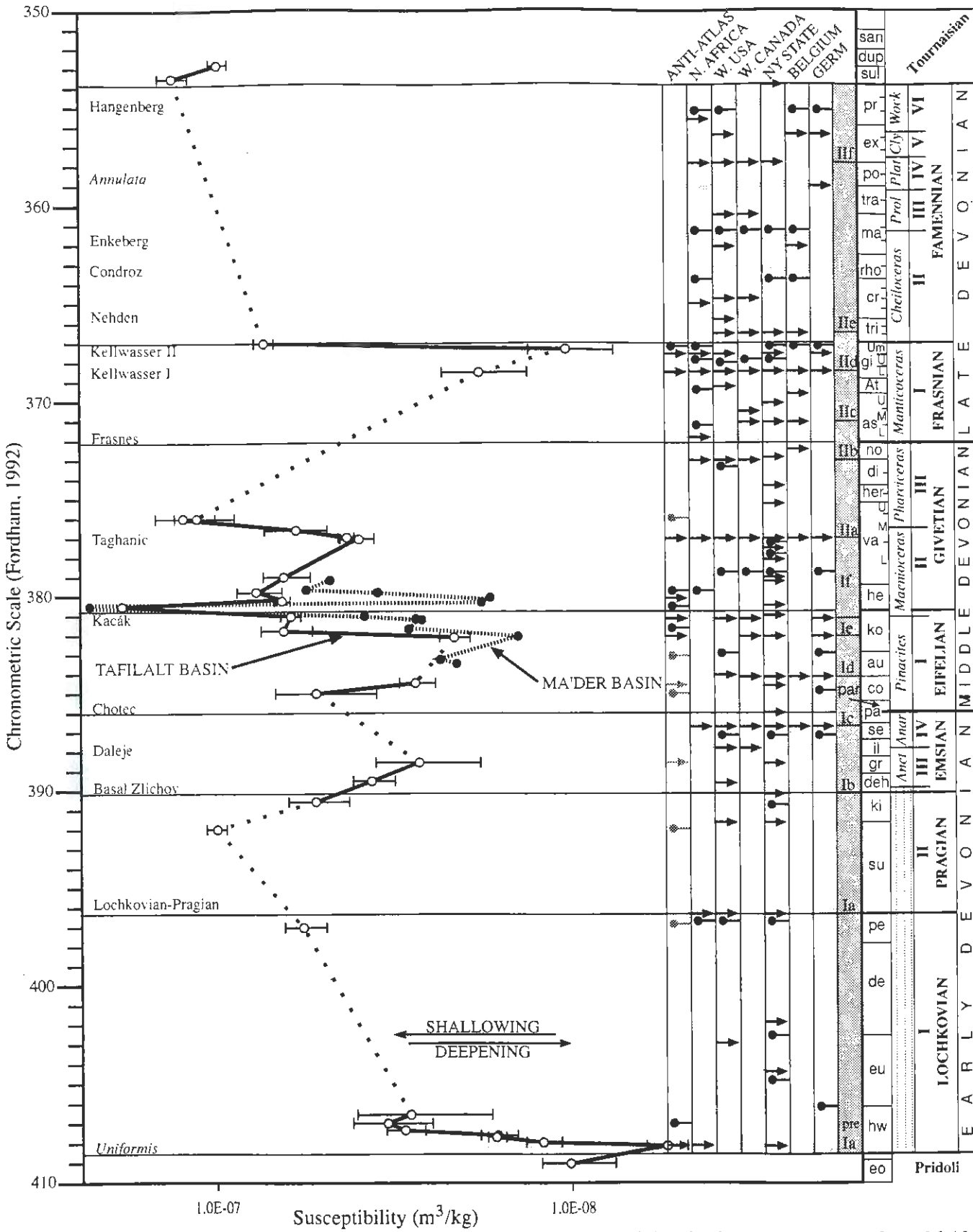

Figure 1 — MSS/biostratigraphic composite plot of log of magnetic susceptibility for five Tafilalt sites and one Ma'der site vs geologic time. Open circles, Tafilalt Basin; closed circles, Ma'der Basin. Tafilalt points positioned by mean of six or more samples with standard deviations shown as error bars. Ma'der points based on two samples each. All samples arranged in time by conodont zonation. Solid lines illustrate trends or patterns of successive samples whose susceptibil-

