MESSAGE FROM THE NEW CHAIRMAN

Dear SDS Members:

This new Newsletter gives me the pleasant opportunity to thank you for your confidence which should allow me to lead our Devonian Subcommission successfully through the next four years until the next International Geological Congress in Norway. Ahmed El Hassani, as Vice-Chairman, and John Marshall, as our new Secretary, will assist and help me. As it has been our habit in the past, our outgoing chairman, Pierre Bultynck, has continued his duties until the end of the calendar year, and in the name of all the Subcommission, I like to express our warmest thanks to him for all his efforts, his enthusiasm for our tasks, his patience with the often too slow progress of research, and for the humorous, well organized and skilful handling of our affairs, including our annual meetings. At the same time I like to thank all our outgoing Titular Members for their partly long-time service and I express my hope that they will continue their SDS work with the same interest and energy as Corresponding Members. The new ICS rules require a rather constant change of voting members and the change from TM to CM status should not necessarily be taken as an excuse to adopt the lifestyle of a "Devonian pensioner". I see no reason why constantly active SDS members shouldn´t become TM again, at a later stage. On the other side, the rather strong exchange of voting members should bring in some fresh ideas and some shift towards modern stratigraphical techniques. The new voting membership (to be selected under the new ICS rules by the SDS executives and to be approved by ICS) consists of all previous members whose names have been put forward as candidates until our annual meeting at the Florence IGC and who agreed to take the responsibility. Representatives cover most of the major Devonian areas (countries) and most research fields. South America, unfortunately, is not yet represented as it should be.

The forthcoming four years will see the continuation of current activities and a shift of emphasis towards new tasks. Integration of SDS and IGCP 499 activities will be stimulating for both. Rex Crick has agreed to continue with the compilation and distribution of our Newsletter and will also place it on the SDS website. His service and our success depends on the contributions you are submitting to him. Whenever you submit a document to our meetings, please send it electronically at the same time to Rex for inclusion in the next Newsletter. At Florence, ICS held a long official meeting, with a strong emphasis on the various ways how to circulate in future the results of its work, which is mostly the output of all the subcommissions. Apart from publishing comprehensive books, internet documentation, involving the North American CHRONOS Project, is getting more and more important. Therefore, SDS should document on its homepage in a sufficient way the relevant data of our GSSP´s. The past author´s of GSSP proposals are asked to submit (as digital images – preferably as jpg-file - and by email) the following GSSP details:

- locality map(s)
- suitable outcrop photo(s)
- a section log with marked GSSP position
- image of the type of the GSSP defining taxon
- image of an oldest specimen of the defining taxon from the GSSP bed
- photos of additional marker taxa which aid the recognition of the GSSP elsewhere
- a more or less complete and up-to-date reference list for the GSSP sections

Our homepage should also offer, as a general service, a complete list of the various SDS publications. Data on our substages will have to be added: photos of defining and other marker taxa (types), lists of selected reference sections including the relevant publications. The same will apply to important auxiliary sections which enable correlation into the neritic and terrestrial realm. SDS has already been asked to supply some of this information to ICS.

In the near future SDS will produce two more volumes, which contain valuable data: the proceedings of our Morocco Meeting, to be published in the "Geological Society, Special Publication" series, and a review of our substage work, which is planned to appear in the modernized "Geological Quarterly". I guess that some of our already planned future symposia may lead to further comprehensive Devonian publications. In this respect, SDS can be proud of its past and current achievements. Once we have solved the current substage definitions, hopefully within this year (perhaps slightly later in the case of the Famennian), we should place more emphasis on the following topics:

- - Pelagic-neritic correlation: identification of suitable regional reference sections, compilation and improvement of regional charts based on correlation with the GSSP levels and substage boundaries.
- - Marine-terrestrial correlation: as above, reference sections and updated regional charts.
- - Refinements of Devonian event stratigraphy, with a focus on smaller scale eustatic and global evolutionary events.
- - Correlation of regional stage names against the global chronostratigraphy (in order to allow an understanding of the wealth of older stratigraphical data).
- - Improvements of geochronological dating and of numerical timescales (e.g., by the integration of various graphic correlation scales and by orbital scaling)

- - Reconstructions of the Devonian world (paleogeography, climate, palaeoceanography, plate tectonics, biogeography, biodiversity) using the finest available time scale.
- The latter task certainly will take us a long way ahead of 2008. I hope you feel encouraged to take part actively in the work of SDS. Of course, SDS is always open for new ideas and suggestions. I am looking forward seeing many of you at our symposium in July in Novosibirsk.

yours sincerely,

R. Thomas Becker, SDS Chairman

MINUTES OF THE SDS BUSINESS MEETING,

RABAT, 1st of March 2004-07-20

No Annual Business Meeting took place in 2003 and there was only an informal meeting of SDS members during the GSA Annual Meeting in Seattle in early November 2003. Instead, two Business Meetings were planned for 2004, the first of which was held in conjunction with the International Meeting on Stratigraphy, on "Devonian neritic-pelagic correlation and events", organized jointly by SDS and the Institute Scientific, most prominently by our TM A. El HASSANI, from 1st to 10th March 2004. The Business Meeting was scheduled at the Institute Scientifique at 4.15 p.m. on the 1st of March. At the Rabat Symposium, 24 talks were given which covered a wide range of topics with strong emphasis on Devonian biostratigraphy, event stratigraphy and sedimentology. A further 20 posters and more than 50 participants give evidence of the symposium success and significant advances in Devonian research. The Guidebook of the subsequent SDS excursion to the Dra Valley is about to be published as volume 19 in the "Documents de l´Institut Scientifique" series (A. El HASSANI, Ed.) and will become available to everybody for purchase. Symposium proceedings will be published in the highly regarded "Geological Society, Special Publications" series (BECKER, R. T. & KIRCHGASSER, Eds.), as a volume dedicated to our late former Chairman M. R. HOUSE. The Geological Society editorial board has just accepted our planning for such volume and all authors who have indicated their wish to contribute will be given more details in early August. Publication is planned for autumn 2005 (new manuscript deadline = 1st December) and will serve as one of the first examples for the new collaboration between IUGS and the Geological Society.

Attendance

A total of 33 people attended which is slightly less than at the Toulouse business meeting in June 2002: **TMs** R. T. BECKER, P. BULTYNCK, A. EL HASSANI, W. T. KIRCHGASSER, P. MORZADEC, ZHU Min, **CMs** M. BENSAID, C. E. BRETT, D. BRICE, CHEN, Xiu-Qin, M. EL BENFRIKA, U. JANSEN, P. SARTENAER, E. SCHINDLER, M. STREEL, N. VALENZUELA-RIOS, **Guests** Z. S. ABOUSSALAM (Münster), M. AMLER (Marburg), F. BIGEY (Paris), J. BOCKWINKEL (Leverkusen), J.-G. CASIER (Bruxelles), C. CORRADINI (Cagliari), C. CRONIER (Lille), GOUWY, S. (Bruxelles), V. EBBIGHAUSEN (Odenthal), A. EL ALBANI (Poitiers), P. KÖNIGSHOF (Frankfurt a m.), LIAO, Jau-Chyn (Valencia), U. MANN (Jülich), G. MCINTOSH (Rochester), J.-P. NICOLLIN (Lille), J. ORSO (Milano), G. PLODOWSKI (Frankfurt a. M.).

Five documents were presented at the meeting which were numbered as follows:

1. TSYGANKO, V.: Levels of the substage boundaries from the Middle and Upper Devonian (European North-East). – 1p.
2. Streel, M., Belka, Z., Dreesen, R., Durkina, A. V., Groos-Uffenorde, H., Hance, L., Hartkopf-Fröder, C., Haydukiewicz, J., Korn, D., Perri, M. C., Piecha, M. & Spaletta, C.: Relation of the neritic microfaunas and continental microfloras with the conodont and other pelagic faunas within the latest part of the Famennian. – 6 pp.
3. BLIECK, A.: Marine/non-marine correlation. – 2 pp.
4. BLIECK, A., CLEMENT, G., BLOM, H., LELIEVRE, H., LUKSEVICS, E. & YOUNG, G. C.: Late Devonian tetrapod-bearing localities: a review including new data, and the need of accurate datings. – 10 pp.
5. KÖNIGSHOF, P., LAZAUSKIENE, J., SCHINDLER, E., WILDE, V. & YALCIN, M. N.: IGCP 499 – Devonian land-sea interaction: evolution of ecosystems and climate. – 2 pp.

1. Introduction and apologies for absence

The Chairman opened the meeting and thanked our Moroccan hosts, especially TM El HASSANI, for their hospitality and the splendid organisation. The fact that SDS has returned to Morocco only five years after the successful 1999 meeting strongly emphasizes the significance of the Moroccan Devonian for international correlation and it is still far from being fully explored.

The audience stood up for a minute of silence in memory of our members which passed away since the Toulouse meeting: TM W. ZIEGLER, TM I. CHLUPAC, and CM (and previous Chairman) M. R. HOUSE.

Apologies: TMs R. Crick, R. Feist, J. Garcia-Alcalde, G. Klapper, V. Menner, C. A. Sandberg, J. Talent, K. Weddige, T. Uyeno, E. A. Yolkin; CMs G. K. B. Alberti, A. R. Ashouri, A. Blieck, G. Brock, P. Carls, B. Ellwood, A. Ivanov, Ma, Xue-ping, R. Mawson, J. E. A. Marshall (later joined the SDS Fieldtrip), W. A. Oliver, J. Over, F. Paris, M. C. Perri, G. Racki, I. Schülke, C. Spaletta, V. S. Tsyganko, M. Truyols-Massoni, C. Ver Straeten, M. Yazdi.

2. Approval of the Minutes of the 2002 Business Meeting, Toulouse

The Minutes were approved. TM MORZADEC complained that he did not receive Newsletter 19 which included the Minutes.

3. Chairman´s Business

The CHAIRMAN highlighted the program for the forthcoming IGC at Florence where SDS will hold a symposium on high-resolution biostratigraphy and the substage definitions (Symposium G – 22.03 on 23rd August, 9 to 11.45 a.m). The program consists of nine talks and nine additional posters. Votes on substage subdivisions should take place immediately

afterwards and it is hoped that the contributions will include further significant data. He emphasized that there will be no substage GSSPs but a range of regional reference sections where substage levels can be recognized. The recent studies on the Taghanic Event were used as an example which will allow to define an Upper Givetian substage. The four chairmen of the Working Groups should plan multi-authored papers which explain and illustrate the subdivision once decisions have been made. Both Episodes and Lethaia are suitable for publication. The latter has recently been announced as an official journal of IUGS. It is hoped that Florence will bring a major step forwards in the substage cases.

4. Report on the informal SDS Meeting held in Seattle, November 2003

Since the Chairman was not able to attend, the Secretary briefly reported on the informal SDS meeting during the GSA Annual Meeting in Seattle, 2nd to 5th November 2003. Apart from a good number of North American members ("Friends of the Devonian") some TMs and CMs made it to the NW of the States since Jarred R. MORROW and Paul WIGNALL had organized an interesting symposium on "Understanding Late Devonian and Permian-Triassic Biotic and Climatic Events". **Present**: TMs R. T. BECKER, R. FEIST, W. T. KIRCHGASSER, G. KLAPPER; CMs J. DAY, B. ELLWOOD, P. ISAACSON, J. E. A. MARSHALL, M. MURPHY, J. OVER, G. RACKI, C. E. VER STRAETEN; various other Devonian workers. The Secretary gave a report of current SDS activities, focussing on the substages and on the (then) forthcoming Morocco Meeting. The immanent major change in SDS voting members was discussed, with specific respect to the future American TMs (see proposals in Topic 7.2). Our North American members then led a discussion when, where and how to organize a future North American SDS meeting with emphasis on Nevada. (see Topic 9). A proceedings volume of the symposium on Devonian and Permian events will be edited by J. MORROW & P. WIGNALL and will be published late in 2004 or in early 2005.

5. Devonian Substages

5.1. Emsian

Progress has been relatively slow in 2003. Significant new data for German and Bohemian sections are still missing, partly due to the loss of our TM I. CHLUPAC. There was a formal decision for Lower and Emsian substages in 2003 but the boundary level is still unsettled: close to the base of the Daleje Event, close to the *inversus* conodont Zone, close to the entry of *Nowakia cancellata*. In the absence of the Emsian Working Group Leader, the CHAIRMAN gave a review talk, using data and illustrations from CHLUPAC (2000), BULTYNCK & MORZADEC (1979), BULTYNCK (1989), and BULTYNCK et al. (2000; SDS Newsletter 17: 10-11). He also drew attention to the complex new conodont data by BARDASHEV et al. (2002) in Senck. lethaea, 82 (2). The detailed nowakiid results, especially the sequence of morphotypes/subspecies of oldest *Now. cancellata*, still have not been published. In the Ardennes, the Daleje Event may be correlated with the transgression of the Hierge Formation. Special attention is given to *Po. gilberti* which enters later than both *Po. inversus* and *Po. laticostatus* in the La Grange Limestone. The entry of *I. corniger ancestralis* and *I. fusiformis* is also relevant. *Po. gilberti* was previously partly included in *Po. laticostatus* and also occurs in Nevada. In The Tafilalt, the upper part of the *Anetoceras* Limestone yielded no *Po. gilberti* but *Po. vigieri*, which does not overlap in the Armorican Massif with the latter in earlier strata.

TM MORZADEC asked whether *Po. gilberti* occurs in Spain which is not the case (but *Po*. aff. *gilberti* is recorded by GARCÍA-LÓPEZ et al. 2002, ECOS VIII Field Guidebook = Publ. Inst. Geol. Min. España, Cuad. Museo Geominero, vol. 1). CMs JANSEN & SCHINDLER reported that studies on samples on Cisarska Rocle are still continuing where a black shale is developed. Palynology is under way and P. BUDIL (Praha) is studying the trilobites. It seems that *Now. cancellata* enters rather early. The secretary explained the Lower/Upper Emsian transition in the western Dra Valley where there is a change from grey to black shales (Black Marl Member) of the upper Oui-n-Mesdour Formation to the *Hollardops* Limestone Member at the base of the Khebchia Formation. The latter has only yielded icriodids, such as I. *fusiformis, I. corniger ancestralis*, and *Caud. culicellus*, but these seem to be of high biostratigraphical significance and similar icriodid faunas are well known from similar levels in Spain. In the eastern Dra Valley, brachiopods studied by CM JANSEN indicate that the base of the Upper Emsian lies within the Rich 3 Sandstone Member of the Mdauer-el-Kbir Formation (outlined in more detail by CM JANSEN during the fieldtrip). The use of *Po. gilberti* as Upper Emsian index species was questioned by the SECRETARY since it overlaps in the La Grange Limestone with the youngest *Anetoceras* faunas which are normally regarded as Lower Emsian or Zlichovian in age.

It is clear that the available data are still insufficient for a final decision. All SDS members are strongly urged to submit relevant data in order to progress with the Emsian subdivision at the Florence meeting.

5.2. Givetian

The CHAIRMAN, in his function as Working Group Leader gave a review of current data concerning the subdivision into three substages. He reminded of previous documents (ABOUSSALAM & BECKER 2001, 2002) which plead for the base of the *hermanni* Zone as the base of an Upper Givetian substage. Unfortunately, this zone is not recognizable in the conodont-poor parts of the Fromelennes Formation of the Ardennes. He pointed out (citing ROGERS 1998) that the correlation of the shallow-water Lower *subterminus* Fauna with the deeper-water zonation is not entirely clear and that it may enter earlier than the *disparilis* Zone. *I. subterminus* does occur in the Upper Fromelennes Formation, but already together with *Pand. insita* which indicates the *norrisi* Zone (= basal *falsiovalis* Zone). The *hermanni* Zone is recommended as a substage boundary level in NW Russia (CM TSYGANKO, Document 1: base of Pashija Suite).

Givetian lithostratigraphy, miospores, brachiopods, corals, and conodonts of the Ardennes have successfully been com-

bined with graphic correlation (GOUWY & BULTYNCK 2003, Rev. Esp. Micropaleont., vol 35) which allow cross-facies correlation, far into the neritic realm. The base of a Middle Givetian substage may be placed at the entry of *Po. rhenanus* and *Po. varcus* (*rhenanus*-*varcus* Zone) within the former Lower *varcus* Zone. Both species are known from the upper part of the Mont d´Haurs Formation in the Ardennes. Their entry in the Eifel Mountains is still unknown. A correlation diagram with the New York sequence is based on the currently known first entry of *Po. timorensis* (base of *timorensis* Zone = base of former Lower *varcus* Zone) in the Centerfield Limestone and of *Po. rhenanus* in the Tichenor Limestone.

The SECRETARY illustrated the Givetian stratigraphy of the Dra Valley which is outlined in detail in the Fieldguide. Sparse conodont data (juvenile *Po. varcus*) suggest that the base of a Middle Givetian as defined in the CHAIRMAN´s proposal would lie in the eastern Dra Valley (Oued Mzerreb, BECKER et al., Fieldguide) within beds with agoniatitids, preceding the entry of *Maenioceras* s. str. and well below the Lower *Pumilio* Bed. The presence of *Maenioceras, Sellagoniatites* and of the *"Tornoceras" amuletum* Group at the top of the Ledyard Shale and in the Wanakah Shale, a typical association of the lower *terebratum* Zone, suggests that the first record of *Po. rhenanus* in the overlying Tichenor Limestone is a facies-controlled late entry. The base of the *rhenanus*-*varcus* Zone must correlate with a much older level in New York where the conodont record is poor.

5.3. Frasnian

In the absence of the Working Group Leader, CM OVER, not much progress was made in the case of Frasnian substages. The SECRETARY reported that the Burgberg section of the Rhenish Massif has been re-sampled together with Sarah ABOUSSALAM but recovered faunas were poor and, contrary to previous work by R. STRITZKE, the base of the *punctata* Zone or MN 5 zone was not encountered so far. New sampling at the classical sections at Giebringhausen and Blauer Bruch will commence in May/June. The CHAIRMAN drew attention to the poster by GOUWY et al. on the correlation of bentonites in the Ardenne which led to modified conodont ranges, including *Pa. semichatovae*, in the Ardenne Composite. This is relevant for the recognition of a future Upper Frasnian substage in the area but the classical biostratigraphical data of the region were mostly confirmed. The SECRETARY briefly discussed the position of the *semichatovae* Transgression in the eastern Dra Valley (Oued Mzerreb, BECKER et al., Fieldguide) where marker goniatites of Upper Devonian I-I suddenly appear in a diverse hypoxic assemblage above reddish limestones with *Avignathus decorosus*, a marker polygnathid which enters in the upper part of MN Zone 10. The goniatites allow straight correlation with the Martenberg of Germany and with faunas from the Canning Basin which yielded *Pa. semichatovae*.

There seems to be good acceptance for both proposed substage levels (base of *punctata* Zone or of MN 5 Zone; entry of *Pa. semichatovae* low in the Early *rhenana* or MN 11 Zones) but documentation is still insufficient. SDS Members are asked to come forward with potential regional reference sections which show the entry of *Pa. punctata* and of *Pa. semichatovae*. The correlation with brachiopod, spore, coral, trilobite and ammonoid successions is of equal importance. CM TSYGANKO (Document 1) repeated the suitability of both levels in northern Russia (base of Domanik Suite and base of Member 2 of the Lyaiol Suite/upper Syrachoy Subsuite).

5.4. Famennian

The SECRETARY, in his function as Working Group leader, briefly repeated the outcome of the formal vote on the number of Famennian substages. The majority for four substages was clear and follows the ICS rules for required majorities. He drew attention to the fact that conodont sampling in the Tafilalt by S. KAISER (Bochum) has proven that *Pa. gracilis expansa*, the marker of the Lower *expansa* Zone, enters well below the Dasberg Event, still in the upper part of the *Platyclymenia* Stufe (Upper Devonian IV) of the traditional ammonoid succession. The last bed below the Dasberg Event does not have *Po. styriacus* any more but may have the first *Bispathodus aculeatus*, the index species of the Middle *expansa* Zone. Therefore, the base of the Lower *expansa* Zone does not coincide with a major transgression in Germany and Morocco but is older. The significant faunal overturn and eustatic rise at the IV/V (Hemberg/Dasberg) boundary falls near the base of the Middle *expansa* Zone. This has serious implications and setbacks for the discussion of an Upper Famennian defined at the level of the Lower *expansa* Zone (see Document 1). Reviews of both levels on different continents are required. The SECRETARY advocated to place the base of the Upper Famennian substage near the *Annulata* Event, which is a major global sedimentary break, more precisely at the entry of *Po. styriacus*. It is also important to note that many authors have used other taxa than *Pa. gracilis expansa* to place the Lower *expansa* Zone in their sections although it is not sufficiently proven that alternative species enter synchronously.

CM STREEL explained Document 2 which focuses on potential biostratigraphic levels for the definition of a Latest Famennian Substage. He illustrated successions from the Etroeungt type area of Northern France, Belgium (Chanxhe), Silesia (Dzikowiec), and the Carnic Alps (Malpasso). Previously discussed potential boundary levels now fall in three sets spanning the Middle *expansa* Zone to the base of the Lower (Early) *praesulcata* Zone. Preference is given to the middle set: either the base of the Upper (Late) *expansa* Zone (= entry of *Bispathodus ultimus*), or slightly higher, at the entry of *Pa. gracilis gonioclymeniae/Ps. marburgensis trigonicus* which is not too far from the traditional base of the Etroeungt, based on the entry of *Quasiendothyra kobeitusana kobeitusana* or from the base of the *Wocklumeria* Stufe of the traditional German subdivision.

The still ongoing discussion shows that it is premature to decide on the level for Upper and Uppermost Famennian substages. There is more consensus regarding the base of a Middle Famenian substage, to be defined at the base of the Lower *marginifera* Zone. However, more documentation of reference sections and of the correlation with neritic faunal groups and

with the spore record is needed in all cases.

6. ICS News

The Chairman drew attention to the new medals awarded by ICS in honour of outstanding lifetime contributions to stratigraphy (Digby McLaren Medal) or on single publications with extraordinary significance for correlation (ICS Medal). It is too late to make a proposal for 2004 but SDS will nominate one of its prominent members in 2005. The first awards will be given this summer.

At the forthcoming IGC, ICS will hold an official meeting, listed (as Workshop DWO 03) as "Challenges and New Directions in Global Stratigraphy (ICS)" (Thursday 26th August, 9 a.m. to 1. p.m., Room 36). Apart from the ICS officers, all interested SDS members are welcomed to attend and to take part in discussions. The meeting will deal with activities of all subcommissions, publications, the International Stratigraphic Chart and will introduce the new officers.

There is now an official collaboration between ICS and the highly regarded journal *Lethaia*. First significant contributions, focussing on general stratigraphical problems, have already appeared in the last issues.

7. Membership

7.1. Election of a chairman and vice chairman for the period 2005-2008

The Chairman, in his function as head of the voting committee, reported on the results of the election of a new chairman and vice-chairman for the period starting on 1st Janurary 2005 (period 2005-2008). There were two proposals for the chairman position: Secretary R. T. Becker and CM E. Schindler. The latter declined to stand for the vote. The ballot resulted in 15 votes in favour of the Secretary and in one vote against. This gives a clear majority and the Secretary accepted his nomination which has been approved in the meantime by ICS.

As recommended by ICS, there were also two nominations for the vice-chairman position: TM El Hassani and CM J. Over who, however, decided not to stand for the vote. The ballot gave a clear majority for the nomination of TM El Hassani (14 votes in favour, 1 vote against). The nomination has also been approved by ICS.

The voting results have been controlled by TM Garcia-Alcalde.

[After the meeting, and following the new ICS procedures, the future Chairman has selected a **new** future **SDS Secretary** for the **2005 to 2008** period which will be CM **J.E.A. Marshall** from Southampton.]

7.2. Discussion on future new TMs

According to the ICS rules, TMs can be re-elected twice which gives a maximum time to serve without interruption as voting member of twelve years. This upper limit was chosen in order to allow a recurrent exchange of TMs and of scientific fields represented by TMs. The forthcoming major change in voting members of SDS has been outlined in a preliminary list of proposals included in Newsletter 10 (p. 11). Since, additional recommendations have been given by various SDS members. The current state is:

Continuing TMs (6)

K. Weddige (for Germany), R. Crick (fore USA), T.T. Uyeno (for Canada), Zhu Min (for China, vertebrates), R. T. Becker (continues as Chairman), A. El Hassani (for Morocco, continues as Vice-Chairman)

(TM W.T. Kirchgasser, who has not yet reached the maximum service time, decided in July to step down as TM since he is now retired. He will actively continue as CM.)

Proposed new TMs (15, election to take place in August 2004)

CM M.C. Perri (for Italy)

CM J. Hladil (for Czechia)

CM J. Marshall (for England)

CM C.E. Brett (for USA)

CM J. Over (for USA)

CM Chen Xiuqin (for China, Nanjing, invertebrates)

CM Ma Xueping (for China, Beijing, invertebrates)

CM A. Blieck (for France)

CM E. Schindler (for Germany)

CM G. Racki (for Poland)

CM R. Mawson (for Australia)

CM G. Young (for Australia)

CM J. I. Valenzuela Rios (for Spain)

CM V. Tsyganko (for Russia)

CM J.-P. CASIER (for Belgium)

An additional TM proposal, Prof. ZHU Huaicheng, a highly experienced palynologists with research focus in Western and Northern China (Tarim Basin, Gansu, Jiangsu, Xinjiang), but covering all Palaeozoic, was brought forward by the Nanjing Institute of Geology and Palaeontology. Since Prof. ZHU has no former experience with SDS, it was decided to propose him first as a CM.

The list of new proposals will continue the voting membership of most countries with significant Devonian outcrops (unfortunately, still with a strong South American bias) and includes specialists for most significant fossil groups (conodonts, ammonoids, nautiloids, palynomorphs, fish, brachiopods, corals, ostracods) and for sequence stratigraphy. In future SDS should seek a stronger involvement of specialists in isotope stratigraphy. It is hoped that the proposal made above will find a broad acceptance.