Continued at bottom of page 65

ing events in the western U.S.A. and Germany. The first deepening event occurs in both basins in the mid-*kockelianus* zone and the beginning of cycle Ie, an event also documented in North America and Germany. The trend then reverses and documents a major shallowing event interrupted by a small magnitude deepening event constrained by three sites in both basins in the upper *kockelianus* zone. The deepening event corresponds in time to the Kacak global eustatic and bio-event. This change marks the beginning of cycle If and the Kacak bioevent. Thereafter the record for the Anti-Atlas describes a shallowing event in both basins in the earliest *hemiansatus* zone (earliest Givetian), signifying what we interpret as a shallowing event of epeirogenic nature as it is not presently recorded outside the study area. This is succeeded by a rapid return (~0.25 Ma) to a deepening profile in the mid *hemiansatus* zone also with no counterpart in other regions. Shallowing conditions rapidly return (~0.25 Ma) in the upper *hemiansatus* zone, an event described from the published sedimentological and paleontological record for north Africa. Deepening conditions return to both basins in the lower *varcus* zone, an event also observed in the New York sequence. This deepening trend peaks at the level of the Taghanic event in the middle *varcus* zone where data from two sites (JA6 & BT6) describe deepening conditions for northwestern Gondwana corresponding to the major global deepening event and the well defined onset of T-R cycle IIa. Three points (BT7, JA7, BT8-17) representing 12 sites document a return to shallowing conditions over approximately 1 Ma continuing at least to the end of the middle *varcus* zone. The peak of this trend cannot be fixed and there are no shallowing events reported at this time in other regions. The 10 sites of BT8-17 are an important test of the within unit variability of susceptibilities described earlier based on 60 samples (6 from each site). Data from these sites document a variability that is generally less than that observed at single sites and suggest that the variability of susceptibility within individual units is low. This relationship is also documented by samples taken from the same horizons from different sections (BT6 & JA6; JA7 & BT8-17).

There can be little doubt that the similarity of MS curves between the Tafilalt and Ma'der Basins represents anything but sea-level control over influx of the ferrimagnetic bearing lithogenic fraction into the two basins. The temporal spacing of the maxima and minima for this interval correspond to either 3rd or 4th order events and provide a means of correlating such events within and among genetic basins. Once established in a composite MSS reference section, the uniqueness of the character of the MS curve would allow for correlation of the type illustrated here without the necessity of detailed biostratigraphic control BUT it would be necessary to have some general biozone control. As good as the correlation is, it will get better with more closely spaced sampling.

Interregional Correlation. — A comparison of the MS curve of the Klonk stratotype pelagic limestones with the pelagic/hemipelagic limestones of the Anti-Atlas across the Silurian/Devonian boundary shows the same basic MS curve in both basins (Fig. 3). As the basins are known to have been isolated paleogeographically and separated by the closing Iapetus Ocean, the agreement in time of the low magnitude peak (deepening event) at the Silurian/Devonian boundary and the following high magnitude peak (shallowing event) at 407 Ma are considered eustatic (as marked). The last peak (406 Ma) may be the result of epeirogenics or eustasy as we have no other data for comparison. The "known" event in the GERMANY column opposite the 406 Ma deepening peak has been reported as a shallowing event (Krebs, 1979). The correlative aspects of the susceptibility signature provides a much more objective index for this interval than the combination of zone fossils (*Monograptus uniformis uniformis, Icriodus hesperius,I. woschmidti,* and *Scyphocrinites elegans*) as well as something approaching a time-synchronous time horizon.

Chlupac and Kukal (1977, pg. 96) reported "At the Silurian/Devonian boundary no change of facies occurs and the boundary proper is precisely recognizable *only* by the palaeontological content" (our italics). Tables in Chlupac and Kukal do show fluctuations in percent lithogenic fraction within limestones and the overall character of the sequence (alternating limestones, marls and shales) is similar to that of eastern Morocco. We feel that we now have a much better picture of the contribution of conodonts in the Silurian which has enabled us to place the Silurian/Devonian boundary more precisely in Morocco where it is defined by the first appearance of the conodont *Icriodus hesperius* in association with *I. woschmidti* and the tentaculite *Nowakia arcuaria*. This level is approximately 1 Ma below the original boundary and

Continued from bottom of page 64

ity record is considered representative for the interval. Dashed lines suggest trends or patterns without sample control. Recognized ammonoid and conodont biozones and their corresponding geologic periods are listed along the outside of the right margin. Modifications to conodont zones after Fordham (1992), Klapper (1988, 1993), Klapper & Foster (1993) and Johnson & Klapper (1992) and the decision of the IUGS Subcommission on Devonian Stratigraphy to use the first appearance of *hemiansatus* as the base of the Givetian. The chronometric scale (Fordham,1992) is used as a guide for illustrating the approximate duration of deepening and shallowing events. The position of Devonian global events (e.g., Kellwasser) relies heavily on House (House, 1989b; House and Dineley, 1985) and Chlupac & Kukal (1986). Vertical bar with grey shading identifies the T-R Cycles of Johnson et al. (1985) with modifications (Johnson and Klapper, 1992; Johnson and Sandberg, 1988). Summaries of principal deepening events (arrows) and shallowing events (balls) for geographic regions shown in six columns to the left of the T-R column (see text for details). Some data of Anti-Atlas and N. Africa columns are unpublished. Grey arrows and balls of Anti-Atlas column are tentative.

about a third of the way through in the *Scyphocrinites elegans* zone. Regardless of the level chosen for the boundary, the character of the MS curve provides a means of recognition of the boundary and interregional correlation of this event independent of biostratigraphy. It is difficult to propose a means of creating near identical MS curves for north Africa and Klonk other than eustatic change in sea-level.

Prospects for Extending MSS Globally — One of our goals is to make the application of MS and MSS as universal as possible in the shortest interval of time possible. It is important to recognize that most commercially available susceptibility bridges DO NOT have the necessary resolution for working with limestones — resulting MS data will not be reproducible. Thus is important to created a set of MS standards which can be used to test and calibrate bridges so that comparisons can be made. Ellwood has agreed to do this and we will produce the first set using the Devonian sequence in the Tafilalt Basin (Anti-Atlas, Morocco concentrating on boundaries of conodont zones and the Eifelian/Givetian GSSP. Gil Klapper (Univ. Iowa) has offered lithics from conodont samples through the Frasnian/Famennian GSSP (Upper Coumiac Quarry, Montagne Noire, southern France) and Jed Day (Illinois State Univ.) has offered well dated samples through the Givetian-Frasnian of the Iowa Basin. The hope is that we will eventually have sets of regional standards from which to make comparisons.

We would also like to make clear that while the standard core sample is 2.54 cm in diameter by approximately 10 cm in length, virtually any sample size will work as the MS is related to sample mass. Thus cuttings from wells (made free of iron from the drilling process), lithics from conodont sections, chips from hand specimens, etc., are all usable. Samples must however be as tightly constrained as possible by biostratigraphy. If you wish to join in the collaborative process of establishing a database of MS values for interregional and intercontinental correlation and standardization please contact Crick for details.

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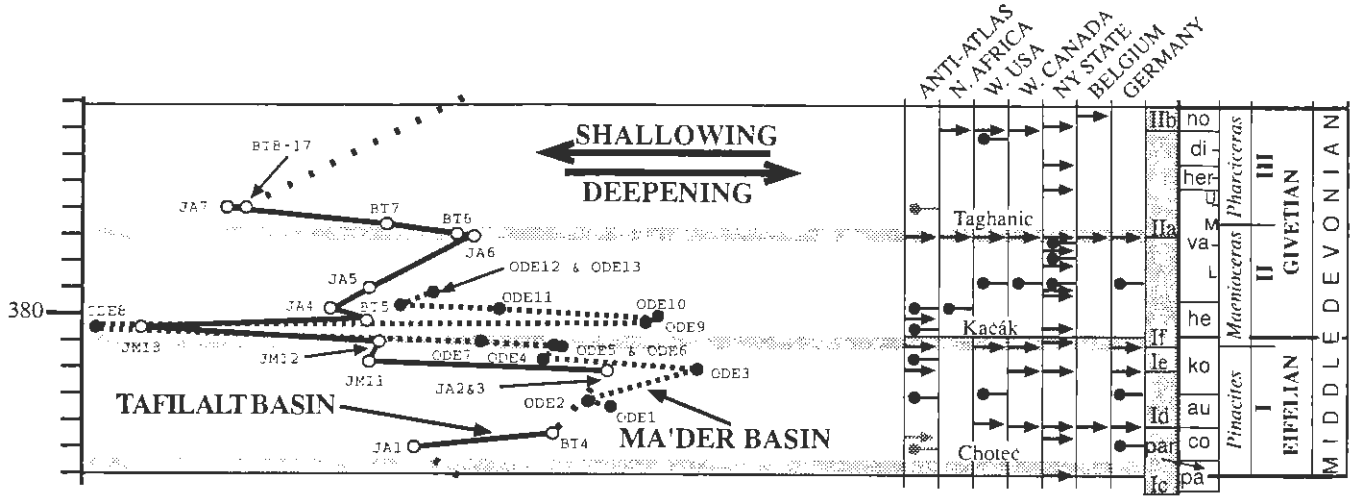