7.3. Election of new CMs

The following Devonian specialists were elected unanimously to become new CMs:

- Jared R. MORROW, University of Northern Colorado, conodonts and sedimentology (proposed by TM C.A. SANDBERG and supported widely by other American SDS members at the inofficial Seattle Meeting)
- Paul BLAKE, Geological Survey of Queensland, rugose corals (proposed by TM J. TALENT)
- Carol J. BURROW, University of Queensland, fish/microvertebrate biostratigraphy (proposed by TM J. TALENT)
- Aye Ko AUNG, Dagon University, Yagon (= Rangoon), Burma/Myanmar, corals, Devonian stratigraphy of Burma (proposed by TMs BECKER & TALENT)
- Gordon F. BAIRD, Department of Geosciences, Fredonia, New York State, sedimentology, biofacies and sequence stratigraphy (proposed by TM BECKER and supported by CM C.E. BRETT)
- B. Mistiaen, University
- The well known Spanish brachiopod worker F. ALVAREZ (proposed by TM TALENT), unfortunately, declined to stand for election. SDS will seek next year a CM for Turkey and perhaps additional CMs for Spain and Russia.

8. Financial Report (by the Chairman)

for the period 2003 to March 2004

Income		US $
-- balance from 2002	450.58	
-- IUGS subvention 2003		1275.00
TOTAL		1725.58
Expenses		
-- Newsletter no. 19	400,00	
-- bank commission	10,00	
-- secretary expenses	250.00	
-- contribution for the organisation of the SDS meeting in Morocco, 2004		500,00
-- room hire for informal SDS meeting at Seattle, November 2003	60,00	
Total	1220,00	
Balance		505,58

9. Future Meetings

9.1. International Geological Congress, Florence, August 20th-28th August 2004

The Business Meeting will take place on 23rd August, from 5 to 8 p.m., in Room 14 of the Congress Center. It is preceded by the SDS Symposium on the same day, from 9 to 11.45 a.m., in the same room. All SDS members are invited to join an informal dinner party straight after the Business Meeting (restaurant still to be chosen).

9.2. SDS and IGCP 499 Symposium and Excursion, southern Siberia, 2005

TM YOLKIN and CM IZOKH have proposed (first about two years ago) to hold the annual business meeting for 2005 in Novosibirsk, followed by a two weeks excursion to the Salair and Altai Mountains, ca. at the end of July and in early August. SDS has accepted this invitation with delight in 2003. (The plans have in the meantime been approved by the director

of the Institute of Petroleum Geology and details will be circulated soon to all SDS members or via the next Newsletter.)

Another international meeting which SDS likes to recommend to all its members is the **6t Baltic Stratigraphic Conference** in St. Petersburg, 22nd to 26th August 2005. The meeting is partly organized by our CMs T. KOREN and A. IVANOV and includes an important fieldtrip to the Devonian of Leningrad and Pskov districts. The first circular has been distributed recently and all interested members may contact our CM IVANOV (at: aoi@AI1205.spb.edu) or the meeting secretary, Dr. A. ZHURAVLEV (at: stratigr@mail.wplus.net).

9.3. ECOS IX, England 2006

With respect to the past successful alignments with ECOS meetings, it has been proposed to hold the Annual Business Meeting in 2006 in conjunction with ECOS IX which will take place in England. Our future SDS secretary has agreed to run a long outstanding fieldtrip to the Devonian of the Old Red Continent which should enhance our understanding of cross facies correlations.

9.4. SDS Symposium, Western Interior/Nevada, 2007

At the informal SDS Seattle meeting, our North American members have proposed to hold in 2007 an international symposium, followed by a fieldtrip, in the Interior Basin, with focus on Nevada. SDS happily accepted this proposal. A first circular will be distributed well in advance.

10. Any other business

None

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Documents submitted: S.D.S. meeting, Morocco, March 2004

REPORT BY A. BLIECK, "MARINE/NON-MARINE CORRELATION"

Several projects concerning Devonian vertebrate taxa and field activities are in progress. A pluridisciplinary study of a section at Alken a/Mosel, in the Emsian of the Mosel-Rhine region, Rhenish Slate Massif (RSM), Germany, involves 10 scientists (palaeontologists, sedimentologists and geochemists) mostly from the Forschungsinstitut Senckenberg, Frankfurt a/Main. It is concerned with both the Lower/Upper Emsian boundary problem and the palaeoenvironment of an Early Devonian land-sea transition (Wehrmann *et al*., in press). Among vertebrates, *Rhinopteraspis dunensis*, drepanaspid fragments, placoderms and "*Porolepis*" have been collected in the Alken quarry. West of the RSM, in the Ardenne Massif of the Grand Duchy of Luxembourg, a psammosteid heterostracan (*Drepanaspis*) has been determined from upper Emsian rocks of a quarry near to Merkholtz. This is the first discovery of this genus in the Ardenne Massif. It is otherwise a classical component of the siliciclastic Pragian-Emsian series of both SW England and the RSM. This discovery confirms that the same vertebrate assemblage is collected from intermediate to near-shore environments along the southern margin of the Old Red Sandstone Continent in Early Devonian times. In Merkholtz, the vertebrate has been sampled within a plant and invertebrate assemblage (miospores, macroplants, bivalves, pterygotids, ostracodes) (Delsate *et al*., 2004). Jumping up to the Famennian, G. Clément (MNHN, Paris) has redetermined a specimen of "fish" from the Condroz Sandstone Group of Strud, in Belgium, as an element akin to *Ichthyostega*, a well-known early tetrapod from the upper Famennian of East Greenland. This is the first confirmed discovery of a Late Devonian tetrapod in Belgium, and the first time that a Late Devonian tetrapod taxon is known from more than one geographical area (Clément *et al*., 2004). Going to fully marine environments, the Master's thesis of C. Randon ("DEA", Univ. Sci. Techn. Lille) was concerned with vertebrate microremains from the Devonian-Carboniferous boundary beds of the Carnic Alps, in northern Italy, on one hand, and from the Early to Late Devonian (mostly Emsian) of the Asturo-Leonese facies, Cantabrian Mountains, northern Spain, on another hand. This material will be published in collaboration with our conodont colleagues from the Universities of Bologna and Oviedo respectively (Randon C. *et al*., in progress).

Devonian vertebrates continue to be studied by "Age of Fishes" lovers from all over the World. They met for honouring the centennial anniversary of the birth of Walter R. Gross at the Gross Symposium 2 in Riga, Latvia, on 8-14 September 2003, during indoor sessions in the Nature Museum of Latvia and two field trips to the Devonian of Latvia and the Silurian of Saaremaa, Estonia. These happenings were professionally organised by our colleagues E. Luksevics, I. Zupins, I. Upeniece, G. Stinkulis (Univ. Latvia) and L. Luksevica (Nature Museum of Latvia), as well as T. Märss (Tallinn Technical Univ., Estonia). We benefited of a splendid weather during our whole stay in the Baltic Republics. Nearly 50 people attended the symposium which was organised in conjunction with the first annual meeting of the new IGCP 491 project on "Middle Palaeozoic Vertebrate Biogeography, Palaeogeography, and Climate" (co-leaders Zhu Min, Beijing, China, and G.C. Young, Canberra, Australia). 25 oral communications and nearly 30 posters were presented. They are concerned with mostly Devonian agnathans and gnathostomes including tetrapods (17 of the 25 oral comm.). Among others, living discussions occurred about chondrichthyans (our "shark" colleagues have shown their teeth!) and the original environment(s) of Famennian tetrapods (fresh water vs. marine as always …). The abstracts of the symposium have been published as a *Special Publication* of *Ichthyolith Issues* (Schultze *et al*., 2003). The papers will be published in the *Acta Universitatis Latviensis* series. In the following years, IPCP 491 will meet during the 10th International Symposium on Early/Lower Vertebrates (Gramado, Brazil, May 2004), the North American Paleontological Convention at Dalhousie University (New Brunswick, Canada, June 2005), the 6th Baltic Stratigraphic Conference (St Petersburg, Russia, August 2005), and the 2nd International Palaeontological Congress (Beijing, China, 2006). M. Ginter offered to co-organize a meeting and field trip to the Devonian of Armenia, in the vicinity of Mt Ararat (…), on May 2005. More informations are available on the IGCP 491 Web page at http://paleoworld.net (secretary Zhao Wen-jin, Academia Sinica, IVPP, Beijing), and on the Palaeozoic Microvertebrate Page at http://www.biology.ualberta.ca/old_site/wilson.hp//Paleozoic.html (maintained by M.V.H. Wilson, Univ. Alberta, Canada).

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LATE DEVONIAN TETRAPOD-BEARING LOCALITIES: A REVIEW INCLUDING NEW DATA, AND THE NEED OF ACCURATE DATINGS

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Introduction

The earliest record of tetrapods (four-legged vertebrates) in the Late Devonian is one of the key events in the evolution of vertebrates. It had a very important impact on the terrestrial ecosystem forever. These vertebrates are the oldest representatives of tetrapods. Tetrapods are a major group of animals that to-day numbers some 24,000 living species.

Our understanding of the origin of tetrapods, better popularly known as the "fish-tetrapod transition", has progressed greatly thanks to recent fossil discoveries. To-day, 8 Devonian tetrapod genera on a total of 12 have been found in the last 10 years (Table 1). These new findings have made possible to reconstruct sequences of character change leading to tetrapod morphologies, to eventually improve phylogenetic analyses, and tentatively identify the genetic basis for some of these changes (e.g. Daeschler & Shubin, 1998). However, these discoveries have raised new questions about the evolutionary context for the origin of tetrapods, questions which need to be answered if the event is to be properly understood (see the recent review of Clack, 2002b).

Palaeoecological and palaeogeographical context

Devonian tetrapods are found in the Famennian and the Frasnian, they have a worldwide, nearly Pangaean palaeogeographical distribution (Laurussia, Gondwana, North China) and, although classically considered as being from terrestrial environment, are found in sedimentary rocks whose original environments are interpreted either as freshwater, brackish or marine (refs on Table 1).

The question of the original environment of early tetrapods has been recently introduced through comparisons between faunal assemblages of fossiliferous localities by the mean of clustering analysis. Among others, the different trials of Schultze & Maples (1992), Schultze *et al*. (1994) and Schultze & Cloutier (1996) proposed different analyses bearing on vertebrates, and vertebrates associated with invertebrates of different localities of Devonian and Carboniferous age, mainly from North America. All these analyses share the same phenetic method using general observed similarities of the fauna and flora to cluster the compared localities. The principal criticism that can be addressed to this phenetic method relies on the fact that both absence and/or presence of taxa are considered. So, the operator can easily be removing from a hypothetico-deductive attitude, selecting instead a method that gives the result he thought to be the best one.

More recently, one of us (Lelièvre, 2002) has proposed a cluster analysis of thirty nine Famennian localities bearing early vertebrates. Different methods have been used, viz., classical hierarchical clustering and neighbour-joining (NJ). The latter method presents the advantage to use distances with metric and additive properties of the data in order to get a tree of minimal length. Fossil assemblages are treated with a taxonomic resolution to genus and family levels as most of the species described from those Famennian localities are monotypic. The result of running NJ method on a localities/taxa matrix gives one tree (artefact due to the phenetic method). This tree shows that no assemblage defines a cluster of localities supposed to be freshwater (Lelièvre, 2002). Some of the localities, i.e., Greenland (where the Aina Dal and Britta Dal formations are distinguished), Dura Den (Scotland), and Pavari (Latvia), cluster with marine localities such as Andreyevka-2 (Russia), or with coastal estuarine localities such as the ones from Belgium (Strud, Modave, Esneux, Evieux). So, to answer the question of whether early, Devonian tetrapods were living in freshwater or nearshore marine environments, the answer given by different clustering methods indicates that there is no palaeontological reason to maintain that the Upper Old Red Sandstones that have yielded early vertebrates were deposited in a freshwater environment. This is in contradiction with other methods as used in sedimentological and sequence-stratigraphical analyses (refs in Friend & Williams, 2000).

Biostratigraphical aim

An important associated flora and fauna is sometimes found with tetrapod remains. The vertebrate faunal composition (placoderms, chondrichthyans, acanthodians, actinopterygians, sarcopterygians) is now more and more used in a biostratigraphical distribution aim. Correlations between biostratigraphical subdivisions of the different tetrapod-bearing localities of the World (USA, Greenland, Europe, China, Australia) are currently attempted by an international early tetrapod working group that assembled in Riga, Latvia, during the Gross Symposium 2 (Sept. 8-14, 2003; Schultze *et al*., 2003). Thus comparisons with contemporaneous tetrapod-bearing localities will improve our understanding of palaeoenvironmental conditions in which the oldest tetrapods were living (see above) as well as their biogeographical distribution. Nevertheless, to be accurate, it is absolutely necessary for these studies to be based on a very consistent and internationally accepted biochronological framework. Four Famennian substages (Lower, Middle, Upper Famennian and Strunian) could most probably be accepted by most Devonian vertebrate palaeontologists. The most important thing is that the different faunal levels are precisely defined and dated.

In this short review, we focus on the localities which have yielded tetrapod bone remains (either fragmentary remains or articulated skeletons), and we do not review the trace and trackway localities (for this topic, we refer the reader to Clack, 1997). A provisional, synthetic view is summarized in Table 1.

Systematic and stratigraphic comments on some of the tetrapod localities ([A] to [H] refer to Table 1)

[A] East Greenland : Apart from the two classically known genera *Ichthyostega* and *Acanthostega* (see, e.g., Clack, 2002b), a third tetrapod genus, known from jaw and tooth morphology, has recently been recognised from specimens collected on the south side of Celsius Bjerg (Blom, in press ; Blom *et al*., 2003).

[B] Scotland, Scaat Craig : In his original papers on *Elginerpeton*, Ahlberg (1991, 1995, 1998) gives the age of the Scaat Craig Beds, a possibly partial lateral equivalent of the Alves Beds in the South Moray Firth area, as « upper Frasnian ». This late Frasnian age is indeed classically advocated for the Scaat Craig Beds (e.g., Friend & Williams, 1978, fig. 13 ; Trewin, 2002, fig. 8.28). However, it does not seem to be based upon firm data, independently from fishes. Miles (1968, table 2) correlates the Scaat Craig Beds with the lower part of the « *Phyllolepis* Series » of East Greenland (also Mykura, 1991, table 9.3), which is now named the Kap Graah Group, and considered as lower Famennnian (Jarvik, 1996, fig. 9 ; Clack & Neininger, 2000, fig. 2). The Kap Graah Group is lying below the Agda Dal and Elsa Dal formations. The topmost part of the latter has been dated of the GF Miospore Zone by Marshall *et al*. (1999), the base of which is correlated to the lower *marginifera* Conodont Zone (Streel *et al*., 1987, fig. 10). So, the Kap Graah Group is pre-GF or pre-*marginifera* in age, that is lower to lower middle Famennian (*sensu* Streel & Loboziak, 2000, in a four-fold subdivision of the Famennian), or older, i.e., upper Frasnian. This means that the Scaat Craig Beds may be or may not be late Frasnian in age. This late Frasnian age is based upon their fish assemblage (Miles, 1968), and there is seemingly no independent biostratigraphical marker such as conodonts, miospores or other fossils. Nevertheless, two other arguments may be given for the Frasnian age of the Scaat Craig Beds :

1— the occurrence of the psammosteid ostracoderm genera *Psammosteus* and *Traquairosteus* in the Scaat Craig Beds (Miles, 1968, p. 8) is an argument for a pre-Famennian age (see Ahlberg, 1998, p. 102, and [G] here below) ;

2— Miles (1968, table 2) correlated the Scaat Craig Beds with the interval between the « c-d Shelon-Ilmen » and the « e-Stage » of the East Baltic area. The Il'men and overlying beds of Latvia and the Main Devonian Field of NW Russia are correlated with the « middle » Frasnian, Daugava Regional Stage (Paskevicius, 1997, fig. 66), considered as equivalent to the « middle » Frasnian *punctata* to *jamieae* Conodont Zones (Esin *et al*., 2000, fig. 1), and the « e-Stage » is equivalent to the Snezha and Pamusis regional stages, which correspond to the late Frasnian *rhenana* CZ. Ahlberg *et al*. (1999) correlated the Scaat Craig Beds with « some part of the Pamusis – Snezha interval » judging from distribution of *Psammosteus*. We will thus retain a « middle » to late Frasnian age for the Scaat Craig Beds (Table 1).

[C] Latvia and western Russia : *Obruchevichthys* was originally described as a sarcopterygian fish (Vorobyeva, 1977). Known only from lower jaw fragments, it may not have had true limbs and digits, although its phylogenetic relationships are likely to be close to tetrapods (Ahlberg, 1991 ; Clack, 2002b, p. 91). The holotype of *Obruchevichthys* comes from the upper Frasnian, Ogre Formation of Latvia which correlates with the *rhenana* Conodont Zone. However, Vorobyeva (1977, Pl. XIV : 4, and p. 204) has inadequately attributed the sandstones of the type-locality of *Obruchevichthys* to the Nadsnezha Beds, a lithostratigraphic unit which is distributed in the Novgorod district of Russia, along the Lovat river. The type-locality of *Obruchevichthys* is Velna Ala, within the lower, Lielvarde Member of the Ogre Formation. This member consists mainly of fine-grained calcareous sandstones, with a gypsum cement in its lower part, and clay, silt and dolomitic marl in its upper part. Sorokin (1978) supposed that these deposits were formed in shallow waters of a narrow gulf of the Baltic palaeobasin, under conditions of variable salinity. In western Russia, the locality of *Obruchevichthys* is unfortunately not precisely known. Vorobyeva (1977, p. 204 and fig. 46) mentions that it originates perhaps from the Novgorod District. After its state of preservation and the matrix, it is likely that it was collected somewhere along the Lovat river where a rich collection of *Bothriolepis maxima* and other fish remains was gathered (the *Bothriolepis maxima* placoderm « zone » being biostratigraphically correlated to the *rhenana* Conodont Zone : Esin *et al*., 2000, fig. 1).

[D] Latvia, Ketleri: Ahlberg *et al*. (1994, p. 322 and fig. 14) suppose the occurrence of a "second tetrapod genus" in Ketleri, together with *Ventastega*, on the basis of a mandibular fragment. We propose that this conclusion must be consid-

ered with caution until more material is collected.

[E] Russia, Tula region, Andreyevka-2: In this locality, Lelièvre (2002, p. 151) cites a Tetrapoda indet., in addition to *Tulerpeton*, after Lebedev & Clack (1993) who have cautiously differentiated the holotype of *Tulerpeton* from all the other sarcopterygian remains in the locality. They suppose that two different tetrapods do occur at Andreyevka-2, on the basis of two types of tabular bones. These bones are variable among sarcopterygians, which could as well be the case among tetrapods. Moreover, one of the bones figured by Lebedev & Clack (1993, fig. 2 H-I) might not be a tabular. So, for one of us (GC), the supposed second tetrapod of Andreyevka-2 should be considered with caution, although O. Lebedev has been advocating two different taxa for 10 years. However, this hypothesis is not in disagreement with the fact that two tetrapods do occur together in the same locality of Pennsylvania, and that more than two tetrapods are known from East Greenland (Table 1).

[F] Russia, Oryol region, Gornostayevka: In this locality Lebedev (2003) cites *Bothriolepis* cf. *leptocheira*, an antiarchan placoderm. *B. leptocheira* is classically known from the Eleja Regional Stage of the Russian Platform (Main Devonian Field, including the East Baltic area) (Luksevics, 2001), a formation which is usually dated as basal Famennian (Esin *et al*., 2000, fig. 1). The Zadonskian Regional Stage of the Oryol region (Central Devonian Field), where the tetrapod comes from, is correlated by Esin *et al*. (2000, fig. 1) to the Joniskis RS of the Main Devonian Field (MDF), just above the Eleja RS. The Zadonskian would thus be equivalent to the upper *curonica* placoderm "zone" of the MDF, and to the *crepida* Conodont Zone (Esin *et al*., ibid.), that is, lower Famennian.

[G] China, Ningxia Hui region: For this locality Zhu *et al*. (2002) propose a late Famennian age "about 355 million years BP", a datum which may be understood as "uppermost Famennian" or better "Famennian/Tournaisian boundary" when using a classical radiochronological scale such as Odin's (1994) one. However, the last revision of the Devonian scale gives –362 My for the Devonian/Carboniferous boundary (Williams *et al*., 2000). So, an age of –355 My would fit the earliest Carboniferous, better than the Famennian. In fact, Zhu *et al*. (2002, ref. 6) base their dating of this tetrapod locality upon Pan *et al*.'s (1987) book for the Famennian age of the Zhongning Formation (Pan *et al*., 1987, p. 184-185). However, when considering the miospore assemblage of the Zhongning Formation as listed and figured by Gao in Pan *et al*. (1987, p. 120-131, 184-185, and Pl. 35-36), G. Playford (in litt. to Ritchie *et al*., 1992, p. 364) as well as S. Loboziak (comm. pers. to AB, 12.05.1989; now deceased) considered that this miospore assemblage is probably older than the Famennian. For Playford, it "… is certainly older than the latest Devonian *Retispora lepidophyta* Assemblage and could even be pre-Late Devonian … (and) datable within the interval mid-Givetian to Frasnian." (Ritchie *et al*., 1992, p. 364). For Loboziak (unpublished), it is likely to be Frasnian. We will thus provisionally consider the *Sinostega* locality as Frasnian in age (Table 1).

Incidently, if the Frasnian age of this locality is confirmed, it re-inforces the generally accepted stratigraphical distribution of ostracoderms (*sensu* Janvier, 1996). The Zhongning Formation has indeed yielded fragmentary remains of a Galeaspida gen. et sp. indet. (Pan *et al*., 1987, fig. 17, and Pl. 1, 2, 3:1). As all other galeaspids are known only from the Lower to Lower Middle Devonian (Macrovertebrate Assemblages I to VI of China: Zhu, 2000, p. 375-376; Zhu *et al*., 2000, fig. 2), and as no other ostracoderm is known after the Frasnian (Blieck, 1991), the galeaspid from the Zhongning Formation, if Famennian in age, would be the youngest record of galeaspids (Zhu, 2000, p. 376), and the youngest record of ostracoderms. But, if the Zhongning Formation has to be considered as Frasnian in age, this confirms that no ostracoderm is younger than the Frasnian, and that the Frasnian/Famennian biological event does not seem to be an artefact for agnathans.

[H] Australia, Jemalong Quarry, SW of Forbes, New South Wales: This locality has produced a fish fauna including a lungfish and placoderms as well as *Metaxygnathus*, a lower jaw of an early tetrapod (Campbell & Bell, 1977, 1982; Young, 1999). The locality is in the Cloghnan Shale, which Campbell & Bell (1977) equated with the Pipe Formation of the Hervey Group to the east. Campbell & Bell (1977, p. 369) suggested an age of « most probably late Frasnian or early Famennian ». They concluded it was more likely at the younger end of this time interval ('Famennian, probably near the middle'; *ibid*., p. 375) after consideration of local stratigraphic correlations with the Upper Devonian to the east, where marine late Frasnian rocks occur in the lower part of succession. Since then the stratigraphy of the Upper Devonian Hervey Group in central NSW has been extensively revised, after detailed remapping (Young *et al*., 2000b), and combined with reconsideration of fossil fish assemblages (Young, 1999) points to a Frasnian age for this tetrapod occurrence. The fish assemblage at this locality belongs to the "Jemalong-Canowindra fauna" *sensu* Young (1993: Macrovertebrate Fauna 13), originally dated as "lower and middle Famennian" (Young, 1993, fig. 9.2; also Rich & Young, 1996, fig. 2), or as lower Famennian (Australian Macrovertebrate Zone 13, in Young, 1996, chart 14). However, the Canowindra fish fauna (Young, 1999, fig. 1, loc. 5) is now considered more likely to be late Frasnian in age (Young, 1999, p. 145) and eventually correlated with the *rhenana/triangularis* Conodont Zone (MAV 13, Young *et al*., 2000a, fig. 17). Arguments supporting a late Frasnian age for the Canowindra fish fauna were given by Young (1999, p. 145). Regarding the Jemalong fauna, Campbell & Bell (1977, p. 374, 375) concluded that the Cloghnan Shale was at the base of the Upper Devonian sequence, was probably equivalent to the lithologically similar Pipe Formation to the east, and was overlain by sandstones (the Weddin Sandstone) which more likely equated to the east with the higher Bumberry Formation, rather than the lower Mandagery Sandstone in the Hervey Group. Essentially the same conclusions have been reached after recent detailed mapping, but with the nomenclatural change that the 'Pipe Formation' in the vicinity of the Canowindra fish fauna has been renamed the 'Mount Cole Formation' (Young *et al*., 2000b).

However, one important point needs correction. Campbell & Bell (1977, p. 375) discussed correlations with the presumed marine/estuarine interval to the east, including advice that 'marine rocks at Parkes are at the base of the Mandagery

Formation'. For this reason they inclined towards a younger (Famennian) age for the Jemalong occurrence. However, as noted by Young (1999), both the lingulid facies and the Canowindra fish fauna to the east of Parkes occur stratigraphically within transition beds between the Mandagery Formation (sandstone), and the overlying finer grained Mount Cole Formation ('Pipe Formation'). Rather than 'at the base', this ?marine/estuarine interval occurs at the top of the Mandagery Formation, thus negating the earlier argument for a younger age. Both the Cloghnan Shale and the Mandagery Formation occur close to or at the base of the Upper Devonian sequence in their respective areas, above which a stratigraphic thickness in excess of 2.5 km has been estimated for the Hervey Group. Both lycopod plants (*Leptophloeum*) and placoderm fishes near the top of the sequence indicate a Late Devonian rather than Carboniferous age (Young *et al*., 2000b), and thus generally support an older (?Frasnian) age for the Jemalong vertebrate fauna. However, in the similarity analysis of Lelièvre (2002, fig. 21, p. 172), Canowindra clusters with most of the Famennian tetrapod-bearing localities such as the ones of the Britta Dal and Aina Dal formations (East Greenland), the locality of the Catskill Formation (Pennsylvania), Andreyevka-2 (Russia), and Pavari (Latvia). So, the problem of the age of the Jemalong fauna does not seem to be fully resolved.

Conclusion

It is certainly difficult to say that tetrapods themselves can be used for correlation until a better fossil record is achieved. However, we need a good biostratigraphical framework which, together with a revised cladistic analysis of the various taxa now known, should lead to a renewed view of the early spreading of tetrapods in Devonian times.

After biostratigraphical revision, it appears that most Devonian tetrapods are not only late Famennian in age as thought in earlier times (e.g., Jarvik, 1996), but span at least the late Frasnian to late Famennian (Table 1).

Final remark

Note that this text was originally written for the SDS Newsletter # 20. It is reproduced unaltered here. However, this text is the basis for a paper being written for inclusion in the SDS volume in honour of M. House (Geol. Soc. Spec. Publ.; in progress on Febr. 14, 2005)

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SUBDIVISION OF THE FAMENNIAN STAGE INTO FOUR SUBSTAGES AND CORRELATION WITH THE NERITIC AND CONTINENTAL MIOSPORE ZONATION

(SDS Business Meeting Florence, August 23, 2004)

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The present report was partly submitted at the IGC Rio de Janeiro SDS Meeting in August 2000 (Streel & Loboziak, 2001) based on proposals made during the Bologna SDS Meeting in June 1998 (Streel et al. 1999, Streel & Loboziak 1999). The subdivision of the Famennian suggested then and proposed again now, is shown on fig. 1. These four subdivisions of the Famennian Stage correspond to respectively 6, 5, 7 and 4 conodont zones.

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Base of a Middle Famennian Substage at the base of the Latest *crepida* Zone.

Sandberg & Ziegler 1999, SDS Newsletter 15, p. 45: "The only other usable position (for the Lower/Middle Famennian limit), easely recognized in conodont faunas is the Latest *crepida* Zone (but this position is too low for approximately equal threefold subdivision of the Famennian)".

Miospores are poorly represented in the early Famennian of western Europe and eastern North America, the tropical southern Euramerica. They are abundant, on the contrary, in eastern Europe and western North America, the equatorial northern Euramerica (Streel *et al.* 1990) where the genus *Cornispora* ,a very distinctive miospore, has its first occurrence in the early-middle Famennian range. In eastern Europe (Pripyat Depression), *Cornispora monocornata* first occurs (Avkhimovitch *et al.* 1993, p. 88) within a *rhomboidea* conodont Zone (Krutchek 1974). In western Canada, *Cornispora monocornata* and *C. varicornata* characterize a very distinctive biozone which, in the Arctic Red River section, yielded an upper *crepida* conodont assemblage, close to the lower boundary of the miospore zone (Braman & Hills 1992, p. 12).

The first occurrence of *Cornispora* in the northern Euramerican belt belongs to the interval late *crepida* to late *rhomboidea* conodont zones and might therefore serve as a miospore guide for the base of a Middle Famennian Substage in these regions..

Base of an Upper Famennian Substage at the base of the Latest *marginifera* Zone.

Becker, SDS Newsletter 15, p. 15: "...*Pemoceras* and *Protomoceras* (which) spread slighly below the entry of *Scaphignathus velifer* in conodont terms, the base of the old *velifer* Zone (now Uppermost or Latest *marginifera* Zone) seems an acceptable level."

A very distinctive miospore, *Retispora macroreticulata,* first occurs in the lower part of the Montfort Formation in the Comblain-au-Pont/Bon Mariage section in the Ourthe Valley, Dinant Synclinorium, into a rock sequence containing conodonts of the Latest *marginifera* Zone (Bouckaert *et al*. 1968). *R. macroreticulata* is considered (Streel et al. 1999) as an ancestor of *R. lepidophyta*.

Base of an Uppermost Famennian Substage at the base of the Late *expansa* Zone

The relation of the neritic microfaunas and continental microfloras with the conodont and other pelagic faunas within the latest part of the Famennian is demonstrated by Streel et al., in press (SDS Newsletter 20) at the SDS Annual meeting Rabat, March 2004 and again during the Florence IGC (August 2004) (See Streel et al., in preparation). The base of the Late *expansa* Zone is the nearest level to the original definition of the Etroeungt (Strunian) in the type region, a subdivision of the Famennian used by many authors in huge regions around the world.

This level corresponds to a distinct level within the biometric range of *Retispora lepidophyta*, a very abundant miospore with a worldwide distribution (The quantitative change from *Retispora lepidophyta lepidophyta* to *Retispora lepidophyta minor* in Maziane et al. 2002).

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Streel, M., Belka, Z., Dreesen, R., Durkina, A.V. Groos-Uffenorde, Hance, L., Hartkopf-Fröder, C., Haydukiewicz, J., Korn, D., Perri, M.C., Piecha, M., Spalletta, C., Relation of the neritic microfaunas and continental microfloras with the conodont and other pelagic faunas within the latest part of the Famennian with a few, new additional data and a synthetic correlation chart. SDS Business Meeting, Florence, August 23, 2004, in preparation

SDS Business Meeting Florence, August 23, 2004

RELATION OF THE NERITIC MICROFAUNAS AND CONTINENTAL MICROFLORAS WITH THE CONODONT AND OTHER PELAGIC FAUNAS WITHIN THE LATEST PART OF THE FAMENNIAN WITH A FEW, NEW ADDITIONAL DATA AND A SYNTHETIC CORRELATION CHART

(SDS Annual Meeting Rabat, March 1st and 2nd, 2004)

(new data given below in Courier New)

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(1)Liège, Belgium, (2) Tuebingen, Germany, (3) Mol, Belgium, (4) Ukhta, Russia, (5) Gottingen, Germany, (6) Louvain-la-Neuve, Belgium, (7) Krefeld, Germany, (8) Wroclaw, Poland, (9) Berlin, Germany, (10) Bologna, Italy.

The existence of a transitional Devonian-Carboniferous fauna was mentioned by Gosselet as early as 1857 in the Etroeungt area (Avesnois, northern France). The base of the Etroeungt Formation (Bultynck & Dejonghe 2001), in the recent Bocahut Quarry for instance, corresponds approximately to the transition between the foraminifers *Quasiendothyra communis* and *Q. kobeitusana* (Mamet & Préat 2003). A chronostratigraphic unit (Latest Famennian) has now to be recognized which would make an end to the long standing uncertainties regarding the definition of the so widely and internationally used terms Strunian or Etroeungt (Sartenaer 1997, Becker 1998).

Some of the formerly proposed bases for this unit (Tn1a base in Conil et al. 1964 and following papers) are found in the railroad section of Avesnelles (now partly walled), starting at the Epinette transgressive level which corresponds approximately to the base of the *Eoendothyra communis radiata* (Df3δ) foraminifer Zone and to the base of the *Retispora lepidophyta – Knoxisporites literatus* (LL) miospore Zone. The next *Quasiendothyra kobeitusana kobeitusana* (Df3ε) foraminifer Zone starts higher but well below the Etroeungt Limestone **(Fig. 1).** Foraminifer *Q. kobeitusana* and miospore *R. lepidophyta* have a wide distribution around the world (Streel et al. 1998, fig. 3).

The calibration of these biostratigraphic markers with the conodont standard zonation needs moving to central and eastern Belgium and western Germany.

In the Anseremme section (Meuse valley, central Belgium, Dreesen & Thorez, 1994 and C.A. Sandberg in Casier et al. 2004) the succession Middle/Late *expansa* is found near but slightly above the base of *Quasiendothyra kobeitusana kobeitusana.*

In the Chanxhe section (Ourthe valley, eastern Belgium) the Late *expansa* conodont Zone is present between Df3δ and Df3ε foraminifer Zones. Above the Df3ε foraminifer Zone occurs the next *Retispora lepidophyta–Indotriradites explanatus* (LE) miospore Zone (Streel et al. 2003, fig. 1). Until very recently the base of the Late *expansa* Zone was unknown in the area but new data from the Refrath 1 borehole (Bergisches Land, western Germany) allow now to fill this gap in our knowledge. The lower part of the LL miospore Zone (with presumed ancestor *Retispora macroreticulata* and large specimens of *R. lepidophyta*) corresponds to the Middle *expansa* conodont Zone and to the early *hemisphaerica-dichotoma* entomozoacean Zone (Groos-Uffenorde, in press; Hartkopf-Fröder, in press; Piecha, in press) **(Fig. 2).** The conclusion is that the base of the Late *expansa* conodont Zone and the base of the *Q. kob. kobeitusana* (Df3ε) foraminifer Zone are obviously much closer than believed so far. The continental to neritic facies scheme shows now **(Fig. 5)** three steps of potential biostratigraphic markers to help defining a Latest Famennian.

This scheme can be applied to huge regions in Eurasia particularly in Belarus and Timan-Pechora (Durkina, Dreesen & Streel in Streel 2001, tab. 2) and, partly by miospores (Filipiak 2004), in the Kowala trench (Holy Cross Mountains, Poland).

The transition from the neritic to the pelagic facies is stratigraphically progressive in Poland near the Variscan Front. On the Holy Cross Mountains side, at a level higher than the lower LL Zone known in the Kowala trench, the Kowala 1

borehole shows (Nehring-Lefeld 1990) Late *expansa* to Early *praesulcata* conodont faunas with *Bispathodus ultimus* and *Pseudopolygnathus marburgensis trigonicus* in succession. However the neritic / pelagic transition is sharper in the Dzikowiec Quarry on the Sudetes Mountains side. The contact of both facies is between the highest part of the neritic Main Limestone with foraminifers Df3δ and Df3ε, below and the pelagic Clymeniid Limestone with ammonoids of the *Wocklumeria* Zone, above (Streel et al. 2003, fig. 3). In both facies conodont data were known after Freyer (1968) as belonging to the *expansa* to *praesulcata* Zones but more detailed data are now available, although still unpublished, provided by Belka (unedited) and Haydukiewicz (unedited). After these authors, the Clymeniid Limestone belongs to the Late *expansa* – Early *praesulcata* Zones with *Bispathodus ultimus, Palmatolepis gracilis gonioclymeniae* and *Pseudopolygnathus marburgensis trigonicus*, *B. ultimus* occurring slightly above the two other species after Dupieralska & Belka (in press). From a manuscript document provided by J. Haydukiewicz and new data provided by Dupieralska & Belka (in press) the lowest specimen of *Siphonodella praesulcata* occurs about 1 m above the neritic/pelagic contact, i.e., according to new ammonoid data by Korn (unedited) near, but below, the *sublaevis/parundulata* limit **(Fig. 3)**. A sample located 50 cm below the top of the neritic facies provided conodonts indicative of the interval from the Early *expansa* to the lower part of the Middle *expansa* Zone but, approximately 30 cm higher, still in the Main Limestone , there is a breccia horizon and the top of this unit is erosional in character. Thus there is at least a small stratigraphic gap between the neritic and the pelagic facies. Consequently, the contemporaneity of the base of the *Q. kob. kobeitusana* foraminifer Zone and the base of the Late *expansa* conodont Zone is not invalidated by these observations.

Many authors have collected material from this famous quarry but rarely using exactly the same log or collecting for different fossil groups using the same bed numbers. As the available thickness of the Clymeniid Limestone is quite variable along the walls of the quarry, this situation does not help defining accurate limits.

Defining the base of the Late *expansa* conodont Zone in pelagic facies is questionable. It was defined by Ziegler & Sandberg (1984) on the entry of *Bispathodus ultimus*, with *Palmatolepis gracilis gonioclymeniae*, *Pseudopolygnathus marburgensis trigonicus* and *Branmehla suprema* having their first occurrence within the zone. However, *Bispathodus ultimus* being unknown in the Great Basin and Rocky Mountain regions of North America, the lower boundary of the Late *expansa* Zone was defined, there, by the lowest occurrence of *Pseudopolygnathus marburgensis trigonicus, Polygnathus vogesi, or Protognathodus meischneri* (Sandberg 1979, p.97).

The base of the Late *expansa* Zone has been intensively investigated in the Carnic Alps by Perri & Spalletta (1998 and new unpublished data). Four sections are concerned: Rio Boreado (RB), Casera collinetta di Sotto A (CSA), Malpasso (ML) and Sentiro Storico A (SSA) . In all four sections, *B. ultimus, Ps. marb. trigonicus and Pa. grac. gonioclymeniae* occur at the same level, not in succession. Resampling of the Malpasso section did not provide better results than before. Three new samples (8d, 8a ,7e) were taken in a one meter interval below the first Late *expansa* fauna (ML9) (**Fig. 4**) but no Pa element of *B. ultimus* appeared. Transitional forms between *Branmehla fissilis* and *Br. suprema* were recognized in ML7e and ML8a. In ML8d (few cm below ML9) one specimen of *B. suprema* have been identified, a species which is reported in literature from the lower half of the Late *expansa* Zone.

The Malpasso section in the Carnic Alps was also investigated by Korn (1998) allowing a direct correlation between ammonoid and conodont zonations (**Fig. 4)**. However the base of the *sublaevis* Zone being not reached, the correlation is not more accurate than in the Dzikowiec Quarry in Poland. Therefore it is not known so far if the "Wocklum German Stufe" base has to be correlated with the latest Middle, the base or the earlier Late *expansa* Zone.

The *Bispathodus ultimus* base is shown in relation with the foraminifer *Quasiendothyra kobeitusana kobeitusana* base and the pelagic conodonts *Palmatolepis gracilis gonioclymeniae* and *Pseudopolygnathus marburgensis trigonicus*, from the Dinant Basin (Belgium) to the Carnic Alps (Italy)(**Fig.5**)

In conclusion, a continental to pelagic facies scheme can now **(Fig.6)** be completed, showing three steps of potential biostratigraphic markers to help defining a Latest Famennian. They group into three levels (3-4, 5-6, 7-8) the former 3 to 8 biostratigraphic levels recognized in Streel (2001, tab. 1). The middle level (5-6) is the nearest to the original definition of the Etroeungt in the type region. Well above the Epinette transgressive level it corresponds to a rather high sea-level reached just before the inception of the Gondwanan end-Famennian glaciation (Miospore Zones LE and LN) which culminated in a deep regression immediately after the Hangenberg Event. More locally, the Variscan orogeny, i.e. at Dzikowiec (Poland), or the Antler orogeny in the western United States(C.A. Sandberg personal communication), may interfere with this global glacio-eustatism.

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Fig. 1: The Avesnelles-St-Hilaire section in the Etroeungt area (northern France): Litho- and biostratigraphic data.

Fig. 2: The Chanxhe section in eastern Belgium and the Refrath 1 Borehole in western Germany: biostratigraphic data. (Groos-Uffenorde, in press ; Hartkoph-Fröder, in press ; Maziane et al. 2002 ; Piecha, in press)

Fig. 3: The Dzikowiec Quarry in the Sudetes Mts (Poland) : biostratigraphic data.

Fig. 4: The Malpasso section in the Carnic Alps (Italy): biostratigraphic data.

Fig. 5. Uppermost Famennian synthetic correlation chart

Fig. 6: Biostratigraphic correlation from continental to neritic and pelagic facies in the latest part of the Famennian. (3-4, 5-6, 7-8 see Streel, 2001, tab. 1)

Working Groups

THE GIVETIAN WORKING GROUP

PROPOSAL FOR A THREEFOLD SUBDIVISION OF THE GIVETIAN

Aboussalam & Becker (2002) proposed the base of the *hermanni* conodont Zone as the base of an Upper Givetian Substage emphasizing that it represents an important conodont and ammonoid event corresponding to a significant eustatic sea-level rise.The base of the *hermanni* Zone is characterized by several marker conodonts that are widely distributed.The consequence of a definition of an Upper Givetian Substage at this level is that in most Givetian successions, pelagic and neritic, a Lower Givetian Substage will represent a much longer-lasting period than the Upper Givetian.For this reason a more time-balanced threefold subdivision is proposed.The base of the *rhenanus/ varcus* Zone (Bultynck 1987) = upper part of the Lower *varcus* Subzone of Ziegler, Klapper & Johnson 1976 is recommended as the base of a Middle Givetian Substage.The basic criteria for a threefold subdivision of the Givetian are summarized in Fig. 1.

DEFINITION OF THE BASE OF A MIDDLE GIVETIAN SUBSTAGE

Preliminary comments concerning the validity of *Polygnathus rhenanus* and the *varcus* Zone and Subzones

The holotype of *P.rhenanus* is from a level just below the lower *pumilio* bed at Syring quarry near Oderhausen, Germany (Klapper et al. 1970).According to Lottmann (1990, p.91) this level is about 0.60 m below the first occurrence of *P. ansatus* in that section (note that in the figure p.91 the base of the Middle *varcus* Subzone is drawn too low according to its definition by Ziegler et al. 1976) .These authors also regarded *P.timorensis* as a senior synonym of *P. rhenanus* " because the latter seems to have been based on a juvenile specimen of *P. timorensis"*.I agree that the holotype of *P.rhenanus* is not a fully adult specimen but Bultynck 1987 (pl.7, figs.13-15) figures adult specimens of *P.rhenanus* that can be easily separated from adult specimens of *P. timorensis* (ibidem pl.7, fig. 9) by the very long free blade and the short, clearly asymmetrical platform, due to the prominent outward bowing of the outer anterior trough margin. Klapper (1980, 1981) introduced a late form of *P. timorensis,* specifying that it corresponds to *P.rhenanus.*The latter species is recognized and figured by Sparling 1999 ,including synonym list, Garcia-Lopez & Sanz-Lopez 2002 and Kaufmann 1998.So *P. rhenanus* is regarded herein as a valid species.

In Fig.1 the *timorensis, rhenanus/ varcus, ansatus* and *semialternans/ latifossatus* Zones are used instead of the Lower, Middle and Upper *varcus* " standard subzones ".Although the use of the Lower, Middle and Upper *varcus* Subzones is deep-seated in conodont literature, *P.varcus* itself is not the critical species for recognizing the base of these subzones according to their definition by Ziegler et al. 1976.Moreover, figured specimens that conform to the revised diagnosis of *P.varcus* by Klapper et al. 1970 are rare.Ziegler et al. 1976 redefining the *varcus* Zone do not figure any *P. varcus.*From the distribution tables in the same paper it appears that *P. varcus* first occurs well above the base of the zone and that in the studied North American sections it occurs only in a few samples.Huddle 1981 did not recognize it in the Givetian of New York.Rodgers 1998 who among others studied Middle *varcus* Subzone conodonts from Iowa only mention " *P. varcus* group ".In the Middle *varcus* Subzone of north-central Ohio Sparling 1999 recognized *P. rhenanus* and *P. ansatus,* both figured, but not *P. varcus,* etc.In my opinion the name *P. varcus* Zone does not reflect the most important changes in the conodont succession of that part of the Givetian and should not be retained only in the interest of nomenclatural stability.

The base of the Middle Givetian in the Morrocan Anti Atlas

The base of the *rhenanus/ varcus* Zone is best documented in the Bou Tchrafine Section a hemipelagic succession in the northern Tafilalt (Bultynck 1987) and in the hemipelagic-neritic succession Ou Driss in the Maider (Bultynck 1989; Belka et al. 1997 and Kaufmann 1998).

In the Bou Tchrafine section (Bultynck 1987, fig. 4) the Givetian is about 14 m thick and conodonts and goniatites are abundant, for the latter see Becker & House (1994, 2000).*P.rhenanus* and *P. varcus* appear in sample 23; the goniatite *Wedekindella* aff. *Psittacina* first ooccurs at the same level.Sample 23 is at the top of a sequence with nodular limestones

just below a crag with compact platty limestones representing a shallower environment.This shallowing upward trend is considered to correspond to the " Lower *varcus* Subzone regression-If of Johnson & Sandberg 1989 and indicated as If-2 in Fig. 1.According to this proposal the Lower Givetian of the Bou Tchrafine section is about 5 m thick, the Middle Givetian 8.25 m and the Upper Givetian 1 m.

In the Ou Driss section (Bultynck 1989; Fig 2 herein) on the southwestern extremity of the Maider basin the exposed part of the Givetian assigned to the *hemiansatus, timorensis* and *rhenanus/varcus* Zones ,is about 57 m thick.Up to sample ODE 4 (Fig. 2) the megafauna contains pelagic and neritic elements: corals, brachiopods, trilobites and goniatites.Above sample ODE 4 only neritic elements occur:corals, brachiopods and trilobites. Rugosa dominate and have been studied by Pedder 1999.This megafaunal change suggests a shallowing upward sequence.*P.rhenanus* first occurs in sample ODE 3, the first limestone bed above the megafaunal change.*P.varcus* appears in sample ODE 2.

Graphic correlation between the Tafilalt sections and the Maider sections indicates that *Icriodus difficilis* appears slightly above the base of the *rhenanus/ varcus* Zone (Belka et al. 1997) and it may be a tool for recognizing the base of the Middle Givetian in shallower water environments.

Approximate level of the base of the Middle Givetian in other areas

- -Belgium, Ardenne, within the lower part of the Mont d' Haurs Fm, based on graphic correlation (Gouwy 2004, p115).
- -Spain, Cantabrian coast, uppermost part of Naranco Fm and lowest part of Candas Fm (Garcia-Lopez & Sanz-Lopez 2002).
- -Western United States, Lower *varcus* – Subzone regression-If (Johnson & Sandberg 1989).
- -North-Central Ohio, within disconformity between the Plum Brook Shale and the Prout Dolomite (Sparling 1999).
- -Western New York, shallowing upward hemicycle from the upper part of the Wanakah Mbr to the Jaycox Mbr (upper part of Ludlowville Fm), below the Tichenor Mbr (Brett & Baird 1996). Klapper et al. 1970 mention *P. rhenanus* from the Tichenor Mbr.
- -Canada, Great Slave Lake area, upper part of the Pine Point Fm, belongs to upper part of If cycle and is assigned to the upper part of the Lower *varcus* and to the lower part of the Middle *varcus* Subzones (Uyeno 1998).
- -Canada, southern Manitoba, unconformity between the Winnipegosis and Dawson Bay Fms (Day et al. 1996).
- -Eastern Australia, Broken River region, SD 128, section through Papilio Fm (Mawson & Talent 1989).Specimens pl. 4, figs.11, 12 assigned to *P. timorensis* by the authors show a clearly asymmetrical platform like *P. rhenanus.*

DEFINITION OF THE BASE OF AN UPPER GIVETIAN SUBSTAGE

See proposal of Aboussalam & Becker 2002, published in Newsletter 19 (2003).

Remark.The earliest occurrence of *Icriodus subterminus* may approximates the base of an Upper Givetian Substage in shallow water platform carbonates, prevailing at that time in many areas.According to Rodgers (1998) the Lower *subterminus* Fauna (corresponding to the range of *I. subterminus* before the first occurrence of *Polygnathus angustidiscus*) in Iowa could be " a cratonic biofacies equivalent of part of the Lower *hermanni* Subzone, or of either part or all of the Upper *hermanni* Subzone, or of either part or all of the Lower *disparilis* Subzone ".

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POSTSCRIPT : Please send your comments and any possible proposals for regional reference sections to pierre.bultynck@naturalsciences.be

Pierre** Bultynck**, Givetian Working Group leader

Meeting Announcements

Baltic Stratigraphical Association

6TH BALTIC STRATIGRAPHICAL CONFERENCE

St. Petersburg, Russia, August 23-25, 2005

SECOND CIRCULAR

We are pleased to announce that almost 50 scientists from Europe, USA, Iran, China and Australia have shown their interest to attend this meeting.

The 6th Baltic Stratigraphical Conference will take place in St. Petersburg, August 19-28, 2005 at the A.P. Karpinsky All-Russian Geological Research Institute (VSEGEI) (Sredny prospect, 74). It includes oral and poster scientific sessions and several days in field. The scientific sessions are planned on August 23-25. Registration and ice-breaking party will be on August 22. Two pre-conference field trips (A - Lower Palaeozoic and Quaternary; B - Carboniferous) would take place on August 19-21, post-conference field trip (Devonian) - on August 26-28.

Organizers: A.P. Karpinsky All-Russian Geological Research Institute (Sredny prospect 74)

St. Petersburg University (Universitetskaya nab. 7/9 and 16 Liniya 29).

Aims

The 6th Baltic Stratigraphical Conference will cover a wide range of topics, with particular emphasis on the sedimentary basin stratigraphy of Baltic and neighbouring regions. The number of sessions and topics of symposia could be specified according to the preferences of registered participants.

The participants are invited to submit abstracts of both oral and poster presentations that will be published in an abstract volume.

Language:

The official language of the Conference is English and no translation facilities will be provided.

Oral Presentations:

It is planned that each presentation will be allocated 20 minutes (including discussion time). In case if the number of oral presentations will be too large, the organizers could change the mode of presentation in agreement with the participant.

Poster Presentations:

Posters will be presented on the separate session. Posters should be designed for a space not larger than 100 x 120 cm.

Abstracts

The deadline for abstract submission is 1st of March 2005.

Abstracts should be submitted as e-mail attachments sent to Tatiana Tolmacheva, e-mail: tatiana_tolmacheva@vsegei.ru.

Abstracts in English should be from one A4 to four A4 pages, including line drawing illustrations and references. Text should be written using 12p Times New Roman font, the margins should be 1.5 cm at top and bottom and 2.5 cm left and right, 1.5-spaced and not justified. Please, sent the text as RTF format, illustrations as TIFF or BMP format (preferably not

exceeding 300 dpi). If you use special characters or national letters, please send a hard copy also.

Abstract example:

Geodynamic evolution of the Baltic basin in Silurian – Early Devonian

Jurga Lazauskiene (1), Saulius Sliaupa (2)

(1) Lithuanian Geological Survey, S. Konarskio 35, Vilnius, Lithuania; jurga.lazauskiene@lgt.lt

(2) Institute of Geology, Sevиenkos 13, Vilnius, Lithuania; sliaupa@geologint.lt

The Baltic basin is a Phanerozoic sedimentary basin, situated on the western margin of the East European Craton (EEC). The basin manifested the maximum subsidence during Silurian - Early Devonian relating to the flexural bending of the Baltic plate margin evoked by docking to Eastern Avalonian plate.