Figure 2 — Interbasin correlation by MSS between Tafilalt and Ma'der Basins (Anti-Atlas, eastern Morocco) for the interval (Late Eifelian/Early Givetian). Labeled samples BT (Bou Tchrafine), HL (Hamar Laghdad), JA (Jebel Amelane), JI (Jebel Ighace), JMI (Jebel Mech Irdane) for Tafilalt and ODE (Ou Dris Est) for Ma'der. See Fig. 1 for other details.

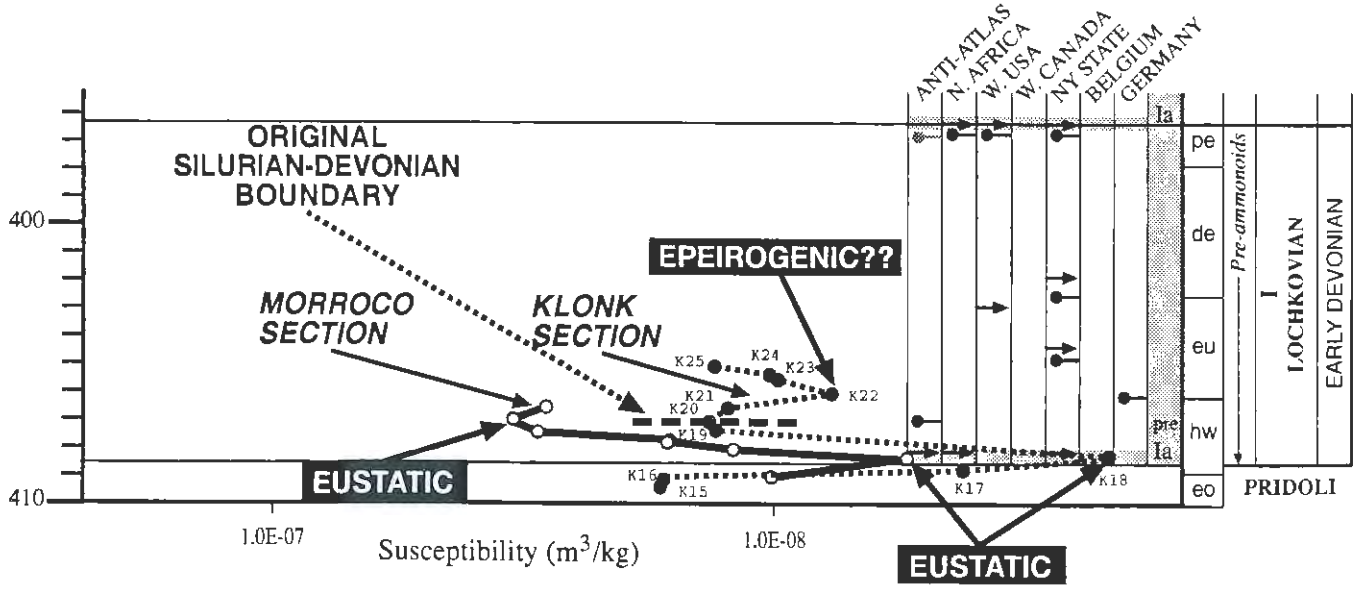

Figure 3 — Correlation between Silurian/Devonian stratotype (Klonk, Czech Republic) and Moroccan Section. Morocco curve is that of Figure 1. See text for explanation of Klonk data. Peaks marked as eustatic correlate between Morocco and Klonk. The peak marked "epeirogenic??" may be eustatic as well.