The tectonic-sedimentary evolution of the Baltic Silurian foreland basin (BSB), recorded by up to 3000 m thick carbonaceous-shaly succession, was analysed quantitatively focusing on the interplay of the geodynamic and basin-infill processes along the EEC margin.

References

Angevine C.L., Heller P.L. and Paola C., 1990. Quantitative Sedimentary Basin Modelling. AAPG Continuing Education Course Note Series, 32, Tulsa, 133.

Baarli B., 1990. Peripheral bulge of a foreland basin in the Oslo Region during the early Silurian. Paleogeography, Paleoclimatology, Paleoecology, 78, 149-161.

Visa requirements

Russian visa is required for all participants with the exception for those from Ukraine, Byelorussia, and Kazakhstan. In order to arrange visa support we kindly ask you to forward to us the following data:

- Passport copy: the copy of two first pages of the passport containing personal data, photograph and information about the duration of the passport validity is required
- Personal information:
- Surname
- Fist name (full)
- Date of birth
- Sex
- Citizenship (in case you have more than one, please note)
- Country of birth
- Place of birth
- Country and region of constant living
- Country and city in which you will obtain visa
- Full name of company of affiliation
- Full company address
- Position in the Company
- Passport number
- Data of issue/expire date
- Where are you going to stay in St. Petersburg

Please, send the foregoing information for the visa support to Dr. Olga Kossovaya before March 1 by e-mail: koss@mail.wplus.net; the copy of passport can be send also by Fax: 7 (812) 328 92 82 to Olga Kossovaya.

Registration fee

Payments in Euros:

Registration fee: 110 EUR (before February 10, 2005) 130 EUR. (after February 10, 2005)

Accompanying person: 20 EUR (before February 10, 2005) 40 EUR. (after February 10, 2005)

The registration fee will entitle you to admittance to the conference, one copy of the abstract volume (not for accompanying person) and program, ice-breaking party and coffee breaks. The registration fee also covers visa support expenses. It does not include daily meals, lodging or the conference dinner.

Methods of payment:

Payment should be submitted to the account № 40502978607001000169 with Bank for Foreign Trade, Branch St. Petersburg, Russia; 29, B. Morskaya street, 190000 St. Petersburg, Russia; SWIFT: VTBR RU M2 SPE via correspondent account № 11.00.0615140-900 with Donau Bank AG, POB 1451, F-1011 Vienna, Austria. SWIFT: DOBA AT WW.

Please e-mail the organizers to confirm your payment.

Accommodation

The following hotels are located a short way of VSEGEI:

Hotel	Class of	Price of single room per night	Price of double room per night	Break-fast	Booking	Visa regist-ration	Phone/Telefax, e-mail and site
Morskaya	****	84 EUR	116 EUR	+	Free by telefax	About 1 EUR	+7-812-3226040 Fax: +7-812-3226055 mv@baltics.ru www.morskaya.ru/
Rinaldi mini-hotels	***	60 EUR	80 EUR	+	Free	Free	+7-812-9735140 www.rinaldi.ru
VSEGEI	***	-	73 EUR	-	Free	28 EUR	
Hotel of Lin-	**	-	45 EUR	-	Free	About 1	+7-812-3522429
Pribaltiyskaya	****	94 EUR	107 EUR	+	See the Internet site	Free	+7-812-3565001 Fax: +7-812-356-44-96

The medium cost of meals in St. Petersburg is ~ 5-10 EUR/per day.

Excursions

Payment of all field trips will be collected at the registration desk during the conference. Please, send the confirmation of your participation in the field trips before April 1st to contact persons.

Pre-conference field trip A:

Lower Paleozoic, August 19-20 and Quaternary, August 21 of Leningrad District

During the first and second days participants of the excursion will observe a complete succession of the Cambrian and

Ordovician rocks exposed in the region. Aspects of paleontology, biostratigraphy, sequence stratigraphy, sedimentary environments and sea-level changes will be discussed in a range of facies from the cool water to tropical carbonates. All sections are located along the Baltic – Ladoga Glint, in 50 to 170 km from St. Petersburg. On the third day the main features of the Quaternary history, climatic and sea-level changes of the eastern Baltics within 150 ka will be shown in several sites of the Neva Lowland. Participants will stay all nights in St. Petersburg.

The field trip cost is 70 EUR for the Lower Paleozoic part and 30 EUR for the Quaternary part. It covers transportation, meals, and guidebook. It doesn't cover the accommodation in St. Petersburg.

Contact person - Dr. Andrey Dronov, e-mail: dronov@gg2686.spb.edu

Pre-conference field trip B (August 19-21):

Lower Carboniferous of the north-western part of the Moscow Syneclise

Three-days geological excursion on the Carboniferous sections includes an examination of stratigraphy, sedimentology, and paleontology in the key sections of the Visean and Serpukhovian marine shallow-water deposits containing abundant brachiopods, corals, ostracodes, forams, conodonts, vertebrates, and plant remains. The sections to be visited are situated in 350-380 km to the south-east from St. Petersburg at the spurs of Valdai Hills. Also the Visean - Serpukhovian deposits will be shown in the vicinity of Borovichi town and in the middle stream of the Msta River, Novgorod District; the Lower Carboniferous bauxite formation - in the vicinity of Boksitogorsk town. Participants will stay all nights in Borovochi town.

The field trip cost is 140 EUR, it covers transportation, accommodation, meals, and guidebook.

Contact person - Dr. Olga Kossovaya, e-mail: koss@wplus.net

Post-conference field trip C (August 26-28):

Devonian of Leningrad and Pskov districts

Participants of the three-days excursion will visit the Middle and Upper Devonian outcrops of southern part of the Leningrad District and western part of the Pskov District. The field trip sections are situated in central part of Main Devonian Field, East European Platform. The Middle Devonian and Lower Frasnian sections will be shown in the Oredezh River Basin in 80-100 km to the south from St. Petersburg. The sections of Arukula, Burtnieki, Gauja and Amata terrigenous deposits contain abundant vertebrate and rare plant remains. The Lower and Middle Frasnian sections will be demonstrated in the Velikaya River Basin and in some quarries near Izborsk town, 300 km from St. Petersburg. The Plavinas, Dubniki and Daugava carbonate and silicaclastic deposits yield diverse fossils, such as brachiopods, ostracodes, gastropods, conodonts, crinoids, as well vertebrates. Participants will stay all nights in Pskov city.

The field trip cost is 120 EUR, it covers transportation, accommodation, meals, and guidebook.

Contact person - Dr. Alexander Ivanov, e-mail: aoi@ai1205.spb.edu

Deadlines

Early registration and payment	February 10, 2005
Abstract submission	March 1, 2005
Information for the visa support	March 1, 2005
Confirmation of excursion participation	April 1, 2005
Late registration and payment	August 22, 2005
Payment of all field trips	August 22, 2005

Organizing committee: Tatyana Koren' (Conference Chairman, VSEGEI), Oleg Petrov (Vice-Chairmen, VSEGEI), Igor Buldakov (Vice-Chairmen, St. Petersburg University), Andrey Zhuravlev (Secretary, VSEGEI), Andrey Dronov (St. Petersburg University), Irina Evdokimova (VSEGEI), Alexander Ivanov (St. Petersburg University), Olga Kossovaya (VSEGEI), Elena Raevskaya (Precambrian Research Institute),Yuri Savitsky (St. Petersburg University), Tatiana Tolmacheva (VSEGEI).

Please address all the enquiries concerning the registration for the Conference and other guestions to:

Dr. Andrey Zhuravlev
All-Russian Geological Research Institute (VSEGEI)
74, Sredny Pr., St Petersburg, 199106
Russia

E-mail: stratigr@mail.wplus.net
Tel.: +07 812 328 92 10

Registration form

Baltic Stratigraphic Association
6th Baltic Stratigraphical Conference
St. Petersburg, Russia, August 22-26 , 2005

First name: …… Family Name: …..…..…….……..
Title: …… Sex: (M/F) …….. ……..
Institution: ……
Address (street): ……. City: ……..…..
Postal code: ……. Country: ……State/Province ……..
Phone: …… Fax:…….. E-mail: …….

Conference contribution:

Oral yes no
Author(s)……...
and title: …….……
Poster yes no
Author(s)……...
and title: …….……

Abstract yes no

I intend to take part in the field trip:

Pre-conference field trip A yes no
Pre-conference field trip B yes no
Post-conference field trip C yes no

I would like to stay in the hotel ……..(please, add the hotel name) for ….. nights
single room double room

I intend to be accompanied by
yes no

ICOS 5 and an SDS fieldtrip to the ORS of Scotland

SDS has agreed to meet at ICOS 2006 which will be held in Leicester in the UK. Leicester is in the East Midlands and has a well established Geology Department with a long tradition of Palaeozoic micropalaeontology. To organise ICOS 2006 the Leicester department is linking with the other large UK conodont group at the University of Birmingham. The provisional dates are 17th-21st July with details available on www.conodont.net. It is anticipated that many SDS members will attend ICOS and we will arrange for a commission business meeting to be held during the conference. ICOS has a post-conference field excursion that will be a transect through Scotland crossing the terranes that make up northern Britain. In addition, the SDS will run a separate pre-conference fieldtrip that will also go to Scotland but specifically the Old Red Sandstone with emphasis on the Devonian palaeoclimate record in terrestrial sediments. As yet the itinerary is provisional and will be fixed when we have an idea of numbers who might attend the excursion. This will also enable us to determine the cost. It is anticipated that the trip would start in Edinburgh (or possibly Inverness) and return to Leicester. Both Edinburgh and Inverness are served by low-cost airlines.

The proposed itinerary (but not running order) would be...

- Siccar Point, Hutton's Unconformity. Famous unconformity between lower Palaeozoic and ORS discovered by James Hutton
- Edinburgh, the National Museum of Scotland to see the spectacular ORS fish and the Rhynie Chert. The Rhynie Chert locality is buried under recent sediment and cannot be seen
- Aberlemno, A Lower ORS lake and fish/plants in the Midland Valley
- Inverness and Tain, marginal lacustrine cycles in the Orcadian Basin,
- Hugh Miller's cottage in Cromarty. Miller wrote *The Old Red Sandstone* in 1841 and brought many aspects of ORS geology to the attention of the scientific community
- Caithness, the classic Middle Devonian lacustrine sediments, the distal lake environment, half-graben & the lake shore
- Orkney, Eifelian and Givetian lacustrine climatic cycles, long Middle Devonian climatic records, fish & the fish museum, marine incursions into the ORS, Eday Marl- the terrestrial Taghanic aridity event; lacustrine, aeolian and fluvial sediments as climatic indicators. Also the famous Neolithic sits of Maes Howe and Skara Brae
- The Fallen Stack of Portgower, a spectacular Jurassic submarine fan deposit with giant ORS slide blocks

If you are interested in attending please complete the form and either fax, post or email the details to:

Dr John Marshall, School of Ocean and Earth Science, University of Southampton, Southampton Oceanography Centre, European Way, Southampton, SO14 3ZH, UK.

email jeam@mail.soc.soton.ac.uk
direct line/answer phone +44 (0)23 8059 2015, fax +44 (0)23 8059 3052

Name:……..

Address……

…….

…….

Email……...

Fax……...

I am attending ICOS and will definitely attend this SDS fieldtrip YES/NO

I may attend this SDS fieldtrip YES/NO

Deadline for these initial replies is 1st July 2005

MEMBER NEWS

CM Gerhard K. B. Alberti (Großhansdorf)

Co-worker: Lore Alberti (Großhansdorf; † 2004)

Homoctenid Tentaculitids from the Upper Devonian Gogo Formation of Western Australian Canning Basin

Compared with the advanced knowledge of Lower Devonian taxa of planktonic tentaculitids (and homoctenids) from Eastern Australia (especially Victoria), thanks to the longstanding research by the author (G.K.B. ALBERTI 1993-2000, in collaboration with LORE ALBERTI) and in contrast to this, our present knowledge of Upper Devon (Frasnian) pelagic tentaculitids (and homoctenids) from Australia seemed as yet to be insufficient, even though their occurrence in the Gogo Formation of the Western Australian Canning Basin was to be expected.

The nearly worldwide Lower- and Middle Devonian planktonic tentaculitid (and homoctenid) research by the author (in collaboration with LORE ALBERTI) in 1989 has been extended to the Australian Upper Devonian (Frasnian), in fact the Canning Basin Gogo Formation, in hope of finding homoctenids in its dark shales and thin microsparitic beds.

But our first common Canning Basin trip in 1989 with the aim of homoctenid findings in the Gogo Formation was not very successful. Only indeterminable incomplete shells have been found, possibly belonging to homoctenids.

Compared with that our second common Canning Basin trip in 1993 was very successful. LORE was just ahead of me in finding the first well preserved but rare complete specimens of homoctenids being identified *Homoctenus* sp. ex aff. *tenuicinctus* (ROEMER 1850) and *Homoctenus* sp. ex aff. *ultimus* ZAGORA 1964, *Striatostyliolina* sp. ex aff. *paucicostata* BOUČEK 1964 and *Viriatellina* sp. A, coming from few decimeter thick portions of the dark shaly succession, outcropped near McWhae-Ridge and near Geikie Gorge. Another bed of dark shales yielded *Homoctenus* sp. ex gr. *derkaouaensis* LARDEUX 1969. LORE did have the patience and indefatigable fossil hunter eyes to sit down in the hot sun to do the not easy bed-by-bed collecting however she this was used to doing in the past in the Algerian Sahara.

Maybe this is the right moment to evaluate LORE ALBERTI's Devonian field-activities in the last five decades in various Devonian areas of the world, mainly in Algeria and Morocco as well as Australia; all the time in the field my constant companion, untiring sampling or collecting fossils with the aid of her microscope or magnifying glass. She was indispensable. Without her activities, especially her sampling of an enormous amount of material to be studied, the level of knowledge would be lower. I owe a great part of the Trilobite- (G.K.B. ALBERTI 1969, 1970, 1981, 1983) and of the planktonic tentaculitid – as well as homoctenid-material (G.K.B. ALBERTI 1993, 1997a, 1997b, 1998, 1999, 2000) to LORE ALBERTI's collecting, essential for my cited monographs.

I still find it difficult to believe, that she went so early. All who knew Lore Alberti will continue to miss her a lot.

Even if measured sections through the shaly successions of the Gogo Formation with bed-by-bed collections of homoctenids and their detailed taxonomy seem to lack so far, our discoveries fill a gap in the fossil record of the lower Upper Devonian from Western Australian Canning Basin. For the moment by the tools of the recorded taxa of homoctenids their levels may be correlated with parts of the *rhenana*-Conodont Zone of Frasnian.

Work will continued in the Canning Basin of Western Australia on the Homoctenids et cetera from the Gogo Formation. It is planned to publish an illustrated paper on our studies.

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ALBERTI, G.K.B. & ALBERTI, Lore (1996): Zur Lithologie, Fauna und Stratigraphie des unterdevonischen Anteils der „Harzgerode-Tongallen- und Kieselgallenschiefer-Formation“ (herzynische Beckenfazies, Unterharz). – Senckenbergiana lethaea, 76: 113-119; Frankfurt/M.

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Fernando Alvarez (Oviedo)

This following is a short note and abstract submitted for the interest of SDS members. The work appeared in July 2004 as published in Palaeontology [47(3):811-857] a revision of the Athyrisininae (and the Homeathyridinae), group of spire-bearing brachiopods with good value for biostratigraphic and paleobiogeographic correlation.

During the process of reviewing brachiopod genera and their contained species for the athyridide section of the revised edition of the Treatise on Invertebrate Paleontology (part H, Brachiopoda) we encountered (Alvarez and Rong 2002) the problem of classifying the athyridide brachiopods commonly included within the athyrisinins. This was mainly due to their variable external morphology, with abundant intermediate forms (in shape and radial ornamentation) between what one would suppose to be different species or even genera. A more serious problem was the lack of knowledge on the internal structures, such as cardinalia and brachio-jugal system, of many of the athyrisinine species. Consequently, specific discrimination has always been difficult, and authors have shown wide differences of opinion as to where the limits of species should be drawn.

The athyridide brachiopod subfamily Athyrisininae, as we reviewed, is made up of Athyrisina Hayasaka, in Yabe and Hayasaka 1920, and allied genera, but follows Rong et al. (1994) in excluding Retziella Nikiforova, 1937, and related genera, which some authors previously included. Athyrisina Hayasaka, in Yabe and Hayasaka 1920, is among the earliest known brachiopod genera based on Chinese specimens. It ranges from late Pragian-Givetian, being abundant in Emsian-Eifelian rocks in southern and north-western China and north Vietnam. Since the subfamily Athyrisininae was erected by Grabau (1931), several new genera were erected and assigned to it. Among them, Athyrisinopsis Zhang, in Zhang and Fu 1983; Kwangsia Grabau, 1931; Kwangsiella Grabau, 1932; Plectospirifer Grabau, 1931; and Pseudoathyrisina Chen, 1979 have been considered, but without discussion, by Alvarez et al. (1998) as subjective junior synonyms of the genus Athyrisina Hayasaka, in Yabe and Hayasaka 1920. Parathyrisina Wang, in Wang, Yu and Wu 1974 is closely related to Athyrisina. The main differences between these two genera, together with the synonymous relationships of Parathyrisina with Athyrisinoides Chen and Wan, in Xu et al. 1978 (non Athyrisinoides Jiang, in Xian and Jiang 1978), Athyrisinoidea Chen and Wan, in Wan1980, and Neoathyrisina Chen, 1988, are discussed in our revision. A new genus, Bruntosina (after C. Howard C. Brunton), was erected with Athyrisinopsis gansuensis Zhang, in Zhang and Fu 1983, from the upper Lower Devonian (upper Emsian) to lower Middle Devonian (lower Eifelian) of the Qinling region (north-western China) as the type species. This genus is characterized by two or three strong, non-bifurcating plicae on the flanks of the shell and a single, narrower median costa in the ventral sulcus.

Three genera, Homeathyris Modzalevskaya, 1997, Pseudohomeospira Nikiforova, 1970, and Squamathyris Modzalevskaya, 1981, from the Upper Silurian of northern Russia, were commonly considered athyrisinins. The revision for us undertaken showed that these Silurian genera commonly have a hypothyridid pedicle opening partially closed by deltidial plates, and a large delthyrial chamber with a pedicle support consisting of pedicle collar (Pseudohomeospira) or two apical plates situated between the dental plates and joined with them at their posterodorsal end (Homeathyris and Squamathyris). These two characters together with a jugum with very short accessory lamellae has encouraged us to separate them into a new subfamily, the Homeathyridinae.

Ikella Tjazheva, 1972, from the upper Emsian-lower Eifelian (patulus-partitus conodont biozones) of the western slope of the southern Urals, was commonly considered an athyrisinin. Ikella has a weakly costate shell surface, without a sulcus and fold. The revision by Tanya Modzalevskaya of topotypical material shows that internally it has a wide, flat cardinal plate, not perforated apically and supported posteriorly by a very short ridge. These characters separate Ikella from the athyrisinins and homeathyridins. Ikella has external and internal similarities with the retziellids, ornamentation and cardinalia in particular, but the highly crystalline nature of the matrix has made examination of internal structures very difficult; the spiralium is not well known and jugal structures are still unknown, therefore the superfamilial and familial assignments of this genus should be regarded only as provisional. This ambiguity should be resolved when non-recrystallized topotype specimens, that will allow the study of these structures in Ikella and also in Argorhynx, Ufonicoelia and Gissarina, genera commonly included within the retzielloids, are found.

The taxonomic revision undertaked shows that the Athyrisininae could be considered a significant biogeographical indicator for the recognition of the South China Province in the Early and Mid Devonian. Geological significance of the stratigraphical and biogeographical distributions of the Athyrisininae and Homeathyridinae was evaluated in terms of new investigations on these endemic groups.

Here is the reference and abstract for this revision:

RONG JIA-YU, FERNANDO ALVAREZ, TATYANA L. MODZALEVSKAYA and ZHANG YAN. 2004. REVISION OF THE ATHYRISININAE, SILURO-DEVONIAN BRACHIOPODS FROM CHINA AND RUSSIA. Palaeontology, 47(4):811-857.

ABSTRACT. Athyrisinine brachiopods from the Upper Silurian of Russia and the Lower to Middle Devonian of China and north Vietnam include over 70 species belonging to Athyrisina and Parathyrisina; generic and subfamilial diagnoses are emended. Five genera are considered synonyms of Athyrisina and three of Parathyrisina. A neotype is selected and illustrated for Athyrisina squamosa, the type species of Athyrisina. Four nomina nova, *Athyrisina xui*, *Parathyrisina wani*, *P. minima*, and *P. cheni*, are suggested as new substitute names for *Athyrisina tumida* Wang, in Xu et al. 1978 (primary homonymy), *Athyrisinoides ganxiensis* Wan, in Xu et al. 1978, *Parathyrisina minor* Zhang, in Zhang and Fu 1983, and *Athyrisinoides tudilingensis* Chen, 1979 (secondary homonyms) respectively. A new genus, *Bruntosina*, is described from the Emsian to Eifelian of the Qinling region. A new subfamily, Homeathyridinae is erected within the Athyrididae with *Homeathyris*, *Pseudohomeospira*, and *Squamathyris* included, revised and their diagnoses emended. *Homeathyris incisus* sp. nov. is described from the Ludfordian of Novaya Zemlya. Ikella is revised and excluded from the athyrisinins. The origin and dispersal of the homeathyridins and the athyrisinins are discussed.

CM Gordon Baird

This past year, I continued correlation work on the Late Givetian Tully Formation eastern clastic correlative succession in eastern New York State (New Berlin-Oneonta area), an area not examined extensively since the 1930s. Although considerable gains were made within the actual Tully - equivalent succession during the period 1998-2003 through the discovery of numerous new sections and tie lines as well as the intriguing occurrences of chamosite at several levels (see Baird and Brett, 2003; Baird, et al., 2003), connections between Tully-equivalent strata and the underlying succession of the Hamilton Group were still not very clear. Given that the Tully Formation is the type unit for the Taghanic Bioevent, one would need to find the most complete (continuous) section in order to constrain the timing and nature of the demise of the Hamilton Fauna and the incursion of the classic Tully Fauna. A vexing problem has been the presence of a persistent, regional, sub-Tully unconformity that obscures any transition that may have existed. Recent unpublished work by Baird in conjunction with Carlton Brett (Univ. Cincinnati) shows that the sub-Tully unconformity closes to near continuity, both in the vicinity of New Lisbon, NY and in central Pennsylvania. What is revealed is a dark, shale dominated interval of dysoxic to minimally oxic facies (Highland Forest Submember, New Lisbon Member) that partially bridges the hiatus. Moreover, the New Lisbon Member marks the first incursion of Rhyssochonetes along with abundant "Leiorhynchus" (*Camarotoechia mesocostale*) at its base followed by a higher reappearance of Hamilton - type forms (*Devonochonetes scitulus, Tropidoleptus*) higher in the section. This Hamilton recurrence is followed by a second major transgression which brings in a second, more sustained Tully Fauna incursion. A similar succession is observed in the Williamsport area of central Pennsylvania where the section is also more continuous. A key remaining issue is a need for more precise assessment of age of the New Lisbon Mbr. relative to the classic Tully carbonate succession in western New York.

Relevant new publications include:

Baird, G.C. and Brett, C.E., 2003, Shelf and off-shelf deposits of the Tully Formation in New York and Pennsylvania: Faunal incursions, eustasy and tectonics, Cour. Forsch. Inst. Senckenerg, 242, P. 141-156.

Baird, G.C., Brett, C.E., and Bartholomew, A.J., 2003, Late Middle Devonian biotic and sedimentological events in east central New York - Tully Formation clastic correlative succession in the Sherburne - Oneonta area, 1 -54, In, Johnson, E. L., ed., Field Trip Guidebook: New York State Geological Association, 75th Annual Meeting, Oneonta, New York.

R. Thomas Becker, Münster

Research activities in 2003 and 2004 had a strong focus on Dra Valley sections in order to provide many new details for the Fieldguide of our SDS excursion which has been published in the meantime as vol. 19 of the “Documents de l´Institut Scientifique” series, edited by A. El Hassani. Sarah ABOUSSALAM, Volker EBBIGHAUSEN, and Jürgen BOCKWINKEL contributed with their own material, with many illustrations and helped significantly to write the chapters. I think our group has made much progress and the co-operation with our friends from Senckenberg was very fruitful. It was amazing to see how many additional discoveries were made when the large excursion party visited the outcrops, including – almost as a running gag – many additional *Uncites* and stringocephalids, chaetetids, stromatopores, colonial Rugosa, edrioasteroids, coiled nautiloids, various trilobites and placoderm remains from the Emsian to Givetian. It is hoped that many of these new discoveries will make it into future publications. Three mapping students in the Torkoz region, Matthias DRÜCKE, Roman LEBEK, and Mounir ABAID managed to find two new good sections through all of the Eifelian and across the Kacak Event. These will be studied more intensively in autumn 2005. Other Moroccan research concentrates on pharciceratids, the Frasne Event

(see abstracts in reference list), the Frasnian-Famennian boundary, the Lower Givetian, and the latest Famennian to Tournaisian.

As announced at the Morocco Meeting, there is progress with the editing of a proceedings volume on "Devonian event stratigraphy and correlations", which will be published, in honour of Michael House, as a Special Volume of the Geological Society of London. Six manuscripts have been submitted by early February, with three to four more to come until the end of the months. Bill Kirchgasser has agreed to help with the editing process.

With some push by Phil Playford and Gil Klapper, a long outstanding manuscript on the complete Upper Devonian ammonoid biostratigraphy and its correlation with the conodont succession has just been completed. It includes many data jointly by Michael and myself, and, consequently, he will co-author the paper. It will be published together with many other details (e.g., a conodont chapter by Gil) on the Canning Basin Devonian in a volume of the Geological Survey of Western Australia. The amount of material is so huge that it will take several more years until all recognized taxa are sufficiently described, probably in a series of taxonomic papers.