Insight into the Devonian Eustatic Curve After the Moscow Symposium

GRZEGORZ RACKI

In a paper of 1985 Johnson, Klapper and Sanberg identified sedimentary events in disjunct marine areas of Euramerican Devonian and compared their timing; the recognized synchroneity of transgressions was the basis for construction of qualitative eustatic curve. This plot was the first such detailed synthesis with reference to the standard conodont zonation, although general transgressive-regressive (T-R) pattern has been well known since the clear-sighted summary by House in 1975.

Five Laurussian areas, analysed by Johnson and co-authors differently contributed to the final conclusions, and North American (especially Nevada) overprint on the established 12 T-R Cycles is evident. Western European sucessions were of secondary importance. Consequently, the GLOBAL status of the curve could be questioned: maybe it was essentially the North American SUPRAREGIONAL bathymetric picture, quite different from real world ocean level changes due to a specific pattern of subsidence and uplift of this craton.

I hope that after almost 10 years of examination in various tectonic and facies-climatic settings we are close to resolution of the above dilemma. The Moscow Symposium on Devonian eustasy summarized the present knowledge, and papers placed in the Abstract Volume are preliminarily reviewed in this context. Despite varying degree of accuracy, eighteen papers present conodont-dated sedimentary events, whilst in seven others sea-level fluctuations are discussed only in terms of substages (subages) of uncertain significance (see my comment in SDS Newsletter no. 10).

In first order, fall of the "iron curtain", results in great influx of more or less reliable data from the former Soviet Union; it is significant for elimination of the North American bias of the eustatic standard. For Russia the event scenario is summarized by Rzhonsnitskaya, Kulikova and Sokiran, and for whole North Eurasia convincingly by Karaulov and Gretschischnikova. Undoubtedly, worldwide extent of several T-R Cycles of Johnson and co-authors seems to be well documented. For example, major deepening events in North Eurasia (i.e. also comprising Siberian craton) are fixed to the following conodont units: the bases of the dehiscens (= initial transgression Ib of Johnson et al.), northoperbonus (upper Ib), patulus (Ic), within the middle varcus (IIa), the bases of transitans (see below), rhenana (?broadly dated IId), middle triangularis (IIe) and expansa (IIf). Comparable pattern is evidenced for other parts of Laurussian shelf (Poland including), as well as for other continents (China, North Africa, Australia).

Nevertheless, some departures from the eustatic curve are repeatedly noted in the above areas. This was underlined by me for the Early Frasnian eustatic rise in the transitans Zone (called IIb/c; Frasnes Event of House); Day and co-authors introduced lately cycle IIb-1 for central and western North American cratonic basins. Another sea-level change, omitted by Johnson and co-authors, is regression near the base of the rhenana (gigas) Zone, as postulated by Narkiewicz since 1988. This presumed late Frasnian (pre-IId) eustatic fall is traced not only in the Eurasiatic sequences (especially across the Russian Platform), but in the U.S. Midcontinent shelf too (Day). In the latter area also the late Givetian IIa T-R Cycle could be divided in two cycles. Becker and co-authors show the worldwide nature of the mid-Frasnian (upper IIc) flooding (Rhinestreet deepening of New York). In contrary, the intra-Eifelian T-R Cycles, in particular Ie, could be identified only in few new areas since synthesis of Johnson and co-authors.

Another valid aspect is quantification of the sea-level changes. Such a calibrated bathymetric curve was presented for New York Devonian by House and Kirchgasser. There are also first estimations of the profound offlap near the Frasnian-Famennian boundary (e.g. 60-100 m by Sandberg and Ziegler). Such data are prerequisite for proper hierarchical evaluation of the T-R cyclicity, and careful paleogeographic analysis of sea ranges is the next step. At the moment, two major Devonian "depophases" of Johnson and co-authors, initiated in sulcatus (I) and varcus (II) Zones, seem to need supplement by e.g. probably more prominent onlaps near the Emsian-Eifelian boundary (Ic) and in the rhenana Zone (IId; Lower Kellwasser Event).

In summary, overall control of Devonian facies progressions by eustatic sea-level movements, as supposed by Johnson and co-authors, is markedly confirmed. However, refinement and new subdivisions of this Euramerican qualitatitive eustatic framework are also necessary in several significant points toward its standarization in the Devonian World.

Vishwa Jit Gupta's Fraudulent Enterprise: Unanticipated Finale

JOHN A. TALENT

V.J. Gupta's 25-year career in academic fraud will be known to most readers. In some 458 publications (involving 128 co-authors and including 5 books), he is documented as having repeatedly plagiarized illustrations from other people's publications, stolen material for use in spurious reports, "recycled" specimens (up to 4 times) for reports from geographically widely spaced localities, given fictitious localities for alleged finds, provided spurious fossil lists for localities he never visited, asserted that identifications he presented had been confirmed by leading authorities who deny having seen materials from the localities in question, made other workers co-authors of papers (or put their names on volumes as co-editors) without seeking their approval, insisted on having himself made co-author (even senior author) of manuscripts by research students to which he made no significant intellectual contribution, and so on. There is no need to continue reciting the litany of Gupta's academic atrocities... He has alleged in his defence, however, that if there is any spurious material in his papers it was entirely due to his numerous co-authors who have been part of an international conspiracy to "bring him down". Such would have been an enormous undertaking, but the 178 publications of which he is the sole author are also shot through with fraudulent 'data', perhaps even more so than his co-authored papers...

Gupta had a penchant for plagiarism. For instance, illustrations plagiarized from F.R.C. Reed's monographs on fossils from Burma and the Central Himalaya published in 1908 and 1912 figured prominently in Gupta's 1966 PhD thesis. The pictures appeared again in Gupta papers, extracted from his thesis, in volumes 20 and 21 of the Panjab University Research Bulletin. Copies of a concordance of plagiarized pictures and their sources was sent to successive vice-chancellors but these were not acknowledged. In 1972 Gupta was awarded a DSc for a thesis consisting of an agglomeration of spurious reports from fictitious localities, based on foreign materials obtained by theft or 'for teaching purposes' from foreign sources or plundered from the teaching collections at Panjab University. Soon afterwards he was given a personal chair in recognition of his contributions to science.

A large slice (42 papers) of Gupta's oeuvre concerned the Devonian system. Many of his early publications based on scruffy illustrations of Late Ordovician-Llandovery macrofossils (brachiopods, corals, trilobites, and mollusks) supplemented by pictures plagiarized from other people's publications were proffered as 'documentation' of Devonian faunas. He soon moved into Devonian conodonts (14 papers) and microvertebrates, drawing heavily on material from Amsdell Creek, New York obtained, it is assumed, during a sojourn at the University of Aberystwyth.

Documentation of Gupta's unacceptable activities has now been presented in some 40 publications in Indian and foreign journals (e.g. 1988, Cour. Forsch.-Inst. Senckenberg 106; 1989, Nature 338: 613-615; 1990, J. geol. Soc. India 34: 575-586, 35: 569-585; 1990, Bull. Ind. Geol. Assoc. 23: 39-61; 1993, J. Paleont. 67: 486-493). The latest significant publication, by 7 Indian authors (Shanker, R., *et al.*, 1994, Indian Minerals 47 (4): 263-286), documents results of an expedition directed by the Geological Survey of India to probe 7 Gupta 'localities', including 5 which he claimed had produced Devonian fossils; all 7 localities proved to be spurious.

In February 1991 Gupta was suspended by Vice-Chancellor R.P. Bambah, but was reinstated on 28 January 1992 by a new Vice-Chancellor, T.N. Kapoor. A month later, a retired former Chief Justice of the Sikkim High Court, M.S. Gujral, was appointed as Enquiry Officer to lead an investigation into Gupta's scientific activities, especially the accusations of plagiarism, recycling, fictitious localities, and duping of co-authors. The sessions, with Justice Gujral presiding, extended over 2 years. In late April 1994, a 151 p. report was submitted by Gujral to Vice-Chancellor Kapoor finding Gupta guilty on all charges. On 30 June 1994 the report was considered by Panjab University Syndicate, but the matter was sidestepped, being referred to the Panjab University Senate for action. The Senate met on 24 September. Though documentation of Gupta's fraudulent enterprise had long since reached a point where there was only one logical solution, the PU Senate perversely opted to do otherwise!