Other recent projects dealt with ammonoids around the Devonian-Carboniferous boundary in the Montagne Noire (BECKER & WEYER 2004), with *Omalodus* teeth from the Givetian of the Tafilalt (HAMPE, ABOUSSALAM & BECKER, 2004), with Canning Basin gastropods (COOK et al. 2003), and with trilobites from the Shotori Range (Feist et al. 2003). A manuscript on one Emsian and mostly Famennian crinoids from the Tafilalt and Maider (WEBSTER, BECKER & MAPLES, 2005) is in press in the Journal of Paleontology. Moroccan maenioceratids are planned to be studied in joint contributions with Volker, Jürgen, Sarah, and C. KLUG (Zürich). An important Famennian colonial rugose corals from southern Morocco will be described by WEYER & BECKER (in prep.). There are also plans for a short note on deeper-water Rugosa from Iran. Several taxonomic papers will be needed in order to establish various ammonoid genera which shall be included in the new Paleozoic Ammonoid Treatise. This applies to cyrtoclymenids, manticoceratids, anarcestids, tornoceratids, sporadoceratids, and agoniatitids. The outstanding announced paper on the *Annulata* Event in Iran has eventually been published in January 2004.

The Münster Devonian group includes further activities of:

Z. Sarah Aboussalam

Her Ph. D. thesis has been published as vol. 97 of our Münster´sche Forschungen zur Geologie und Paläontologie series and marks major progress in the understanding of the event (better crises) and of late Givetian conodonts. Subsequent conodont work concentrated on the Upper Givetian and basal Frasnian of the Tafilalt, Montagne Noire, and Germany and aims at a better ammonoid-conodont correlation (see abstracts below). A wide range of new taxa has been found, including a new genus and several new species of *Polygnathus, ?Skeletognathus*, *Tortodus*, and *Schmidtognathus*. Publications on the base of the Frasnian and the Frasne Event are planned. Currently she is also involved with latest Tournaisian conodonts from the Montagne Noire and samples from around the Frasnian-Famennian boundary of Morocco and the Rhenish Massif.

Judith NAGEL

continues her Ph.D. on Givetian to Famennian bivalves from the pelagic biofacies of Westphalia. Currently she concentrates on forms around *Loxopteria, Kochia*, and supposed Devonian *Praecardium* and seriously struggles with an absolutely outdated taxonomy. She has given several talks and posters in 2004 (see abstracts below).

Holger NÜBEL,

unfortunately, has decided to opt for a safe job and will become a teacher, instead of continuing his Ph.D. on Devonian reefs from Germany and Morocco.

Sven Hartenfels

has joined the Münster Group from 1st of August of 2004, coming from Cologne, where he worked for a M. Sc. on the classical Schübelhammer section of Franconia, mostly on microfacies. His Ph. D. will compare the high resolution event stratigraphy, palaeoecology, and geochemistry of the *Annulata* and Dasberg Events.

Tanja Stegemann

completed a M. Sc. on the taxonomy, biostratigraphy and phylogeny of Middle and Upper Givetian phacopids (the former supposed *koeneni* Group) from Morocco and Germany. Detailed biometric investigations showed that there was almost no morphological change in the *Hypsipariops* lineage across the Taghanic Event although there were massive extinctions in other trilobite groups at the same time. Moroccan material included an unusual, very large-eyed new species, which, unfortunately, is still only known from insufficiently preserved specimens. A publication of results is planned.

Carsten Spellbrink

has measured and sampled intensively a rather basinal Upper Frasnian to basal Famennian section N of Adorf for his M. Sc. The two Kellwasser levels are rather thick and consist of a complex sequence of beds. Apart from the stratigraphy he

will have a closer look on some low divers ostracod faunas around the F-F boundary; advice from outside will be needed. Sarah will identify the conodonts.

Michaela SPIESKE

has finished a joint mapping project with M. PIECHA from the survey (now Geologischer Dienst) at Krefeld which resulted in the discovery of two new nice Famennian sections to be studied by Sven. Reefal debris limestones allowed to date the drowning of the extensive reefs in the area just W of the Hönne Valley. Conodonts are in the hands of Sarah. Some important shallow-water Rugosa have been given, as other material from Morocco and the Rhenish Massif, to Stefan SCHRÖDER from Cologne. Two other students (A. SCHÄFER, T. RIEDEL) mapped the Lower Givetian in the same region, with the special task to trace carbonate lenses in the Honsel Formation below the onset of the major reef development. Unfortunately, all carbonates turned out to be conodont barren but one locality provided new material of octactinellid sponges, which is a relatively poorly studied group.

Sandra I. KAISER

from Bochum has just finished her Ph. D. on conodont and isotope stratigraphy around the Devonian-Carboniferous boundary. New results on organic carbon nicely correspond with a positive isotope excursion in carbonates known only from the Grüne Schneid. The most interesting results have been submitted for publication (KAISER, STEUBER, BECKER & JOACHIMSKI, in prep.). She has presented results at various meetings (see abstracts).

Maren HÜBERS

has decided to write a B. Sc. on some rare Emsian and Givetian *Gerastos* from Morocco.

Jennifer REMKE

is about to start a M. Sc. on the biometry of *Aulacella*, which seems to have been resistent against major events although this mall orthid lived in the same pelagic environments as the event-sensitive ammonoids and trilobites.

Abstracts (smaller print) and publications of the Münster Group (and co-authors) since July 2003:

2003

KAISER, S. I., STEUBER, T. & BECKER, R. T. (2003b): Conodonten- und Chemostratigraphie an der Devon/Karbon-Grenze. – Terra Nostra, 0**3/3**: 39.

BECKER, R. T. & ABOUSSALAM, S. Z. (2003): Das Frasne-Event – ein vernachlässigter globaler Faunenschnitt im basalen Oberdevon. – Terra Nostra, 0**5/3**: 26-27.

KAISER, S. I., STEUBER, T. & BECKER, R. T. (2003c): Biostratigraphie, Sedimentologie und Geochemie im Devon/Karbon-Grenzbereich. – Terra Nostra, 0**5/3**: 77.

NÜBEL, H. & BECKER, R. T. (2003): Ein Phillipsastreen-Biostrom im Ober-Givetium des Maider (Anti-Atlas, Marokko). – Terra Nostra, 0**5/3**: 120-121.

FEIST, R., YAZDI, M. & BECKER, R. T. (2003): Famennian trilobites from the Shotori Range, E-Iran. – Annales de la Societe Géologique du Nord, 10 (2ème série): 285-295.

Cook, A. G., Blodgett, R. B. & BECKER, R. T. (2003): Late Devonian gastropods from the Canning Basin, Western Australia. – Alcheringa, **27**: 181-207.

2004 (a busy year)

BECKER, R. T., ASHOURI, A. R. & YAZDI, M. (2004a): The Upper Devonian *Annulata* Event in the Shotori Range (eastern Iran). – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **230**: 1-25.

HAMPE, O., ABOUSSALAM, Z. S. & BECKER, R. T. (2004): *Omalodus* teeth (Elasmobranchii: Omalodontida) from the northern Gondwana margin (middle Givetian: *ansatus* conodont Zone, Morocco). – In: ARRATIA, G., WILSON, M. V. H. & CLOUTIER, R. (Eds.), Recent Advances in the Origin and Early Radiation of Vertebrates: 487-504, Pfeil Verlag, München.

BECKER, R. T. & ABOUSSALAM, Z. S. (2004): The Frasne Event – a phased 2nd oder global crisis and extinction period around the Middle-Upper Devonian boundary. – In: Devonian neritic-pelagic Correlation and Events, International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Abstracts: 8-10.

BRICE, D., LEGRAND-BLAIN, M., NICOLLIN, J.-P., BECKER, R. T. & KAISER, S. (2004): Brachiopod Biostratigraphy around the Devonian-Carboniferous boundary in Morocco and surrounding localities in Algerian Sahara. - In: Devonian neritic-pelagic Correlation and Events, International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Abstracts: 15-18.

EBBIGHAUSEN, V., BECKER, R. T., BOCKWINKEL, J. & ABOUSSALAM, Z. S. (2004a): A neritic alien in the pelagic Givetian of the Dra Valley. - In: Devonian neritic-pelagic Correlation and Events, International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Abstracts: 22-23.

KAISER, S., STEUBER, T. & BECKER, R. T. (2004a): Conodont biostratigraphy, oceanic anoxia and climatic change during the Latest Devonian to Earliest Carboniferous. - In: Devonian neritic-pelagic Correlation and Events, International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Abstracts: 25-26.

KAISER, S., BECKER, R. T. & STEUBER, T. (2004b): Sedimentology and sea-level changes around the Devonian/Carboniferous boundary in southern Morocco. – In: Devonian neritic-pelagic Correlation and Events, International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Abstracts: 71-72.

NÜBEL, H. & BECKER, R. T. (2004): A Phillipsastreid Biostrome in the Late Givetian of the Maider (SE Anti-Atlas, Morocco). – In: Devonian neritic-pelagic Correlation and Events, International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Abstracts: 79-80.

WEBSTER, G., BECKER, R. T. & MAPLES, C. G. (2004): Biostratigraphy, paleoecology, and taxonomy of Devonian (Emsian and Famennian) crinoids from southeastern Morocco. – In: Devonian neritic-pelagic Correlation and Events, International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Abstracts: 87.

BECKER, R. T., JANSEN, U., PLODOWSKI, G., SCHINDLER, E., ABOUSSALAM, Z. S. & WEDDIGE, K. (2004b): Devonian litho- and biostratigraphy of the Dra Valley area. An overview. – In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 3-18.

BECKER, R. T., ABOUSSALAM, Z. S., BOCKWINKEL, J., EBBIGHAUSEN, V., EL HASSANI, A. & NÜBEL, H. (2004c): The Givetian and Frasnian at Oued Mzerreb (Tata region, eastern Dra Valley). - In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 29-43.

EBBIGHAUSEN, V., BOCKWINKEL, J., BECKER, R. T., ABOUSSALAM, Z. S., BULTYNCK, P., EL HASSANI, A. & NÜBEL, H. (2004b): Late Emsian and Eifelian stratigraphy at Oufrane (Tata region, eastern Dra Valley, Morocco). - In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 44-52.

ABOUSSALAM, Z. S., BECKER, R. T., BOCKWINKEL, J. & EBBIGHAUSEN, V. (2004): Givetian biostratigraphy and facies development at Oufrane (Tata region, eastern Dra Valley, Morocco). - In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 53-59.

ABOUSSALAM, Z. S. & BECKER, R. T. (2004a) : Givetian stratigraphy and faunas at Tiguisselt (Tata region, Dra Valley, Morocco). - In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 60-63.

KAISER, S., BECKER, R. T., BRICE, D., NICOLLIN, J.-P., LEGRAND-BLAIN, M., ABOUSSALAM, Z. S., EL HASSANI, A. & NÜBEL, H. (2004c): Sedimentary succession and neritic faunas around the Devonian-Carboniferous boundary at Kheneg Lakahal south of Assa (Dra Valley, SW Morocco). - In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 69-74.

BECKER, R. T., ABOUSSALAM, Z. S., BOCKWINKEL, J., EBBIGHAUSEN, V., EL HASSANI, A. & NÜBEL, H. (2004d): Upper Emsian stratigraphy at Rich Tamelougou near Torkoz (SW Dra Valley, Morocco). - In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 85-89.

BECKER, R. T., BOCKWINKEL, J., EBBIGHAUSEN, V., ABOUSSALAM, Z. S., EL HASSANI, A. & NÜBEL, H. (2004e): Lower and Middle Devonian stratigraphy and faunas at Bou Tserfine near Assa (Dra Valley, SW Morocco). - In: El HASSANI, A. (Ed.), Devonian neritic-pelagic correlation and events in the Dra Valley (western Anti-Atlas, Morocco), International Meeting on Stratigraphy, Rabat, March 1-10, 2004, Documents de l`Institut Scientifique, **19**: 90-100.

ANDERSON, T., BECKER, R. T. et al. (2004) : Twic-baked ammonoids : Famennian (and later) events at Dugan Pond, Sierra County, California. – GSA Rocky Mountains/Cordilleran Sections, Abstracts: 1 p.

BECKER, R. T. (2004a): Ammonoid Definitions of Upper Devonian Substages. – Document of the International Subcommission on Devonian Stratigraphy, Firenze, 8 pp. (also: 32nd International Geological Congress, Florence, Italy, August 20-28, 2004, Abstracts, 1 p.).

ABOUSSALAM, Z. S. & BECKER, R. T. (2004b): Late Givetian to basal Frasnian ammonoid-conodont correlations and extinctions. – Sixth International Symposium, Cephalopods – Present & Past, Sept. 16-19, 2004, Abstracts: 15-16.

BECKER, R. T. (2004b): Ammonoid extinctions near the Frasnian-Famennian boundary. - Sixth International Symposium, Cephalopods – Present & Past, Sept. 16-19, 2004, Abstracts: 25-26.

ABOUSSALAM, Z. S. & BECKER, R. T. (2004c) : Neue Conodontenfaunen aus dem Ober-Givetium und basalen Frasnium von Marokko und der Montagne Noire. – 74. Jahrestagung der Paläontologischen Gesellschaft, Göttingen, 02 bis 08. Oktober 2004, Kurzfassungen der Vorträge und Poster: 41-43.

BECKER, R. T. (2004c): Neue Erkenntnisse zur Bedeutung der globalen Kellwasser-Krise (höchstes Frasnium) für die Evolution der Ammonoidea. - 74. Jahrestagung der Paläontologischen Gesellschaft, Göttingen, 02 bis 08. Oktober 2004, Kurzfassungen der Vorträge und Poster: 54-55.

HARTENFELS, S. & TRAGELEHN, H. (2004): Karbonatmikrofazies und Conodontenbiofazies ausgewählter Profile im Oberdevon und Unterkarbon des Frankenwaldes und des Bayerischen Vogtlandes – Geuser, Kirchgattendorf, Köstenhof (NE-Bayern, Deutschland). - 74. Jahrestagung der Paläontologischen Gesellschaft, Göttingen, 02 bis 08. Oktober 2004, Kurzfassungen der Vorträge und Poster: 99-101.

NAGEL, J., AMLER, M. W. & BECKER, R. T. (2004a): Pelagische Muscheln – die Stiefkinder der oberdevonischen Biota. - 74. Jahrestagung der Paläontologischen Gesellschaft, Göttingen, 02 bis 08. Oktober 2004, Kurzfassungen der Vorträge und Poster: 168-169.

NAGEL, J., AMLER, M. W. & BECKER, R. T. (2004b): *Praecardium* BARRANDE im Oberdevon des Rheinischen Schiefergebirges? - 74. Jahrestagung der Paläontologischen Gesellschaft, Göttingen, 02 bis 08. Oktober 2004, Kurzfassungen der Vorträge und Poster: 189-170.

KAISER, S. I., STEUBER, T. & BECKER, R. T. (2004d): Paläoklimatische und –ozeanographische Veränderungen an der Wende Devon/ Karbon. – Abschlußkolloquium des DFG-Schwerpunktprogrammes 1054, 11.-12. Oktober 2004, Institut für Geologie und Mineralogie, Erlangen, Abstracts: 28-29.

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BECKER, R. T. & WEYER, D. (2004): *Bartzschiceras* n. gen. (Ammonoidea) from the Lower Tournaisian of Southern France. – Mitteilungen des Geologisch-Paläontologischen Institutes, Universität Hamburg, **88**: 11-36.

TM Alain Blieck (Paris)

Scientific activities

Continue work on Ordovician to Devonian vertebrates (Spitsbergen, Severnaya Zemlya, Ardenne, Poland, Carnic Alps of Italy, North Spain, etc.). Supervise Ph. D. thesis of Zivile Zigaite, from Vilnius University, Lithuania, on "Early Vertebrates of the Silurian of North Eurasia and their role in palaeogeographical and palaeoclimatic reconstructions". Participate in IGCP Project 471 « Evolution of Western Gondwana during the Late Paleozoic : tectonosedimentary record, paleoclimates and biological changes » (French Group coordinator), IGCP Project 491 « Early Vertebrate-Biogeography, Palaeogeography and Climate » (French Group coordinator), IGCP Project 499 « Devonian land-sea interaction: evolution of ecosystems and climate », and IGCP Project 503 « Ordovician Palaeogeography and Palaeoclimate ».

Publications

Papers published

Clément, G., Ahlberg, P.E., Blieck, A., Blom, H., Clack, J.A., Poty, E., Thorez, J. & Janvier, P. (2004).- Devonian tetrapod from western Europe.- *Nature*, **427** (6973) : 412-413, 1 fig.; London [also World Wide Web address: http://gateway2.ovid.com:80/ovidweb.cgi].

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Turner, S., Blieck, A. & Nowlan, G.S. (2004).- Vertebrates (Agnathans and Gnathostomes).- *In*: Webby, B.D., Paris, F., Droser, M.L. & Percival, I.G. (eds), *The Great Ordovician Biodiversification Event* (IGCP 410 volume). Columbia University Press, "Critical moments and perspectives in Earth history and paleobiology", chapter 30: 327-335, 2 fig., 1 tabl. ; New York.

Malvesy, T. & Blieck, A. (2004).- A quoi sert un inventaire ? Les collections géologiques du Musée d'Histoire Naturelle de Lille.- *In* : De Wever, P., Guiraud, M., Cornée, A., Beckary, S. & Lasnier, B. (organ.), *Des collections en sciences de la Terre, pour quoi faire ?* (Actes Table Ronde, 15-16 octobre 2002, MNHN, Paris). Office de Coopération et d'Information Muséographiques (OCIM) édit. : p. 125-131, 5 fig.

Papers in press

Blieck, A. (in press).- La biodiversité au cours du Paléozoïque d'après l'exemple des Vertébrés aquatiques.- Les Amis du Muséum national d'Histoire naturelle ; Paris [In French, accepted].

Blieck, A. (in press).- Dossier spécial : Stratigraphie du Paléozoïque — Introduction.- In : Blieck, A. (coord.), Dossier spécial : Stratigraphie du Paléozoïque. Ann. Soc. Géol. Nord ; Villeneuve d'Ascq [In French, accepted].

Servais, T., Blieck, A., Caridroit, M., Chen Xu, Paris, F. & Tortello, M.F. (in press).- Use and utility of plankton and nekton for Ordovician palaeogeographical reconstructions.- In : Colloque de paléogéographie (Paris, 8-9 Mars 2004). Bull. Soc. Géol. Fr. ; Paris [submitted].

Wehrmann, A., Blieck, A., Brocke, R., Hertweck, G., Jansen, U., Königshof, P., Plodowski, G., Schindler, E., Schultka, S. & Wilde, V. (in press).- Palaeoenvironment of an Early Devonian land-sea transition: a case study from the southern margin of the Old Red Continent (Mosel valley, Germany).- Palaios; Soc. Econ. Paleont. & Mineral. publ., Tulsa (OK, USA) [accepted].

Others

Blieck, A. coord. (sous presse).- Dossier spécial : Stratigraphie du Paléozoïque.- *Ann. Soc. Géol. Nord* ; Villeneuve d'Ascq [accepted].

Blieck, A., Brice, D., Courville, P., Crônier, C. & Derycke, C. (2004).- The Micropalaeontological Society Field Trip and Evening Session in Boulonnais and Villeneuve d'Ascq (N. France). Thursday 16 December 2004. Programme and Field Trip Guide Book.- Univ. Sci. Techn. Lille, Lab. Paléont. Palaéogéogr. Paléoz. (LP3) publ., Villeneuve d'Ascq : 15 p., 8 fig. [mimeographed]

Blieck, A. ed. (2004).- Groupe Français du Paléozoïque : Bulletin de Liaison n° 6 : 17 p. ; Univ. Sci. Techn. Lille, Labo. Paléont. Paléogéogr. Paléoz. (LP3) édit., Villeneuve d'Ascq [mimeographed].

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Servais, T., Blieck, A., Caridroit, M., Chen Xu, Paris, F. & Tortello, F. (2004).- L'utilité et l'utilisation du plancton et du necton dans des reconstructions paléogéographiques du Paléozoïque inférieur.- *In* : Paléogéographie (Coll. Acad. Sci. & Soc. Géol. Fr., Paris, 8-9 mars 2004). Résumés : 1 p. [abstract]

Randon, C., Blieck, A., Derycke-Khatir, C., Perri, M.C. & Spalletta, C. (2004).- Vertebrate microremains from across the Devonian-Carboniferous boundary in the Carnic Alps (northern Italy).- *In* : Richter, M. & Smith, M.M. (eds), 10th International Symposium on Early Vertebrates/Lower Vertebrates (Gramado, Brazil, 24-28 May 2004). Programme and Abstracts Volume : 27-28 ; UFRGS & Sociedade Brasileira de Paleontologia. [abstract]

Pille, L., Blieck, A. & Crônier, C. (2004).- Biodiversité des Vertébrés éodévoniens à partir de l'étude des gisements de Wihéries et de Paliseul (Belgique).- *Ann. Soc. Géol. Nord*, 2e série, **11** (3) : 121-122, 1 fig. ; Villeneuve d'Ascq [extended abstract].

CM Carlton Brett (Cincinnati)

During 2004 research on Devonian sequence stratigraphy and biofacies and bioevents proceeded on several fronts in collaboration with University of Cincinnati, graduate students Alex Bartholomew and Mike DeSantis, Gordon Baird (SUNY College at Fredonia), D. Jeffrey Over (SUNY Geneseo), and Brooks Ellwood (Louisiana State University).

STRATIGRAPHY, PALEOECOLOGY, AND UNUSUAL FAUNAS OF THE MIDDLE DEVONIAN BOYLE FORMATION IN CENTRAL KENTUCKY

Research on the stratigraphy of the Middle Devonian carbonates in Madison and Estill counties, central Kentucky has produced a refined biostratigraphic and sequence stratigraphic framework for this region (Brett et al., 2004). Conodonts from the Boyle Formation, processed by D.J. Over, confirm an early Givetian (lower *varcus* Zone) age for this unit; a series of three thin sequences traced within this formation and tentatively correlated with the upper Skaneateles-Ludlowville formations of New York State. Moreover, we have recognized a pattern of very localized changes in thickness that appears to reflect a karstic unconformity and sequence boundary beneath the overlying Portwood Member (Ohio shale). This work was fostered in part by excellent new roadcut exposures, which yielded a well preserved and unusual fauna including typical Hamilton Group taxa, such as *Eldredgeops (Phacops) rana*, together with anachronistic echinoderms, including undescribed rhombiferan and diploporan cystoids. The latter belong to a family previously thought to have become extinct in the Late Ordovician; hence the Boyle specimens present a range extension of nearly 50 million years for this family and perhaps 20 million years for the Class Diploporita. Conversely, the same beds yielded specimens of a new evolutionarily advanced spiraculate blastoid in a family otherwise known from the Mississippian. We have obtained sufficient material to fully describe the diploporan and blastoids (Dexter, Sumrall, and Brett, 2004); further study is required to investigate why this peculiar mix of archaic and advanced echinoderm taxa occurs within the Givetian of Kentucky.

SEQUENCE AND EVENT STRATIGRAPHY OF THE MIDDLE DEVONIAN PORTWOOD FORMATION: CENTRAL KENTUCKY

Further work has been extended toward correlation and sequence stratigraphy of the overlying upper Givetian (middle-upper *varcus* Zone) Portwood Formation, a dark gray to black shale and dolomicrite succession. Despite extensive dolomitization of the carbonate we have been able to identify and correlate three depositional sequences, each bounded by an erosionally-based carbonate, typically with large firmground burrow casts, marking sequence boundaries (Brett et al., 2004). We correlate these three divisions with three sequences identified recently in the Tully Formation in New York and Pennsylvania (Baird and Brett, 2003); it is particularly noteworthy that the lower two divisions have yielded rare lower Tully taxa (e.g. *Tullypothyridina venustula*, *Emmanuella* cf. *E. subumbona*), whereas the upper unit yields poorly preserved remnants of a more typically Hamilton fauna with atrypid brachiopods and rugose and tabulate corals. This pattern mirrors the distribution of faunas within the sequences of the Appalachian Basin Tully Formation (Brett et al., 2004). The Portwood also features spectacular soft-sediment deformation that we interpret as seismites generated by far-field tectonic movements associated with the third tectophase of the Acadian Orogeny.

MIDDLE DEVONIAN LATE EIFELIAN BIOEVENTS IN EASTERN NORTH AMERICA

A second project, piloted by UC PhD student Mike DeSantis, is documenting event and sequence stratigraphy and patterns of faunal change in the upper Eifelian succession of the Ohio and Ontario carbonate platform and comparing these patterns with those seen in the lower Hamilton Group (Marcellus Sub-group) in the Appalachian foreland in New York and Pennsylvania. During the late Eifelian a series rapid faunal turnovers took place that terminated a long block of faunal stability (Onondaga ecological-evolutionary subunit) and ushered in the well-known Hamilton stable block in the Appalachian Basin. Significantly, these events correlate approximately with the well known Kacak bioevents already recognized and

studied in Europe, Africa, and elsewhere. We are testing for similarity of pattern and timing of biotic turnovers in the Mid-continental carbonate platform vs. those in the Appalachian Basin.

We have identified stratigraphic sequences and events and established correlations in the previously ill-defined Delaware Formation of Ohio and Ontario and has made the first detailed correlations with the Appalachian Basin.

One of the exciting issues that has emerged from this study is possibility of discriminating a series of ash beds as regional time markers in the Middle Devonian. Mike has nearly completed sampling and analyzing K-bentonites (ash beds) from New York and Ohio to test the synchroneity of sequence stratigraphic and biostratigraphic patterns. Bentonites are being fingerprinted by analyzing patterns of trace element abundance in apatite phenocrysts using IC-PMS. This has led to the first secure event correlations between the Devonian sections in Ohio and those of the Appalachian Basin.

In 2004 Mike also completed analysis of a drill core through the study interval in central New York State. He also documented the shale petrography, faunas, gamma ray spectrometry of this core. We have also worked with Dr. Brooks Ellwood (Louisiana State University) documenting the magnetic susceptibility (MSEC) of the stratigraphic interval. Initial results suggest similar patterns to those seen in the Eifelian-Givetian boundary stratotype in Morocco. We next hope to document MSEC in drill cores of the Delaware formation in Ohio as another approach to refining correlations with Appalachian Basin. We are also working with Jeff Over to refine conodont-based correlations.

Correlations to date point to an interesting faunal pattern. A major late Eifelian extinction of a high proportion of older Columbus taxa took place at approximately the same time as the extinction of Onondaga fauna in the Appalachian Basin. However, the overlying Delaware carries a higher proportion of hold-over species than does the coeval Union Springs Formation in New York. Moreover, most elements of the unusual immigrant Old World Realm fauna found in the Union Springs Formation are absent from the Delaware Limestone. This suggests that shallower carbonate platform was less affected by the Kacak events than the deeper foreland basin. Indeed, the Delaware fauna also shows much more similarity with the younger Hamilton fauna than does the Union springs. This observation suggests that the Delaware region may represent a refugium from which major elements of the Hamilton fauna were re-established in the Appalachian foreland in earliest Givetian time.

EVOLUTIONARY PALEOECOLOGY AND SEQUENCE STRATIGRAPHY OF THE MIDDLE DEVONIAN TRAVERSE GROUP MICHIGAN BASIN.

The third project that forms the primary PhD dissertation research of UC graduate student Alexander Bartholomew. A primary purpose of this study is comparison, on a sequence-by-sequence basis, of the megafaunal associations of the Traverse Group in the Michigan with those we have recognized in the Hamilton Group in New York. The first phase of the work, now largely completed, has documented the sequence stratigraphy of the rim of the Michigan Basin and made detailed correlations with New York. During the summer of 2004 we made very important headway in correlating and establishing a sequence stratigraphic framework in the eastern part of the Michigan Basin itself. As a result of this detailed fieldwork in previously unavailable sections of strata (exposed by recent quarrying) Alex has been able to make high-resolution correlations between the classic Traverse Group succession and the framework he has previously developed in the area transitional to the Appalachian Basin. He also retrieved and has partially processed a large number of faunal samples that will permit characterization of biofacies in the constraints of a sequence stratigraphic framework. This research is a follow on to our studies of evolutionary ecology and sequence stratigraphy in the Appalachian Basin. The rich fossil assemblages of the Traverse Group are equivalent in age to those of the better-known Hamilton Group, the "type section" for the model of "coordinated stasis" that I proposed with Gordon Baird about a decade ago. We continue to test and document aspects of this pattern in the Appalachian Basin, but, to date, no one has attempted to discern similar patterns elsewhere in coeval strata. The Michigan Basin, while adjacent to the Appalachian and evidently affected by similar sea level fluctuations, was sufficiently isolated that it developed distinctive faunas and formed a separate biogeographic province. Hence, it provides a critical testing ground for the ubiquity (or not) of faunal stability and changes. Preliminary results suggest that the timing of the faunal turnover associated with the change in the Michigan Basin from the Rogers City fauna into the overlying Traverse fauna is related to the Kacak Bioevent mentioned above and coincides with the same faunal turnover in the Appalachian Basin. The upper limit of the Traverse fauna has yet to be fully established with regards to coeval strata in the Appalachian Basin.

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Bartholomew, A.J. and Brett, C.E., 2004. Gradient analysis of third-order cycles in the Middle Devonian Hamilton Group in New York State: A test of faunal recurrence. Geological Society of America Abstracts with Programs 36 (6)

DeSantis, M., Brett, C.E., and Bartholomew, A.J. 2004. Latest Eifelian –Early Givetian (Middle Devonian) succession in the subsurface

of Ontario: Correlation of sequences/bioevents between the Appalachian and Michigan Basins. Geological Society of America Abstracts with Programs 36 (6)

Dexter, T., Sumrall, C. and Brett, C.E. 2004. A new and unusual Middle Devonian echinoderm fauna from the Boyle Formation in Madison County, Kentucky that extends the range for diploporan cystoids. Geological Society of America Abstracts with Programs 36 (6)

CM Carole Burrow (Australia)

The main focus of my work is on the phylogeny, and stratigraphic and geographical distribution, of acanthodian, placoderm and early actinopterygian jawed fishes, based mainly on their microremains. In September 2003, I started collaboration with Hervé Lelièvre and Philippe Janvier (MNHN, Paris) on Early Devonian microvertebrates and fin spines from Saudi Arabia, Iran, Turkey and Bolivia, supported by an Australian Academy of Science Visiting Scientist award as well as funding from my Australian Research Council Fellowship 2002-4. I also continue to work with Sylvain Desbiens (Miguasha Natural History Museum) on the Early Devonian fish fauna of the Gaspé Peninsula, with Juozas Valiukevicius (Lithuanian Geological Institute) on the taxonomy and distribution of 'nostolepid' acanthodians, with Gavin Hanke (Royal BC Museum) on acanthodian cladistics, with John Long (Museum of Victoria) on Middle - Late Devonian acanthodians, with Gavin Young (Australian National University) on Middle Devonian acanthodians from Antarctica and Early Devonian Australian placoderms, and with Sue Turner (Queensland Museum) on gyracanthid acanthodians of the world, and on microvertebrate assemblages from Arctic Canada. I am also working independently on the Early Devonian acanthodians of western USA, and on any and all Australian (well OK, worldwide!) Devonian microvertebrate faunas which I am able to get my hands on, in the hope of improving and refining our microvertebrate-based biostratigraphic zonations.

Recent Publications of Interest

Burrow, C.J., and Young, G.C., 2005-in press. The acanthodian fauna of the Craven Peaks Beds (Early to Middle Devonian), western Queensland. Memoirs of the Queensland Museum.

Burrow, C.J., 2004. A redescription of Atopacanthus dentatus Hussakof and Bryant 1918 (Acanthodii, Ischnacanthidae). Journal of Vertebrate Paleontology, v. 24(2), p. 257-267.

Burrow, C.J., 2004. Acanthodians with dentigerous jaws: the Ischnacanthiformes and Acanthodopsis. Fossils and Strata, v. 50, p. 8-22.

Long, J.A., Burrow, C.J. and Ritchie, A., 2004. A new ischnacanthid acanthodian from the Upper Devonian Hunter Formation near Grenfell, New South Wales. Alcheringa, 28: 147-156.

Valiukevičius, J. and Burrow, C. J., 2005-in press. Diversity of tissues in acanthodians with "Nostolepis"-type histological structure. Acta Palaeontologica Polonica.

Young, G.C. and Burrow, C.J., 2004. Diplacanthid acanthodians from the Aztec Siltstone (late Middle Devonian) of southern Victoria Land, Antarctica. Fossils and Strata, v. 50, p. 23-43.

Abstracts

Desbiens, S. and Burrow, C. J., 2004. Lower Devonian fish occurrences in central Gaspé Peninsula, Québec, Canada. In: M. Richter and M. M. Smith (eds.), 10th International Symposium on Early Vertebrates/Lower Vertebrates. Gramada, Brazil, 24-28 May 2004, Programme and Abstracts, pp. 40-41.

Turner, S. and Burrow, C. J., 2004. Gyracanthids from western Gondwana. In: M. Richter and M. M. Smith (eds.), 10th International Symposium on Early Vertebrates/Lower Vertebrates. Gramada, Brazil, 24-28 May 2004, Programme and Abstracts, pp. 46-47.

CM Peter Carls (Braunschweig) and CM Ladislav Slavik (Prague)

Last year L. Slavik started a research stay at Technische Universität Braunschweig, so we launched our joint-project "Late Silurian and earliest Devonian Conodont faunas – taxonomic and biostratigraphic implications", which is supported by the Alexander von Humboldt Foundation. The main orientation is particularly on conodont biostratigraphy throughout this time-interval with special attention to the boundaries (to the Silurian/Devonian boundary especially), and, to the taxonomic revision of relevant taxa. Although the late Silurian and the earliest Devonian strata have already been correlated by means of conodonts on a global scale, we are convinced, that only a comparatively low share of existing taxa in this interval was formally distinguished and named. Recent revisions of important species have shown that current concepts of intraspecific variability were too liberal and that this has resulted in lumping of actually different taxa under the same name. Their lumping has considerably blunted the precision of taxonomy, phylogeny, and correlation – this concerns particularly the Pridoli and the so called "eosteinhornensis Zone" – just below the Devonian base. Accordingly, we study ample material from the corresponding stratigraphic levels under revised concepts, in order to improve this situation, to eliminate errors, and to progress somehow in the global correlation. We have already obtained several tens of thousands of conodonts from more than 120 heavy conodont samples from the Pozary section (the stratotype section of the Pridoli Series) in the Barrandian area (Czechia). We have submitted a publication on incipient alternating denticulation in late Ludlow Spathognathodontidae. Delotaxis elegans detorta appears already below the taxon eosteinhornensis s.s. (which needs a new generic assignment); above all it means that the current conodont zonal scale around the Silurian/Devonian boundary urgently needs revision. Conodonts from the Late Lochkovian of several Barrandian sections also provide substantial information for future

revision of the Late Lochkovian conodont zonation. We have developed an alternative method for conodont sample concentration – by means of upgrading of the magnetic susceptibility of the residues before magnetic separation.

PUBLICATIONS in 2004:

Slavík, L. (2004): A new conodont zonation of the Pragian in the Stratotype area (Barrandian, central Bohemia). – Newsletters on Stratigraphy, 40/1,2: 39-71. ISSN 0078-0421. Berlin, Stuttgart.

Slavík, L. (2004): The Pragian-Emsian conodont successions of the Barrandian area: search of an alternative to the GSSP polygnathid-based correlation concept. – Geobios, 37/4: 454-470. ISSN: 0016-6995. Elsevier Science. Lyon.

Slavík, L. & Hladil, J. (2004): Lochkovian/Pragian GSSP revisited: evidence about conodont taxa and their stratigraphic distribution. – Newsletters on Stratigraphy, 40/3: 137-153. ISSN 0078-0421. Berlin, Stuttgart.

Valenzuela-Ríos, J.I. & Slavík, L. (2004): Pragian- an enigmatic Stage. – Devonian Neritic-Pelagic Correlation and Events. International Meeting on Stratigraphy, Rabat. March 1-10 (present. 2nd March): 47-48. Oral presentations and posters Abstracts, SDS/IUGS and Institute Scientifique, University Mohamed V – Agdal, Rabat, Morocco.

Valenzuela-Ríos, J.I. & Slavík, L. (2004): ¿Existe el Praguiense (Devónico Inferior) en Europa?. – In Calonge, A.; Gozalo, R.; López Carrillo, M. D. y Pardo Alonso, M. V. (eds.). Libro de Resúmenes de las XX Jornadas de la Sociedad Española de Paleontología, October 20-23: 187-188. Alcalá de Henares. ISBN 84-8138-614-6.

CM James R. Ebert (Oneonta, New York, USA)

Sequence and event stratigraphic correlations within the Přídolían-Lochkovian Helderberg Group of New York are ongoing and have resulted in the recognition of several regionally traceable unconformities and three significant anoxic events. The lowest anoxic event occurs within the Green Vedder Member of the Manlius Formation (Přídolí). The upper events are Lochkovian (Broncks Lake Member of the Kalkberg Formation) and New Scotland Formation. Re-evaluation of correlations of the Becraft, Alsen and Port Ewen formations (Lochkovian – Pragian (?)) in the upper part of the Helderberg Group (New York) are in an early state of investigation.

Preliminary correlation of several of the sequence-bounding unconformities and anoxic events from New York to the Central Appalachian Basin (Pennsylvania, Maryland, West Virginia and Virginia) has established ties between these areas. Supported by the first occurrence of *Icriodus woschmidti* and tracing of the Bald Hill K-bentonites, it has been possible to equate several unconformities and units between New York and the Central Appalachians (Table 1).

Table 1: Preliminary Correlations of the Helderberg Group in the Eastern United States	
New York	Central Appalachian Basin (C
New Scotland Formation – dark shales and interbedded limestones, includes some K-bentonites	Mandata Shale – black shale K-bentonites near base, upper
Broncks Lake Member – Kalkberg Formation – anoxic event recorded at base	Possible correlation to lower present a separate anoxic event t CAB, carbonate phases of Bron corded in CAB
Hannacroix Member – Kalkberg Formation – includes Bald Hill K-bentonites	Corriganville Limestone – in
Punch Kill Unconformity	
Ravena/Deansboro Members – Coeymans Formation	New Creek Limestone
First *Icriodus woschmidti* - Base of Lochkovian Howe Cave Unconformity/Keyser – New Creek Unconformity	
Elmwood/Clark Reservation/Jamesville members – Manlius Formation	LaVale Member - Keyser For
Olney/Dayville Members – Manlius Formation	Jersey Shore Member - Keyse
Terrace Mountain Unconformity	Glauconitic Sandstone
Green Vedder Member – Manlius Formation	Big Mountain Shale
Clockville Discontinuity	Pyritic/phosphatic hardground
Thacher Member – Manlius Formation	Byers Island Member/Lower I
Minelot Falls Unconformity	Tonoloway-Keyser Unconform
Rondout Formation	Tonoloway Formation

Recent Publications:

Bishuk, D., Hairabedian, J. and Ebert, J.R., 2003, Coastal Margin Interfluve Paleosols and their Stratigraphic Relationships with Tidally-Influenced Deltaic Deposits in the Sonyea Group (Frasnian) of Northwestern Delaware County, New York: New York State Geological Association Field Trip Guidebook, 75th Annual Meeting, p. 55-101.

Ebert, J.R. and Matteson, D.K., 2005, Preliminary Sequence and Event Stratigraphic Correlations within The Helderberg Group (Silurian – Devonian) between New York and the Central Appalachian Basin: in press, will be presented at the meeting of the Northeastern Section of the Geological Society of America in March, 2005

Ebert, J. R. and Matteson, D. K., 2003, Grabau's "Transition Beds" – Key Elements in a Radical Revision of Helderberg Stratigraphy, New York State Geological Association Field Trip Guidebook, 75th Annual Meeting, p. 213-237.

Ebert, J.R. and Matteson, D.K., 2003, Distal Stratigraphic Effects of the Laurentia - Avalon Collision: a Record of Early Acadian (Přídolí-Lochkovian) Tectonism in the Helderberg Group of New York State, USA: Courier Forschungsinstitut Senckenberg, v. 242, p. 157-167, Frankfurt a.M.

Ver Straeten, C., Ebert, J.R., Bartholomew, A., Shaw, G.H., Benedict, L.J., Matteson, D.K, 2005, Devonian stratigraphy and K-bentonites in the Cherry Valley – Schoharie Valley Region: Field Trip Guidebook for Northeast GSA Conference, Saratoga Springs, New York, 58p.

TM Ahmed EL HASSANI (Rabat)

Research:

My research tasks were concentrated this year on the organization of the SDS Annual Meeting in Rabat with field trip in the Dra Valley. In addition, my field investigations were in the Anti Atlas (Dra Valley and Tafilalt) and the north western Moroccan Meseta (Central Morocco: Azrou area, Oulmes and Tiflet area) with the following topics: Devonian stratigraphy, sedimentology and magnetostratigraphy.

National program:

Continuation of investigations with my Ph.D students:

* *Rehamna* : Fouad EL KAMEL has defended his Ph.D in January 2002 at Casablanca University, on the following topic: Sédimentologie, magmatisme pré-orogénique et structuration du Paléozoïque des Rehamna et d'Oulad Abbou (Meseta occidentale, Maroc). This important work is now published in the Notes et Mémoires du Service Géologique of Morocco.

In the carbonated platform of Upper Emsian to Givetian age, the reef edification is previous to, and contemporaneous with, a tilted block tectonic that has favored the bioconstruction in its upper part. The tectonic expression is illustrated by several instability marks, such as tension faults, progressive unconformity and the resulting landslide, observed in both the reef development zone and the external platform.

* *Tiflet*: A Ph.D on The Devonian sedimentology continued this year in the Tiflet and Oulmes area. (Mr. Abdelkader RAZOUANI). This program is in cooperation with Prof. Thomas BECKER (University of Munster) under research collaboration.

* *Eastern Anti Atlas*: Mr. Youssef RADDI is continuing his Ph-D on the following topic: Late Devonian Formations: sedimentary environment, water resources and porosity.

SDS Meeting

Organization of the SDS Morocco Meeting (1-10 March, 2004). The annual meeting of the SDS "Devonian neritic–pelagic correlation and events" in combination with the IGCP 499 "Devonian land-sea interaction: evolution of ecosystems and climate : DEVEC" , was organized by the Institut Scientifique de l'Université Mohammed V, Agdal under the guidance of TM Ahmed EL HASSANI , with the help of CM Mohamed Bensaid, CM Elmostafa Benfrika and Mohamed Saghi (Director of the Institut Scientifique. The meting included an extended field trip to Devonian key sections in the Dra Valley.

24 oral presentations on Devonian matters including e.g., biostratigraphy, palaeontology, events, and chemostratigraphy were given during the first two days of the meeting in Rabat. Additionally, 20 posters have been presented touching similar topics. 60 participants from various countries attended the technical part of the meeting.

During the technical part of the meeting the just accepted IGCP Project 499 was introduced for the first time. Additionally, a brief overview about other new IGCP projects showing some relations to IGCP 499 was also given (e.g., IGCP projects 491, 497, and 503).

We put together a volume summarizing the abstracts of the oral presentations and posters on 87 pages (entitled: Devonian neritic–pelagic correlation and events).

The successful field trip was the result of a fruitful cooperation between Institut Scientfique and the German Groups of the Senckenberg Institute Frankfurt (G. Plodowski, E. Schindler, U. Jansen, P. Königshof) and the Paleontological Institute of Munster (T. Becker, S. Aboussalam, V. Ebbighausen, J. Bockwinkel). The Success was also due to the big cooperation of the Governor of Assa, the Military base of Tata. The 10 contributions to the sections of the fieldtrip (+ intruductory remarks and an overview article) that had been prepared as a pre-print guidebook for the trip have inbetween been published as a separate volume [El Hassani, A. (ed.): Devonian neritic-pelagic correlation and events in the Dra Valley. – Documents de l'Institut Scientifique, vol. 19, 2004.]. This guide book was electronically published on the Institut Scientifique Website (see references).

Field Work (2003-2004):

Our important investigations in Western Anti Atlas in co-operation and coordination with colleagues from the University of Munster (Prof. Thomas BECKER):

1. Stratigraphy & paleontology of several sections in the Area of Torkoz, Assa (Boutserfine and Jbel Tazout) and South of Tata (Oued Mzerreb, Oufrane).

2. Investigation in the area of Oulmès: Souk Jema and Moulay Hassane sections (Central Western Meseta)

3. Investigations in the Tafilalt area in collaboration with Jean-Georges CASIER (Ostracods) from the Natural Sciences Museum of Brussels and Prof. Alain PREAT (Sedimentology) from the Université Libre de Bruxelles.

Important investigations for the Magnetostratigraphy in cooperation with Prof. Brooks ELLWOOD (University of Louisiana) and Prof. Rex CRICK (University of Texas at Arlington). New results on shocked quartz at several Devonian boundaries in relation with mass extinction events. Our work is focused mainly in the Tafilalet, but we shifted this year in the Meseta (area of Azrou) within Visean/serpoukhouvian boundary.

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EL HASSANI, A. – Introduction to the fieldtrip. *Doc. Inst. Sci. Rabat*, 19, pp: 1-2

BECKER, R. T., ABOUSSALAM, Z. S., BOCKWINKEL, J., EBBIGHAUSEN, V., EL HASSANI, A. & NÜBEL, H. - The Givetian and Frasnian at Oued Mzerreb (Tata region, eastern Dra Valley). *Doc. Inst. Sci. Rabat*, 19, pp : 29-43.

EBBIGHAUSEN, V., BOCKWINKEL, J., BECKER, R. T., ABOUSSALAM, Z. S., BULTYNCK, P., EL HASSANI, A. & NÜBEL, H. - Late Emsian and Eifelian stratigraphy at Oufrane (Tata region, eastern Dra Valley, Morocco). *Doc. Inst. Sci. Rabat*, 19, pp : 44-52.

KAISER, S., BECKER, R. T., BRICE, D., NICOLLIN, J.-P., LEGRAND-BLAIN, M., ABOUSSALAM, Z. S., EL HASSANI, A. & NÜBEL, H. - Sedimentary succession and neritic faunas around the Devonian-Carboniferous boundary at Kheneg Lakahal south of Assa (Dra Valley, SW Morocco). *Doc. Inst. Sci. Rabat*, 19, pp : 69-74.

BECKER, R. T., ABOUSSALAM, Z. S., BOCKWINKEL, J., EBBIGHAUSEN, V., EL HASSANI, A. & NÜBEL, H. - Upper Emsian stratigraphy at Rich Tamelougou near Torkoz (SW Dra Valley, Morocco). *Doc. Inst. Sci. Rabat*, 19, pp : 85-89.

BECKER, R.T, BOCKWINKEL, J., EBBIGHAUSEN, V., ABOUSSALAM, Z.S., EL HASSANI, A. & NÜBEL, H. - Lower and Middle Devonian stratigraphy and faunas at Bou Tserfine near Assa (Dra Valley, SW Morocco). *Doc. Inst. Sci. Rabat*, 19, pp : 90-100.

ELLWOOD, B. B., BENOIST, S.L., EL HASSANI, A., WHEELER, C, and CRICK, R. (2003) : Impact Ejecta Layer from the Mid-Devonian: Possible Connection to Global Mass Extinctions, *Science* (Jun 13th 2003) Vol:300 (N°:5626) : pp:1734-1737.

EL HASSANI A.; TAHIRI A. & WALLISER O.H. (2003).- The Variscan Crust between Gondwana and Laurasia. *15th International Senckenberg Conference*, Frankfurt, Cour. Forsch. Senckenberg , 242, pp:81-87.

CM Ulrich Jansen, Frankfurt am Main

Research

Research in 2003 and 2004 concentrated on Upper Silurian to Frasnian brachiopods from the Rheinisches Schiefergebirge, the Dra Valley (S Morocco), and the Western Sahara. All activities were part of Senckenberg research programs, partly in cooperation with other institutions.

In the Rheinisches Schiefergebirge, detailed Pridolian to Eifelian brachiopod biostratigraphies have been worked out. New collections of exactly horizonted materials give new insights in the distribution of index brachiopods. A first biostratigraphy is based on total ranges and overlapping of spiriferids, a second one is based on brachiopod assemblages. The brachiopod zones can partly be traced into other Devonian successions of Europe and North Africa. More than 90 stratigraphically relevant brachiopod taxa are currently revised, often on the base of type materials. This work shall be finished until the end of 2005. In cooperation with Senckenberg colleagues, two papers on Devonian sections along a new gas pipeline in the Eifel Hills could be published.

The Senckenberg group including myself was much involved in the preparation and guidance of the SDS Morocco field trip in 2004. In the Dra Valley previous brachiopod work has been supplemented by more detailed investigation of the faunas from the Mdâouer-el-Kbîr Formation (upper Lower Emsian to lower Upper Emsian). Oral presentations on neritic-pelagic correlation in the Lower Devonian of Europe and North Africa were given at the SDS meeting in Rabat and the meeting of the German Palaeontological Society in Göttingen.

A new colleague, Mena Schemm-Gregory from the University of Marburg, finished a diploma thesis on spiriferids from the Emsquarzit Formation in 2004 (Upper Emsian, Rheinisches Schiefergebirge). After that, we studied together Givetian to Frasnian brachiopods from reef-related strata in the Western Sahara, a manuscript is shortly before submission. Mena is now starting a Ph.D. study on the phylogeny of spiriferid brachiopods.

Finally, we have begun a cooperation with Chen Xiuqin (Academia Sinica, Nanjing) on Devonian brachiopods from Europe and China – it will be intensified in 2005-2006 with field work and institute visits thanks to support by the German Academic Exchange Service (DAAD) and the China Scholarship Council.

Finally, I am especially interested to find a good reference section for the Lower/Upper Emsian boundary in the classic type region of the Emsian. With respect to this, field work is planned for 2005.

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CM SEMEN A. KRUCHEK (MINSK, BELARUS)

In recent years Dr. Kruchek together with colleagues (CM Dr. T.G. Obukhovskaya, Dr. V.I. Pushkin, Prof. E.A. Vysotsky et al.) have been engaged in studies of different aspects of Devonian deposits in the western regions of the East European Platform (stratigraphy, palaeontology, lithology, palaeogeography, mineral resources, etc.). Results of these studies were reported at various conferences (15th International Senckenberg Conference – 2001, Frankfurt am Main, Germany; The Fifth Baltic Stratigraphical Conference, 2002, Vilnus, Lithuania; The International Symposium "Geology of the Devonian System, 2002, Syktyvkar, Russia; The Gross Symposium 2, 2003, Riga, Latvia, etc) (see list of papers). As a Chief of the Stratigraphic Commision of Belarus he was an organizer of the scientific conference "Stratigraphy and palaeontology of geological formations of Belarus (2003) commemorating the 100th anniversary of A.V. Fursenko, who made a major contribution to the study of stratigraphy and palaeontology (brachiopods) of Devonian deposits in the Pripyat Trough (Belarus). At present Dr. Kruchek together with his colleagues is involved in preparation for publishing of the new improved "Stratigraphic chart of Devonian deposits of Belarus". New results of investigations into the Devonian stratigraphy are expected to be reported at the 6th Baltic Stratigraphical Conference in St. Petersburg and the SDS and IGCP 499 Symposium (DECONS) in Novosibirsk.

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CM Elga Mark-Kurik (Tallin, Estonia)

Some papers already indicated in the References of the SDS Newletter # 20 are published now. Two papers concern early arthrodires of wide distribution. Recent (but still preliminary) study of the Early Devonian fishes from Tajikistan together with Lithuanian colleagues Vytautas Leleshus (Dushanbe) and Valentina Karatajute-Talimaa (Vilnius) has shown that buchanosteids and perhaps also homostiid *Tityosteus* occur in Pamir mountains. Information on the Tajikistan fish finds will be presented as an extended abstract of talks on the IGCP 491 meeting in August in St. Petersburg, Russia.