The issue was no longer Gupta's guilt but what to do about it. The issue, if mishandled, had potential to do great institutional damage. This is exactly what happened. Panjab University already had an image problem, but it is now worse. The chairman at the meeting, Vice-Chancellor Kapoor, gave no lead regarding the implications of any potential decision compared with any others. The final decision fell just short of exonerating Gupta, only 5 out of the 55 present believing he should be dismissed. In their haste to protect a colleague, regardless of consequences, they transmitted an image of their institution as a refuge for individuals having little if any committment to the broader community whose servants one assumes them to be. Though the Panjab University Academic Senate may be highly deserving of a bundle of sharp bits and pieces being directed their way, all is not gloom. There is an upside to the affair: all major Indian newspapers expressed indignation at the outrageous decision.

Ideally, an Academic Senate so indelibly associated with self interest should be somehow sidelined or, even better, got rid of. And why, one might ask? It is because it was they who got the Gupta affair so wrong. If similar circumstances were to recur, they could be relied on to get it wrong again!

New Data for Correlation of Early Devonian Bearing the Euryspirifer tonkinensis fauna in Vietnam and South China

TONG-DZUY THANH & TA HOA PHUONG

Lower Devonian deposits are widespread in North Vietnam and South China and thanks to the similar faunal assemblages each pair of formations in both areas is easily correlated as follows:

Sika Formation of North Vietnam correlates with Lianhuashan Formation in South China

Bac Bun Formation = Nagaoling Formation

Mia Le formation = Yukiang Formation

New data on the *Euryspirifer tonkinensis* assemblage characteristic for Mia Le formation in Vietnam and its equivalent in South China (Yukiang formation) are provided in this comment. The Mia Le formation bearing the *Euryspirifer tonkinensis* fauna was first described by the french geologist J.Deprat (1915) as the Mia Le series in Dong Van-Song Nho Que section, Hagiang Province, northernmost Bac Bo, near the Vietnamese-Chinese frontier, and has been revised by Tong Dzuy Thanh et al.(1988). The latter author dated this formation as Pragian in age, while its equivalent in south china bearing the similar *Euryspirifer tonkinensis* assemblage is dated as Emsian (Zho g keng, wu yi, yin baoan et al.1992) (Zhong keng, wuyi, yin baoan et all.1992). In the Dong Van-Song No Due section marls, shales and limestone lens of the Mia Le formation lie conformably on the Bac Bun Formation bearing the *Howittia wangi* (=*orientospirifer wangi* in China) assemblage.

The rocks of Mia Le formation contain abundant associations of benthic faunas in particular corals: *Favosites goldfussi, F.saurini, F.styriacus, Enmonsia yenlacensis,E.intricatus, Squameofavosites cechicus, Sqf.obiquesspinus, Echyropora grandiporosa, Roemeripora bohemicus, Heliolites praeporosus, Calceola sandalina, Hadrophylum? Brancai, Tryplasma sp., Pseudomicroplasma sp., Billingsastrea sp.* and others. Brachiopods: *Euryspirifer tonkinensis, Indospirifer kwangsiensis, Glyptospirifer chui, Stropheodonta pattei, Megastrophia aff. concava, Dicoelostrophia annamitica, Parachonetes zeili, Howellella sp, Megastrophia orientalis, Cymostrophia sp., Thiemella (?) communis* and others. Bivalves: *Mytilarca (Plectomytilus) oviformis,Pteria (cornelites) dochotoma, Pterinea (tolmaia) linealaerecta, Posidonia sp.* Trilobites: *Proetus indosinensis, Praedechenella* sp.

Conformably on the Mia Le formation are beds of black grey, fine-grained limestone with marl, pelitomorphic limestone and coaly shale interbeds. In addition,some black, thin (2-8 cm), very hard siliceous interbeds are observed in the sequence. In these beds an abundant tentaculites association has just been collected and indentified,from the bottom upwards the following species have been identified: *Nowakia acuaria, N.zlichovensis, N.mana, N.praecursor, N.ex gr.barrandei* and chitinozoans *Bursachitina riclonensis* (paris et al. 1993). At the same level Pham kim ngan 1981 has discovered conodonts *Polygnathus perbonus, Spathognathodus steinhornensis, S. optimus, Hindeodella denckmanni, Trichonodella symetrica.* From the upper layers of these beds some conodonts have just been identified by Ta Hoa Phuong :*Belodella devonica, Panderodus unicostatatus , Pandorinellina sp, Polygnathus linguiformis linguiformis.*

CONCLUSION

The above-mentioned data provide a convincing basic for identifying the Mia Le formation bearing the *Euryspirifer tonkinensis* fauna in the Dong Van - Song No Due section in particular, and in North Vietnam in common as Pragian in age, Its equivalent (Yukiang Formation) in South China bearing the similar *Euryspirifer tonkinensis* fauna may be of the same age.