It is worth to mention that in the paper on obrucheviids, the gigantic and curious Late Devonian psammosteid heterostracans, photos of complete branchial plates of *Obruchevia heckeri* (Obruchev, 1936) will be published for the first time. Oleg Lebedev (Moscow) kindly sent them to the autors. The Canadian obrucheviid represents a new taxon, *Perscheia pulla* (its bones, large and massive are quite black, whereas those of *Obruchevia* from NW Russia are almost white). The authors of above paper hope to continue cooperation on the Canadian Arctic specimens and correlation problems.

New information is given in the paper on the sensory system of psammosteids (it will be published soon). Psammosteid lateral lines were mainly in tubes below ornament. However, in some cases they were held in open surface grooves.

The Geological Survey of Estonia has published in its Bulletins detailed descriptions of a number of deep drill cores of Estonia. In the Bulletin # 6 Mehikoorma core (SE Estonia) will be described. J. Valiukevicius and E. M.-K. will characterize range of Devonian fossils, including largely fishes and miospores (in cores acanthodian scales are the most common fish fossils).

Mark-Kurik, E. 2004. Buchanosteids (Placodermi, Arthrodira) from Central Asia. In: Arratia, G., Wilson, M. V. H. & Cloutier, R. (eds.).

Recent Advances in the Origin and Early Radiation of Vertebrates. Verlag Dr. Friedrich Pfeil, München: 431-438.

Mark-Kurik, E. & Carls, P. 2004. *Tityosteus*, a marine fish (Arthrodira, Homostiidae) from the Emsian of Aragón, Spain, and its distribution. Revista Española de Paleontología, **19**(2): 139-144.

Elliott, D. K., Mark-Kurik, E. & Daeschler, E. B. 2004. A revision of *Obruchevia* (Psammosteida: Heterostraci) and a description of a new obrucheviid from the Late Devonian of the Canadian Arctic. Acta Universitatis Latviensis. Earth and Environmental Sciences, **679**: 22-45.

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TM John B. Richardson (London)

Silurian – Lower Devonian (England & Wales)

Lower Devonian of the Anglo-Welsh Basin

Edwards, D. & Richardson, J.B. 2004. Silurian and Lower Devonian Plant Assemblages from the Anglo-Welsh Basin: a Palaeobotanical and Palynological Synthesis. *Geological Journal* 39, 375-402

Work continues on the study of spore assemblages and subdivision, and correlation, of Lochkovian-Breconian strata from the Anglo-Welsh Basin with the object of refining the current zonation.

Upper Famennian (NYS Pa)

Research on an Upper Devonian (Strunian) Event in Pennsylvania continues with sedimentologists and stratigraphers in the U.S.A. Additional material was collected from new Pennsylvania sections last May, and palynologically examined. This confirmed previous studies of the stratigraphical age. Recent work has involved tracing stratal equivalents of the event into previously studied sequences in mid Pa and western NYS & Pa. Attempts are being made to establish whether the Strunian event was due to a bolide impact, a giant mudslide or, glaciation.

Richardson, J.B., Woodrow, D. & Sevon, W. 2002 Palynological evidence for dating a Late Famennian Event in northern U.S.A.: Extraterrestrial or meteorological? First International Palaeontological Congress, Abstracts, 68, 137.

All the Upper Famennian (Strunian) samples collected between 1965 –2005 from New York State and Pennsylvania have been studied and most subjected to detailed palynological analyses. The ranges of miospore species ascertained in a joint study with Dr. V. Avkhimovich (formerly BelNIGRI Research Institute, Minsk). There is evidence that some assemblages previously thought to be distinct (Richardson & Ahmed 1988) are strongly influenced by facies and probably overlap. Precise correlation of certain sections in Continental Facies is difficult and variations in assemblages result probably mainly from provenance, ecology and sedimentation. A fact previously remarked on by *inter alia* Maurice Streel in his studies of the Famennian from other areas and Streel and myself from the Middle Devonian.

This North American data is now being prepared for publication.

Studies of the *Vallatisporites pusillites* morphon with Dr. V. Avkhimovich. The variation of the morphon was studied in assemblages from western NYS and Pa and the studies showed 16 intergrading variants (morphs) of the genus *Vallatisporites* showing differing similarities to *V. pusillites* originally described from Byelorussia by Kedo 1957 but the New York State and Pennsylvanian sequences show material over a much thicker sequence of upper Famennian deposits.

TM Susan Turner (Queensland)

AUSTRALIAN DEVONIAN FISH RESEARCH IN PROGRESS

Dr Kate TRINAJSTIC is working in the Department of Geology and Geophysics, University of Western Australia with Dr Annette George (UWA) and Dr Nancy Chow (University of Manitoba. engaged in platform to basin correlation in the Canning Basin and Leonard Shelf. This research involves an integrated approach using palaeontology, sedimentology, facies analyses and isotope geochemistry. In the platform deposits microvertebrates are the only age indicators and have confirmed the proposed date of Frasnian for the whole unit. There had been some uncertainty as to the presence of Givetian rocks in the lower part of the section. In addition she is looking at Canning Basin conodonts. There are a number of old residue samples from the Geological Survey that contain numerous fish remains that will help to refine the fish zones for the area. As noted earlier by Turner (e.g. 1993) there are many shark teeth, which we hope to tie in with the work done by Drs Ginter and Ivanov. The presence of thelodont scales and phoebodont shark teeth in some samples is allowing correlation of shallower facies with deeper continental shelf deposits.

Recent Papers:

George, A. D., Chow, N. and Trinajstic, K. M. (submitted WABS 3: 22.2.02) Integrated approach to platform-basin correlation and deciphering the evolution of Devonian reefs, northern Canning Basin, Western Australia. In Purcell, P.G. & Purcell, R. R. (eds) Pro-

ceedings of the West Australian Basins Symposium 3. Petroleum Exploration Society of Australia, Perth p 39.

Collaboration between Dr Carole BURROW CM and Sylvain Desbiens (Migusha) on the Lower Devonian of the Gaspé peninsula mirrors work by Drs Sue Turner and Randall Miller across the Restigouche River in northern New Brunswick on the Campbellton section. New shark material is being described (e.g. Miller et al. 2003). Revision of the Lower Devonian geology of these sections will help with correlation to northern Europe especially the Midland Valley of Scotland and as far as Roumania. Comparison of the fish and eurypterid faunas as well as floras is underway and new radiometric dating has also been carried out and so the relationship of these Emsian biotas should be clarified.

Dr Sue TURNER (TM) is also working with Prof. Dale Sparling on a series of sections from Ohio to refine the Eifelian to Givetian shark biozonation in relation to conodont data that Dale has published. Studies of the relationship of shark taxa to the Taghanic Event will allow definition of zones. With Wang S-T she is working on a Late Devonian fauna from Guangdong Province. Work with Jillian Garvey (La Trobe Univ.) on the fish microfauna of the Devil's Plain Formation, Mansfield, Victoria does not rule out the possibility that these red beds might be latest Devonian in age.

Other news

Ian MACADIE is working in New Zealand on new fish faunas from the Lower Devonian Reefton Beds.

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CM Chuck Ver Straeten, New York State Museum

A large focus on my work over the last couple years has been on Devonian K-bentonites. The project has been working in a few directions: 1) to document Lochkovian to Eifelian K-bentonites across the Appalachian Basin; and 2) to explore what the K-bentonites might tell us about volcanism on the eastern margin of North America during the Lochkovian to Eifelian. These have both led to questions about the preservation potential of volcanic ash layers in depositional environments. This "stratinomic" study, examining the various physical, biological and chemical processes that could contribute to the preservation, modification, or destruction of a primary volcanic ash layer, is similar to taphonomic studies on fossils. Recently I've started to explore more recent volcanic ash deposits, for indications of post-depositional processes and biases.

As a part of the K-bentonite study I have become research advisor to a M.S./Ph.D. candidate from the State University of New York-Albany, Lucas Benedict. Last fall he defended his Master's thesis, entitled "Complexity of Devonian K-bentonites in the Appalachian foreland basin: Geochemical and physical evidence supporting multi-layered K-bentonite horizons". His Ph.D. will look at more Devonian K-bentonites, and younger (Cenozoic) ash beds.

I have also started work to establish correlations between Givetian to lower Frasnian terrestrial and marine rocks in the

classic New York succession. At present I am taking two approaches: searching for any distinctive small- to large-scale markers of time significance through the terrestrial succession; and working with two paleobotanists, Drs. Paul Strother and John Beck of Boston College, in part to establish a palynostratigraphic framework for the strata in the Catskill Mountain front.

I am finally finishing up a large synthesis paper on the Emsian to Eifelian of the Appalachian Basin (Eastern United States), with a basinwide Pragian to Eifelian sequence stratigraphy.

Two years ago I began a search for Emsian conodonts useful for correlation outside of the Appalachian Basin. The New York successions over the years did not yield any useful forms for international correlation. So, based on the new basin-wide, high resolution correlations of Emsian strata, I collected large samples of argillaceous limestones from deeper water facies toward the basin center (Pennsylvania). I've begun to process some of the samples, but so far I've only found icriodids – no polygnathids yet.

Recent publications:

Ver Straeten, C.A., Ebert, J.R., Bartholomew, A., Benedict, L.J., Matteson, D.K., and Shaw, G.H., in press, Devonian stratigraphy and K-bentonites in the Cherry Valley – Schoharie Valley region: Field trip guide for the Northeastern Section meeting of the Geological Society of America, March 2005.

Ver Straeten, C.A., 2004, Sprout Brook K-bentonites: New interval of Devonian (Early Emsian?) K-bentonites in eastern North America: Northeastern Geology and Environmental Science, vol. 26, p. 298-305.

Ver Straeten, C.A., 2004, K-bentonites, Volcanic Ash Preservation, and Implications for Lower to Middle Devonian Volcanism in the Acadian Orogen, Eastern North America: Geological Society of America Bulletin, v. 116, p. 474-489.

Sageman, B.B., Murphy, A.E., Werne, J.P., Ver Straeten, C.A., Hollander, D.J., and Lyons, T.W., 2003, A tale of shales: The relative roles of production, decomposition, and dilution in the accumulation of organic-rich strata, Middle-Upper Devonian, Appalachian basin, Chemical Geology, v. 195, p. 229-273.

Recent Abstracts:

Ver Straeten, C.A., 2005, Volcanic Ash Preservation/Stratinomy in Marine and Lacustrine Settings: Biases of Processes and Scale: Accepted for theme session "Bentonites is the Geological Record", Northeastern Geological Society of America Meeting, March 2005.

Benedict, L. J., and Ver Straeten, C.A., 2005, Geochemical and physical evidence indicating complex depositional and eruptive histories for Devonian K-bentonites of the Appalachian foreland basin: Accepted for theme session "Bentonites is the Geological Record", Northeastern Geological Society of America Meeting, March 2005.

Beck, J.H., Ver Straeten, C.A., and Strother, P.K., 2005, Palynofacies analysis and biostratigraphic correlation across the Devonian Catskill Front: accepted for the Northeastern Geological Society of America Meeting, March 2005.

Ver Straeten, C.A., 2004, Volcanic Ash Bed Formation and Condensation Processes: An Examination from Devonian Stratigraphic Sequences: Geological Society of America, Abstracts with Programs Vol. 36, No. 5, p. 98.

Ver Straeten, C.A., 2004, Volcanic Ash Layers in Shallow Marine Settings: Post-Depositional Processes and Preservation Potential: abstract accepted for 32nd International Geological Congress (International Union of Geological Sciences), Theme session G-21.12, Sedimentology of Volcanoclastic Sediments, Florence, Italy, August 2004.

Ver Straeten, C.A., 2004, The Emsian of the Appalachian Basin (Eastern United States): Data Pertinent to Subdivision of the Emsian Stage: abstract accepted for 32nd International Geological Congress (International Union of Geological Sciences), Theme session G-22.03 High-resolution stratigraphy for the subdivision of the Devonian stages, Florence, Italy, August 2004.

Ver Straeten, C.A., 2003, Volcanic Ash Bed Preservation in Epicontinental Seas/Foreland Basins: Geological Society of America, Abstracts With Programs, v. 35, no. 7, p. 601.

Ver Straeten, C.A. 2003, Devonian K-Bentonites, Appalachian Foreland Basin: A Reliable Proxy for Acadian Volcanism?: Abstract accepted for symposium, "Evolution of the East Laurentia Continental Margin, Eastern USA-Canada: From Late Proterozoic Rifting to Devonian Collisions," at Northeastern Section of the Geological Society of America Meeting, March 2003, Halifax, Nova Scotia. Geological Society of America, Abstracts With Programs, v. 35, no. 3, p.

TM K. Weddige (Frankfurt)

Devonian Correlation Table (DCT), Supplements 2003 and 2004

Further annual supplements of the Devonian Correlation Table (DCT) have been published in the periodic journal Senckenbergiana lethaea.

The 2003 issue includes DCT-columns on global trilobite occurrences and on the regional stratigraphies of the Hartz Mountains, Germany. For the first time, an attempt has been made to document recent (still hypothetical) m. y. calibrations and proportion estimations of conodont zone intervals by graphs within the DCT-column system. The graphs reflect so-called "zoom factors" each of which is indicating how much a conodont zone has been stretched or shrinked by the cited calibration in relation to the zone interval in the DCT. Moreover, annotations about absolute time proportions (Weddige

2003) require an empirically compiling of elementary data on proportions of stratigraphic time units, for the future – in order to approximate iteratively to correctly proportioned time-linear chronologies (compare also Weddige 2001). It is proposed to standardize empiric proportion data by the DCT system and its centimetre time-ruler so that they could be demonstrated for synoptic comparisons by matrix tables.

The 2004 issue includes DCT-columns on latest, but also historical, zonations of conodonts, ammonoids, plant megafossils, spores and chitinozoans, and on regional stratigraphies of the Czech Republic and of the Ardennes.

On the whole, the DCT has reached now an amount of 545 DCT-columns resp. a volume of about 180 printed pages, without the consideration of the separately published annotations. The total index of all hitherto published DCT-columns and the columns themselves are electronically available via Internet under http://www.senckenberg.de/publ/. On the other hand, there are still reprints and CDs available. Thus, please, do not hesitate to ask for, via karsten.weddige@senckenberg.de

References

Weddige, K. (2001): The absolute time proportioning of biochrons as a project of current interest. – SDS Newsletters, 17 (for 2000): 67-68; Arlington, Texas (R.E. Crick, Dep. Geology, Univ.).

Weddige, K. (2003): Anmerkungen zur Devon-Korrelationstabelle: absolutzeitliche Proportionen. – Senckenbergiana lethaea, 83 (1/2): 205-211, 9 tabs; Frankfurt am Main.

Weddige, K. [Ed.] (2003): Devonian Correlation Table. Supplements 2003, compiled by I. Chlupac, P. Buchholz, H. Hüneke, F.W. Luppold, G. Schraut, K. Weddige & H. Weller. – Senckenbergiana lethaea, 83 (1/2): 213-234, 59 Tab.-columns; Frankfurt am Main.

Weddige, K. [Ed.]: Devonian Correlation Table. Supplements 2004, compiled by R. Brocke, K. Weddige, H. Weller & V. Wilde. – Senckenbergiana lethaea, 84 (1/2): 385-415, 85 Tab.-columns; Frankfurt am Main.

Contra Ruth Mawson's critizising Bardashev, Weddige & Ziegler 2002, e.g. in SDS Newsletters 20 (2004)

Dear Colleagues,

In agreement with the senior author, I would like to express that the initiative by Ruth´s letter resp. the paper of MAWSON & TALENT (2003) is appreciated because it is the first serious feed-back within the working on Emsian stratigraphy and conodont taxonomy. To initiate such "repercussions" [Ruth] was one of my motives, too, to participate in a publication of Igor´s ideas that actually could be regarded as an ingenious, impressively comprehensive, and forseeably controversial form-taxonomical analysis and synthesis of the early polygnathid forms. Because of its broad database of forms it is predominantly a study on the morphologies and less on the stratigraphic references.

That there could be indeed a demand for a morphological subdivision of the genus *Polygnathus* may demonstrate my conodont taxa register, which counts – as the top seven – the following amounts of taxa (species or subspecies, = mainly form-taxa) per genus: 545 *Polygnathus*, 263 *Gondolella* or *…gondolella*, 241 *Ozarkodina*, 199 *Palmatolepis*, 163 *Icriodus*, 160 *Hindeodella*, 117 *Gnathodus*.

The genus subdivision proposed by BARDASHEV, WEDDIGE & ZIEGLER (2002) might be regarded as a subgeneric subdivision. In form-taxonomy, however, and the paper represents a pure form-taxonomic study, subgenera are not in usage. Because of the pure form-taxonomy, moreover, resp. because of a more or less subgeneric level of the proposed subdivision, a multielement reference, e. g. by suspect statistics, is not needed, for the first. Thus, a distinctive serious discussion has to focus on (form-) taxonomic characters, i. e. the valuation and order of the diagnostic characters as they are used for the generic subdivision by BARDASHEV et al.. Admittedly, a broadly splitted form spectrum, often including revolutionary ideas, is a hard diet. On the other hand, a well known unchanged form spectrum is a usual and therefore easy diet that, moreover, becomes much easier to digest when the spectrum, or parts of it, is furthermore lumped. The differentiation in "splitters" and "lumpers" is an inadequate simplification -- since the study by BARDASHEV et al. is not only a splitting because of different new taxa, it has rather more the character of a synthesis because of its search for phylogenetic lines by which single species were "lumped"). Thus, the study is a lumping on a quality level, higher than a taxonomic lumping that resigns to differentiate and searches for a conservative comfortable easy diet. Conservatives bloc progress, that is their job – and it would be a total misunderstanding that a SDS commission or a Working Party is entitled to condemn per joint decision (that could not be the target of a discussion!).

Nearly the same concerns "the dramatic increase in the number of zones" [Ruth; MAWSON &TALENT 2003]: the finer the analyses of guide fossils like the polygnathids the more data have to be "lumped" resp. synthesised within new zones (what, besides, is not the main topic of the paper). It is self-evident that the proposal of new zonations is correlated with an increase of regionality/provincialism – as it is the same with the GSSPs of substages, which could not be applied globally anymore like the stage GSSPs (more or less)! The new zonations are clearly correlated with the conservative "global" (not to say "standard") zonation demonstrated in fig. 17 of BARDASHEV et al. (2002) and are thus examinable. They mostly reflect phylogenetic lines ("trends" in fig. 17), and thus each zonation represents, in major parts at least, in details a phylogenetic continuum concept (= 'autochronology') better than the global zonation. Critical comments therefore have to focus on zones the stratigraphic order of which could have been confused by BARDASHEV et al..

As to Ruth's circular, I have my problems with the "… until …" in the sentence "… division of the Emsian into two substage and to suggest names for possible substages and to suggest names for possible substages until the conodont zones

for the Emsian are stabilized.": The substage definition actually does not depend on the stabilization of the conodont zones because each fossil group could propose one form as a boundary index. And a so defined substage should be named after the local name of the defining GSSP, according to my opinion and my previous proposal (in SDS Newletters).

As to MAWSON & TALENT (2003), I have my problems with the logic correlation "… Some authors as they grow older become taxonomic splitters … " (and with this style in a serious publication). As it is demonstrated above, BARDASHEV et al. are actually rather more (synthesizing) lumpers than splitters -- and thus could not be regarded as senile!

Apropos serious publication: for papers and comments on the discussion around the topic, with competent arguments, will find space in our journal 'Senckenbergiana lethaea' in form of a regular publication (after peer review, e.g. by Ruth or John, I hope).

As to the references, the correct and complete citations are:

BARDASHEV, I.A., WEDDIGE, K., & ZIEGLER, W. (2002): The Phylomorphogenesis of some Early Devonian Platform Conodonts. – In: K. WEDDIGE & W. ZIEGLER † [Eds], Advances in Conodont, Devonian and Carboniferous Research. – Senckenbergiana lethaea, **82** (2): 375-451, 17 text-figs; Frankfurt am Main. *[Please, note: not " ... **poly**morphogenesis ..." what might have been a Freudian slip by Ruth and John: Polymorphology is actually the work of splitters!]*

BARDASHEV, I.A. & WEDDIGE, K. (2003): The invalid genus name *Costapolygnathus* BARDASHEV, WEDDIGE & ZIEGLER 2002 and the new conodont genus *Eucostapolygnathus*. – Senckenbergiana lethaea, **83** (1/2): 1-2; Frankfurt am Main.

There are still reprints of both papers available -- so, please, do not hesitate to ask for via my new e-mail address: karsten.weddige@senckenberg.de

With best regards

Karsten Weddige

TM E. Yolkin (Novosibirsk)

This is my first information for the SDS Newsletter after its issue 18, 2000. Since that time I had worked together with colleagues from my team on: (1) subsurface Paleozoic of the West Siberian Lowland (stratigraphy, paleontology, facies zonation, paleogeography) (2) Devonian stratigraphy of the Altai-Sayan Folded Area (Altai, Salair, Kuznetsk Basin) and (3) Devonian conodonts and trilobites. The list of publications see below.

Alekseenko A.A., Yolkin E.A. (2002): Predstaviteli semeistva Synphoriidae Delo iz emsa (nizhnii devon) Gornogo Altaya, Zapadnaya Sibir' // Novosti paleontologii i stratigrafii, 5: 113-121. Prilozhenie k zhurnalu Geologiya i geofizika, 43. [News of Paleontology and Stratigraphy, Supplement to Russian Geology and Geophysics, 5: 113-121]

Bakharev N.K., Sennikov N.V., Yolkin E.A., Izokh N.G., Alekseenko A.A., Obut O.T., Rodina O.A., Saraev S.V., Baturina T.P., Kipriyanova T.P., Timokhina I.G., Yazikov A.Yu. (2004): [Nauch. red. E.A. Yolkin]. Klyuchevye razrezy devona Rudnogo Altaya, Salaira i Kuzbassa. Novosibirsk: Izd-vo SO RAN: 104 p.

Izokh N.G. & Yolkin E. A. (2004): The Devonian of West Siberia // In: Reiner J., Reich M. & Schmidt G. (Eds.). Geobiology. 74 annual meeting of the Paläontologische Gesellschaft, October 02-08. 2004, Göttingen. Abstracts of talks and posters. Universitatasdrucke Göttingen: 117-118.

Kipriyanova T.P., Kipriyanov A.A.Jr., Yolkina V.N., Yolkin E.A. (2002): Experience in application of data analysis methods (FOREL and KRAB) in paleobiogeography // Brock G.A. & Talent J.A. (eds). First International Palaeontological Congress (IPC 2002). Geological Society of Australia, 6-10 July, 2002, Macquarie University, N.S.W., Australia. Abstracts, 68: 90.

Wang Chengyan, Ziegler W., Minjin Ch., Sersmaa G., Munchtsetseg J., Gereltsetseg L., I(zokh) Nadya. (2003): The first discovery of the earliest Devonian conodont zonal fossil from the "Gavuu Member" in Mushgai Area of South Gobi, Mongolia // Journal of geoscientific research in Northeast Asia, 6(1): 14-20.

Yolkin E.A., Krasnov V.I., Bakharev N.K., Belova E.V., Dubatolov V.N., Izokh N.G., Klets A.G., Kontorovich A.E., Peregoedov L.G., Sennikov N.V., Timokhina I.G., Khromykh V.G. (2001): Stratigrafiya neftegazonosnykh basseinov Sibiri. Paleozoy Zapadnoy Sibiri. Novosibirsk: Izdatel'stvo SO RAN, filial "GEO": 163 p.

Yolkin E.A. (2002): Professor Willi Ziegler // Novosti paleontologii i stratigrafii, 5: 161-163. Prilozhenie k zhurnalu Geologiya i geofizika, 43. [News of Paleontology and Stratigraphy, Supplement to Russian Geology and Geophysics, 5: 161-163]

Yolkin E.A., Bakharev N.K., Izokh N.G., Kirda N.P., Klets A.G., Kontorovich V.A., Obut O.T., Timokhina I.G. (2003): Paleogeograficheskie obstanovki v pozdnem devone na territorii Zapadno-Sibirskoi ravniny i eyo gornogo obramleniya // Geologiya i geofizika, 44(1-2): 172-182.

Yolkin E.A., Klets A.G., Izokh N.G., Bakharev N.K., Obut O.T., Rodina O.A. (2003): Paleogeograficheskie obstanovki na territorii Zapadno-Sibirskoi geosineklizy v pozdnem devone i na rubezhe rannego i srednego karbona // Geodinamicheskaya evolyutsiya litosfery Central'no-Aziatskogo podvizhnogo poyasa (ot okeana k kontinentu). Materialy nauchnogo soveschaniya po Programme fundamental'nykh issledovaniy (20-23 oktyabrya 2003 g., IZK SO RAN, g. Irkutsk). Irkutsk: Izd-vo In-ta geografii SO RAN: 97-100.

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Yolkin E.A., Kontorovich A.E., Kontorovich V.A., Sennikov N.V., Belyaev S.Yu. (2004): Sootnoshenie v fundamente Zapadno-Sibirskoy geosineklizy struktur sibirskogo i kazakhstanskogo kontinentov s kollazhem ostrovoduzhnykh sistem vostochnogo sklona Urala // Geodinamicheskaya evolyutsiya litosfery Central'no-Aziatskogo podvizhnogo poyasa (ot okeana k kontinentu). Materialy nauchnogo soveschaniya (Irkutsk, 19-22 oktyabrya 2004 g., IZK SO RAN). Irkutsk: Izd-vo In-ta geografii SO RAN, 1: 129-132.

Yolkin E.A., Sennikov N.V., Bakharev N.K., Izokh N.G., Klets A.G., Rodina O.A., Timokhina I.G. (2002): Zapadno-Sibirskiy shel'f Sibirskogo kontinenta v paleozoe: etapnost' sedimentatsii i evoljutsii bioty, global'nye sobytiya, paleogeograficheskie rekonstruktsii // Geologiya, geokhimiya i geofizika na rubezhe XX i XXI vekov. Materialy Vserossiyskoi nauchnoi konferentsii, posvyaschennoi 10-letiyu Rossiyskogo fonda fundamental'nykh issledovaniy. Irkutsk: IZK SO RAN: 39-40.