Integrated study of conodont biostratigraphy and physical stratigraphy of the Beaverhill Lake Group (Late Givetian to Early Frasnian), Western Canada

TOM UYENO AND JACK WENDTE (GEOLOGICAL SURVEY OF CANADA, CALGARY, ALBERTA)

The authors are conducting an integrated study of conodont biostratigraphy and physical stratigraphy of the Beaverhill Lake Group (BhL Gr) (210 m thick; late Givetian to early Frasnian) across the Western Canada Sedimentary Basin of Alberta. We recognize major depositional successions from the study of cores and they are correlated across the basin using wireline logs. Cores are extensively sampled in each of the major depositional successions.

The BhL Gr extends from the Watt Mountain Formation (Fm) of the Elk Point Gr to the platformal carbonates of the Cooking Lake Fm or the deeper-water basinal equivalents, the Duvernay Fm, both of the Woodbend Gr. The underlying Watt Mountain Fm includes carbonates, evaporites and terrigenous sediments deposited on a coastal plain or in a very shallow sea. The BhL Gr is divided into nine major depositional cycles, and the shifts of facies in these depositional cycles define two major transgressive-regressive (T-R) successions. The lower major T-R cycle extends from the top of the Watt Mountain Fm to the the top of Cycle D, a position equivalent to about the middle of the Moberly Member (Mbr) of the Waterways Fm (of the old stratigraphic terminology; see Uyeno, 1974). This cycle includes conodont zones ranging from within the subterminus Fauna (approximately Upper disparilis Subzone; see Klapper, in Witzke et al., 1985; Klapper and Johnson in Johnson, 1990) to the lower part of Klapper's (1989) Zone MN3. The upper major T-R cycle extends from the top of Cycle D to the base of the Woodbend Gr, and corresponds to the upper half of the Moberly Mbr and the Mildred Mbr of the

Waterways Fm. Conodonts from this cycle are assigned to zones MN3 and a part of MN4. The Watt Mountain Fm was previously suggested to be a part of the subterminus Fauna (Uyeno in Day et al., in press). In the BhL Gr, we recognize T-R cycles (after Johnson et al., 1985) IIa-2 (within the subterminus Fauna, approximated with the base of the Upper disparilis Subzone; Day et al., in press), IIb, and probably IIb-2 (of Day et al., in press) and IIb/c (of Racki, 1992).

The top of the BhL Gr on the eastern shelf of Alberta is unconformable and overlain by shallow-water carbonates of the Cooking Lake Fm. Basinward, the shales of the uppermost member of the BhL Gr, the Mildred Mbr, grade conformably up into basinal carbonate equivalents of the Cooking Lake Fm.

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TIME SCALE FORUM

CM Becker has written in response to a request to review the Devonian Time Scale illustrated on the back cover.

A significant error in your chart is the placing of the *Annulata* Event. It forms the very base of the UD IV and falls in the uppermost part of the *trachytera* Zone. The Condroz Event embraces two distinctive regressive episodes at the *crepida/rhomboidea* transition and within the Upper *rhomboidea* Zone. The Taghanic Event lies already in the highest part of the Middle *varcus* Zone, not at its base. Most *Maenioceras* faunas of the world fall in the Middle *varcus* Zone but they do not range into the transgressive event period which is marked in the Tafilalt by a thin black styliolinite. The distinction of the Middle and Upper *varcus* Zones is anyway very difficult and there may be no Middle *varcus* Zone pharciceratids but only facies-controlled absence of the Upper *varcus* Zone marker conodonts in some important sections (e.g., Tully LImestone of New York). All of these things, of course, do not affect your overall picture but give only better stratigraphic precision.

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Chronometric Scale (Ma) after Fordham (1992)