Reminder about the IGCP499/SDS Conference in Siberia

We would like to remind you about the IGCP499/SDS Conference in Siberia during this summer. Our intention now is to get a financial support from Russian Foundation for Basic Research. However for a preparation of the application we should have a scientific program with topics of presentations and their authors. According to the First Circular potential participants should pass to us these data until February, 15 (see attachment). We invite you to take off all your doubts and shoot ahead to wild Siberia where you will meet a lot of interesting things. We are sure this venture will create many positive emotions.

We would like to inform you that there are direct flights to Novosibirsk from Frankfurt and Seoul. They are very convinient but at that time Russian flights are quite cheep. We are looking forward to welcome you in Novosibirsk,

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MEMBER REPORTS

Devonian ammonoid biostratigraphy of the Canning Basin

R. Thomas Becker* and Michael R. House

Introduction

The Canning Basin is now known to be one of the best regions in the world for abundant and diverse Upper Devonian ammonoid faunas. They occur in numerous sections belonging to different facies types of the extensive reef margins and their successions allow a very fine subdivision of slope and basinal sediments into more than forty regional zones and subzones. These span the Lower Frasnian to early Upper Famennian, using the Upper Devonian substage definitions proposed to the International Subcommission on Devonian Stratigraphy (e.g., Becker, 2003; Over, 2004). Many faunal levels show strong regional characteristics and some zones are currently only known from single outcrops. However, there are close palaeobiogeographic ties with distant regions of the Prototethys (Becker, 2000a; Becker in Talent et al., 2000), enabling easy correlation. The usual association with conodonts also makes the area one of the best known for precise ammonoid-conodont correlation.

The first Devonian goniatites were collected by E. T. Hardman in 1883/1884 and given to the British Museum of Natural History where they were identified and published by Foord (1890). Later collections from the Mt. Pierre area were published by Wade (1924, 1938) and Delepine (1933, 1935) who proved the presence of Frasnian and Famennian marker taxa, including several new species. Intensive stratigraphical studies commenced with the pioneer work of Curt Teichert whose faunal lists (Teichert, 1941, 1943, 1949) indicated the presence of very rich assemblages in a succession of faunas. These and subsequent collections were later treated in monographs on Frasnian (Glenister, 1958) and Famennian (Petersen, 1975) faunas. The available collections were used to correlate the Western Australian faunas with the well-established European zones and with the conodont succession (Glenister and Klapper, 1966) but, unfortunately, the establishment of a finer and independent, regional succession was not attempted. Both initial monographs suffered from the lack of designated types and adequate descriptions of most European taxa. Consequently, it is no surprise that recent revisions proved that many Canning Basin forms need to be re-assigned to other or new species. Intensive fieldwork by the authors, mostly in the period from 1989 to 1995, and in collaboration with P. E. Playford (Perth), W. T. Kirchgasser (Potsdam, New York), G. Klapper (Iowa), Bob Nicoll (Canberra), R. W. Brown (Canberra), and others, led to the discovery of many completely new faunas, more than doubling the number of known taxa, and to the establishment of a new regional ammonoid zonation for the Frasnian (Becker et al., 1993). The new Famennian zones have so far only been briefly mentioned in studies on sealevel changes (Becker and House, 1997) and on regional ammonoid palaeobiogeography and diversity (Becker, 2000a). The review pre-

sented here includes all recognized zones and subzones and briefly mentions recent taxonomic changes in order to allow an understanding of former literature data. Currently almost 170 species and subspecies are recognized but ca. 45 % of these still need to be named in new monographic studies which are in preparation. Therefore, even some important zonal markers have to be quoted in open nomenclature. The preliminary segregation of Manticoceras into several taxa with independent and parallel evolution, announced by Becker (2004b), has not yet been followed.

Ammonoid localities

For each zone biostratigraphic reference sections, whose location is indicated in Figs. 1 and 2, will be given. Locality names used in inverted commas refer to informal field names for outcrops. If available, localities are accompanied by regional (WCB) locality numbers. The individual bed-by-bed ammonoid records of all sections are too voluminous to be presented here and, together with updated taxonomy, will be published elsewhere. For previous ammonoid locality data see Glenister (1958), Glenister and Klapper (1966), and Petersen (1975). The following sections and spot localities, roughly from NW to SE (giving topographic sheet numbers and GR = grid references), have yielded important new collections:

Sheet 3963, Richenda

Fore-reef subfacies of Napier Formation at Eastern End of Windjana Gorge, southern side, Napier Range, GR ca. 093-734 (see Playford, 1981, fig. 54, and Playford, 2002, figs. 17 and 31).

Marginal Slope succession (fore-reef subfacies and Pillara Sequence 6 of the Napier Formation) of the Classic Face of Windjana Gorge, southern side, Napier Range, GR 082-737 (see Playford, 1981, fig. 54, and Playford, 2002, figs. 17 and 31)

Sheet 3962, Leopold Downs

Dingo Gap, Section A, youngest parts of the Napier Formation, Napier Range, GR 314-446 (see George et al., 1997, figs. 2 and 5).

Sheet 4061, Fitzroy Crossing

Ca. 1.3 km NE Outcamp Hill, Limestone Billy Hills area, collections of P. E. Playford (see Fig. 1).

WAPET H, section in creek ca. 1 km NE of Needle Eye Rocks, GR 041-783 (see Glenister and Klapper, 1966, and Petersen, 1975, fig. 1).

"Syncline Gully", shallow gully exposing a gentle syncline, ca. 1.5 km S of Needle Eye Rocks, GR 024-759.

"Cattle Creek", creek running in SW-NE direction towards Mt. Pierre Creek, a tributory to the Margaret River, between 0.8 and 1.5 km E to NE of Mt. Pierre, GR 050-753.

Mt. Pierre Creek, section across old airstrip, ca. 1.7 km E of Mt. Pierre.

"Straight Gully", small creek running almost straight in SE-NW direction, between 2.5 km SE and 700 m E of Needle Eye Rocks.

Flats ca. 2 km SW of Donald´s Yard, SE margin of Home Range (see Feist and Becker, 1997, fig. 2).

Sheet 4060, Bruton

Sadler Ridge, 300-400 m W of Long´s Well, northern Emanuel Range, GR 146-393 (see Becker et al., 1993, p. 303)

"Kite Hill", small hill ca. 5.5 km E of Bob´s Bore, eastern Virgin Hills, GR 130-486 (see Feist and Becker, 1997, fig. 2).

"Ant Hill", northern part of a NW-SE running sequence of hills, ca. 3.5 km SE of Bob´s Bore, GR 119-484 (see Feist and Becker, 1997, figs. 2 and 3).

"Sprite Ridge", two sections (East and Middle) at a marked ridge ca. 700 m N of Bob´s Bore, forming the southernmost end of the Home Range, GR 088-501 (eastern section) and 086-501 (middle section; (see Feist and Becker, 1997, figs. 2, 4). Further rich goniatite collections were made by P. E. Playford at a cave at the eastern end of the ridge.

"King Brown Hill", small hill ca. 1.5 km NE of Virgin Creek Bore, western Virgin Hills, GR 030-491 (see Feist and Becker, 1997, fig. 2; near DP4 in Petersen, 1975, fig. 1).

"Ayers Rocklet", isolated small sandstone hill ca. 2.3 km NW of Bob´s Bore, Virgin Hills, GR 074-502 (see Feist and Becker, 1997, fig. 2).

Sheet 4161, Elma

South Piker Hills, various collecting spots and sections (A-G) around the southern hill of Piker Hills, GR 912-983 (for section B; see Becker et al., 1993, fig. 3, and Fig. 1).

Various collection spots between 2.7 and 4.5 km S of Siphon Spring, Horse Spring Range, GR ca. 850-800 (see Becker et al., 1993, p. 304)

Horse Spring, WCB 362, 364 (main section) and lateral section (SW Section) to WCB 364, northern Horse Spring Range, GR 865-854 (for WCB 364; see Becker et al., 1991, p. 186-189, fig. 1c, 2-3, Becker et al., 1993, p. 305, and Becker and House, 1997, fig. 6)

Sheet 4160, Bohemia

"Timanites Hill", WCB 370, NE Glenister Knolls, central Bugle Gap area, GR 882-324 (see Playford, 1980, fig. 11, Becker et al., 1993, p. 303; aerial view in Playford, 2002, fig. 21; ca. WAPET D of Glenister and Klapper, 1966, see Petersen, 1975, fig. 1).

Section ca. 1 km W of McPhee Knoll, WCB 365, northern Bugle Gap area, Old Bohemia Valley, GR ca. 943-370 (see Becker et al., 1993, p. 304).

Sections ca. 400 m W of McIntyre Knolls, WCB 367, northern Bugle Gap area, Old Bohemia Valley, GR 955-372 (see Playford, 1981, fig. 32, and Becker et al., 1993, p. 304-305).

Section between McPhee and McIntyre Knolls, WCB 366, northern Bugle Gap area, Old Bohemia Valley, GR 945-369 (see Becker et al., 1993, p. 305).

"Windy Knolls", WCB 369, 1.5 km SW of Waggon Pass, northern Bugle Gap area, GR 907-356 (see Playford, 1981, fig. 11, and Becker and House, 1997, fig. 2).

"Flare Hill", 1 km N of Waggon Pass, hill with top bed characterized by flare-bearing atrypids, northern Bugle Gap area, GR 916-375 (see map in Playford, 1981, fig. 11).

Flats and trench ca. 350 m W of McWhae Ridge, WCB 372, southern Bugle Gap area, southern extension of the Lawford Range, GR 917-261 (see Becker et al., 1993, p. 306, and Becker and House, 1997, figs. 4 and 7).

Southwestern Slope of McWhae Ridge, lateral sections WCB 371A-D around the "Frutexites Tump", ca. = WAPET B of Petersen (1975), southern Bugle Gap area, GR ca. 917-261 (see Becker et al., 1991, p. 189-191, fig. 1b, and Becker and House, 1997, figs. 4 and 7).

McWhae Ridge, Graben Section, floor of graben and succession at southern end of graben in the center of the southern McWhae Ridge, southern Bugle Gap area, GR 920-264 (see Becker and House, 1997, figs. 4 and 7).

"Orthoceras Tump", southwestern slope of McWhae Ridge, hill SE of "Frutexites Tump" with peculiar orthoceratid marker limestone near its top, southern Bugle Gap area, GR 919-261 (see Fig. 2)

Steep slope near the southern end of McWhae Ridge, Mesobeloceras Section (shown to us by A. Holmes), southern Bugle Gap area (see Fig. 2).

WAPET C, hill separated from McWhae Ridge by Millard Creek, southern Bugle Gap area, GR 918-257 (see Glenister and Klapper, 1966, Petersen, 1975, fig. 1, Becker and House, 1997, figs. 4 and 7).

"Red Rubble Island", isolated steep hill consisting of reddish rubbly limestones just E of WAPET C, southern Bugle Gap area, GR 919-258 (see Fig. 2).

"Phacopid Gully", four sections (A-D) on the southeastern slope of McWhae Ridge, southern Bugle Gap area, GR ca. 922-262 (see Becker and House, 1997, figs. 4, 7).

Casey Falls, E of McWhae Ridge, WCB 357, southern Bugle Gap area, GR ca. 925-258 (see Playford, 1981, fig. 29, Becker et al., 1991, p. 191-193, figs. 1a, 4-5, Nicoll and Playford, 1993, fig. 3, Becker and House, 1997, figs. 2, 4, 5, 7).

"Calyx Corner", crinoid-ammonoid locality at the corner where the track from Kellys Pass to Casey Falls crosses the Millard Creek, ca. 250 m N of Casey Falls (see Playford, 1981, fig. 33, and Fig. 2).

"Calyx Creek", creek leading from "Calyx Corner" ca. 400 m upslope to the East (see Playford, 1981, fig. 33, and Fig. 2).

"Berigora Gully", eastern slope of McWhae Ridge, ca. 250 M of "Phacopid Gully (see Fig. 2).

"Esko Gully", named in the field after the late Esko Rokylle who showed us the collecting site, eastern slope of McWhae Ridge, ca. 450 m NW of Casey Falls (see Fig. 2).

Ammonoid Zones and Subzones

All zones and subzones are named after the characteristic and defining taxon which, however, as is normal in ammonoid biostratigraphy, is not necessarily restricted to the zone bearing its name but may range higher. All distinguished levels are defined by the entry of its marker taxon but mostly can be positively identified with the help of other species. In some sections, the marker species even may be lacking and correlation is based on alternative index forms. Levels which are less

distinctive than others are referred to as subzones. Zonal abbreviations follow the international genozone terminology that was summarized by Becker and House (2000a). UD stands for Upper Devonian, UD I for the Frasnian (Adorfian of the classical German terminology or Manticoceras Stufe), UD II for the Nehdenian (Cheiloceras Stufe), and UD III and IV for the lower and upper Hembergian (Prolobites-Platyclymenia Stufe) of the classical German terminology. As was shown earlier (Becker, 2000a), there were strong regional fluctuations in total diversity and in the relative level of endemism from interval to interval. The Frasnian/Famennian boundary mass extinction led to a regionally complete extermination of ammonoids. After a long delay of recovery (four to five conodont zones), goniatite faunas re-immigrated into the Canning Basin from the west. There were no similarities with sparse Famennian ammonoid faunas of southeastern Australia. In Australia, Frasnian ammonoids are so far restricted to the Canning Basin. There is no reliable regional record of any Givetian specimens although the sedimentary record of the carbonate complex extends down into the Givetian. Teichert (1949, p. 13) listed Maenioceras ? sp. from his "Atrypa zone" but the presence of this Middle Givetian index genus has not been substantiated subsequently.

The given regional correlation with the conodont scale (Fig. 3) is either based on data supplied by G. Klapper (using the Montagne Noire zonation, numbered 1-13, for the Frasnian), published information (Glenister and Klapper, 1966; Nicoll and Playford, 1993; Metzger, 1994) or based on known ammonoid-conodont correlation in other regions. Fig. 4 gives an overview of the main sampled ammonoid localities, their location (sheet numbers and grid reference) and their time ranges. Fig. 5 summarizes the overlapping stratigraphical ranges of all important marker species.

Koenenites n. sp. B Zone (UD I-B1)

Definition: Entry of Koenenites n. sp. B which is related to the oldest North American Koenenites, Koen. styliophilus, but it differs in the even weaker outer umbilical lobes, oblique umbilical shoulders and suboxyconic mature stages.

Other markers: Oldest Tornoceras contractum.

Remarks: The oldest Canning Basin goniatites occur as haematitic molds (Gogo facies) together with neritic fauna, such as brachiopods, in wide areas S of Siphon Spring and near Horse Spring. They show very low diversity. The taxonomic status and, hence, the correct age assignment was originally hampered by rather poor preservation of available material. Specimens identified as Manticoceras cf. evolutum (Becker et al., 1993), and later as Chutoceras n. sp. (Becker, 2000a), are now regarded as early morphotypes of the oldest known Koenenites in which the outer umbilical lobes do not develop until rather late in ontogeny. There is complete intergradation with more advanced morphotypes that show the diagnostic sutures with very weak U2 lobe at earlier stages. Rare specimens with rounded lateral lobes and asymmetric lateral saddles at comparable size indicate the presence of intermediates between Acanthoclymenia and Koenenites. The true Chutoceras (Becker et al., 2000) is a descendant of Ponticeras and has very different, extended, semicircular flank saddles.

Reference section: Faunas are only known from isolated outcrops but the best collections come from between 3 and 4.5 km S of Siphon Spring.

Conodont correlation: The very primitive sutures of the zonal marker clearly indicate a stratigraphic position at the base of the international Koenenites Zone, which in New York (House and Kirchgasser 1993) is known to start about at the base of Zone 2.

"Hoeninghausia" pons Zone (UD I-B2)

Definition: Entry of various subspecies of "Hoeninghausia" pons, characterized by strong shell compression and by an incipient third umbilical lobe on the umbilical seam at maturity.

Remarks: Becker et al. (2000) confirmed that Protimanites lacks a third U-lobe and that it is a subjective junior synonym of Hoeninghausia. Therefore, Hoen. pons cannot be assigned to the first genus as was advocated in Becker et al. (1993). Based on the German type-species, true Hoeninghausia are rather large-sized and possess a single acute outer umbilical lobe, which is not the case in pons. The relatively small Canning Basin species should be placed in a new genus of the Timanitinae.

A second low-diversity and haematitic fauna was collected by P. E. Playford and D. C. Lowry three miles SE of Virgin Bore and contains a different and new species of "Hoeninghausia", which is related to the German "Hoen." galeata and to "Hoen." nalivkini from northern Russia. All these forms retain a single rounded outer umbilical lobe and, in terms of morphology, are simpler than true Hoeninghausia. The new Canning Basin species may fall in a time interval between zones I-B1 and I-B2. Becker et al. (1993) tentatively placed this fauna in UD I-D but new investigations of the Timan goniatite succession (Becker et al., 2000) proved that there are no simple-lobed Timanitinae younger than UD I-B.

Reference section: Sadler Ridge, 400 m W of Long´s Well.

Conodont correlation: Zone 2 at the reference locality.

Koenenites n. sp. A Zone (UD I-B3)

Definition: Entry of various morphotypes of Koenenites n. sp. A that are characterized by distinctive, narrow flank saddles.

Reference section: This zone (or subzone) is only known from Sadler Ridge, 400 m W of Long´s Well.

Conodont correlation: Upper part of Zone 2 to Zone 3 (level with Ancyrodella recta) at the reference locality.

Timanites angustus Zone and Subzone (UD I-C1)

Definition: Entry of Timanites angustus which is closely related to Tim. keyserlingi, the type-species of the genus from Russia, but differing in a more highly arched ventrolateral saddle, more asymmetric lateral lobe and, perhaps, in stronger shell compression.

Reference section: "Timanites Hill" (WCB 370). Other records (British Museum of Natural History) are from around Long´s Well.

Conodont correlation: Zone 4 at the reference locality. In the Timan (House et al., 2002), the marker genus ranges from the upper part of Zone 3 to Zone 4.

Manticoceras sp. Subzone (UD I-C2)

Definition: Entry of regionally oldest Manticoceras sp.

Remarks: In North America (New York) oldest manticoceratids occur earlier in UD I-B (Genundewa Limestone) but the rather rich collections from Sadler Ridge prove that this is not the case in NW Australia. The entry of the genus in the upper part of the Timanites faunas correlates with its entry in the upper part of division I-C in the Timan (Becker et al., 2000). Therefore, Becker et al. (1993) used it to distinguish a regional faunal level that, however, is best regarded as a subzone only. Poorly preserved manticoceratids have been found at other localities of the Gogo Formation (e.g., around Long´s Well) and may fall in this subzone.

Reference section: "Timanites Hill" (WCB 370).

Conodont correlation: By superposition, higher part of Zone 4 at the reference locality. Oldest manticoceratids from the Timan (House et al., 2002) and Morocco (Becker and House, 2000b) also fall in Zone 4.

Topmost Lower Frasnian (UD I-D)

Remarks: Currently no Canning Basin ammonoid faunas are correlated with the level of the Middlesex Shale of New York, which contains the oldest Sandbergeroceras. The multilobed Triainoceratidae are completely lacking in Australia. There is also no evidence for the Komioceras faunas known from several regions of Russia (e.g., Becker et al., 2000).

Probeloceras lutheri lutheri Zone (UD I-E1)

Definition: Entry of Prob. lutheri lutheri, characterized by thin, flat shells and angular flank lobes and saddles, which makes the form very characteristic and easily identifiable.

Other markers: The endemic Mixomanticoceras exploratum, oldest Ponticeras n. sp. (with strong ventrolateral furrows, first illustrated by Glenister, 1958, plate 5, fig. 1), Acanthoclymenia n. sp. A, and Acanthoclymenia aff. neapolitana enter in this zone. This level regionally also has the first and abundant Manticoceras lamed (very compressed) and Mant. cordatum (somewhat thicker). Australian early manticoceratids lack the juvenile ribs and flares of North American species (for which the generic name Gephuroceras is available, see Miller and Furnish, 1960). Forms previously assigned to Aulatornoceras n. sp. belong to a new genus that lacks the characteristic ventral band of typical members of the genus. It closes the umbilicus during ontogeny and includes the widespread "Truyolsoceras" keyserlingi Group.

Reference section: With certainty only known from the area W of McPhee Knoll, Old Bohemia Valley (WCB 365). Poorly preserved probeloceratids have also been observed in the Gogo Formation at Glenister Knolls.

Conodont correlation: Not dated at the reference section. The index species is first known from the lower Cashaqua Shale of New York which falls in Zone 5 (House & Kirchgasser, 1993).

Ponticeras discoidale Zone (UD I-E2)

Definition: Entry of Ponticeras discoidale.

Remarks: The index species has also been reported from the Frasnian of Belgium and may allow international correlation.

Reference section: WCB 365, W of McPhee Knoll. Probably also present in the flat below the trench at McWhae Ridge (WCB 372).

Conodont correlation: A level well above the base of Zone 5, with Polygnathus timanicus and Ancyrognathus ancyrognathoideus (see range of these taxa in the Timan in House et al., 2000a, and in the Frasnian composite of Klapper, 1997), is indicated at the reference locality in the upper part of the zone.

Manticoceras n. sp. 1 Zone (UD I-E3)

Definition: Entry of Manticoceras n. sp. 1 (= sp. nov. in Becker et al., 1993), which is characterized by very compressed and suboxyconic whorls.

Other markers: Probeloceras lutheri n. ssp. with rather narrow and strongly triangular flank saddle. Rare but distinctive

is the regionally oldest species of Gogoceras (sp. A) with ribbed early whorls and convex growth lines at maturity.

Reference section: WCB 365, W of McPhee Knoll. Other good faunas occur in the lower part of WCB 367; also present in the flats below the trench (section 372, with a single but oldest Aulatornoceras) and in the graben at McWhae Ridge.

Conodont correlation: Higher part of Zone 5 (by superposition) at the reference locality and in the lower part of WCB 367.

Prochorites alveolatus Zone (UD I-F1)

Definition: First occurrence of Prochorites alveolatus which is probably an older (and valid) synonym of Proch. strix from New York.

Other markers: Oldest Acanthoclymenia neapolitana, Probeloceras aff. lutheri (with fastigate venter), oldest Linguatornoceras (still intermediate to Tornoceras), and a second, still unnamed, new and rare Gogoceras (sp. B).

Remarks: Silicified and radiolarian-rich nodules from the Gogo Formation at Outcamp Hill (Billy Hills) yielded a fauna dominated by Probeloceras lutheri holzapfeli (with well rounded inner flank lobe), tornoceratids, two new species of Acanthoclymenia, and a new serpenticonic homeomorph of Maternoceras. The probeloceratid suggests a rather low level in UD I-E but rare Prochorites fragments prove that at least some part of the fauna falls in I-F1.

Reference section: WCB 367 near McIntyre Knolls, Old Bohemia Valley.

Conodont correlation: Higher part of Zone 5 (by superposition) in the reference section. Conodont correlation indicates that equivalents of the alveolatus Zone are present in the non-ammonoid-bearing upper part of WCB 365. In New York (House and Kirchgasser, 1993), Prochorites enters very high in Zone 5 and ranges into Zone 6.

Gogoceras nicolli Zone (UD I-F2)

Definition: Entry of Gogoceras nicolli.

Other markers: Acanthoclymenia aff. n. sp. A, Manticoceras n. sp. 2 (with evolute early whorls, previously recorded as Mant. aff. lamed), Manticoceras n. sp. 3 (relatively rare, with angular ventrolateral shoulders). Especially characteristic is a new beloceratid with incipient third ventral lobe and pointed internal umbilical lobe, which falls in a new genus intermediate between Probeloceras and Naplesites. Becker et al. (1993) recorded it as Probeloceras lutheri n. ssp. Possibly it has a slightly older range than the zonal index species.

Reference section: WCB 367 near McIntyre Knolls. Also present in the graben on top of McWhae Ridge.

Conodont correlation: By superposition highest part of Zone 5 in the reference section, laterally projecting into non-ammonoid-bearing strata in the upper part of WCB 365.

Sphaeromanticoceras affine Zone (UD I-F3)

Definition: Entry of faunas with Sphaeromanticoceras affine and with the related Sphaero. cf. orbiculum.

Other markers: Oldest Aulatornoceras eifliense eifliense and Maternoceras n. sp., which lacks the ventral groove of the type-species, Mat. calculiforme.

Remarks: In the basalmost, condensed part of the Virgin Hills Formation near Horse Spring (WCB 362, 364), there are limestone faunas with poorly preserved oldest Sphaeromanticoceras, Carinoceras sp. indet, and still with Probeloceras. These are thought to represent the affine Zone in a different limestone facies.

Reference section: WCB 366 near McIntyre Knolls.

Conodont correlation: Zone 6, based on definite records of the zone in the underlying top part of WCB 365 and also based on the basal part of WCB 364.

Naplesites naplesense Zone (UD I-G1)

Definition: Entry of oldest Naplesites with three ventral lobes and additional outer umbilical lobe(s).

Remarks: This level was previously (Becker & House, 1997; Becker, 2000a) not separated from the next following faunal interval. There are forms with one outer umbilical lobe, resembling Napl. naplesense and, forms with two outer umbilical lobes as in Napl. angustisellatus (type-species of Chaoceras Yatskov, 1990), and an evolute new species with three outer umbilical lobes that also occurs in Morocco.

Reference section: WCB 364 (Horse Spring), which, unfortunately, is rather condensed in the lower part.

Conodont correlation: Zone 6 in the reference section. The same conodont correlation is indicated for the museum material of New York Naplesites (House and Kirchgasser, 1993). Moroccan Naplesites occur together with Sandbergeroceras in Zone 6 and early parts of Zone 7 (Becker and House, 2000b; conodont data supplied by G. Klapper).

Mesobeloceras housei Zone (UD I-G2a)

Definition: Entry of Mesobeloceras housei with fourth incipient ventral lobe and four outer umbilical lobes.

Remarks: The index species possesses a fourth incipient ventral lobe and in this respect is transitional between Naple-

sites and Mesobeloceras. Therefore, it has been variably assigned to either genera in the past. Here (see Becker et al., 2004, p. 38) more emphasis is placed on the origination of a new morphological feature that restricts Naplesites to species with three ventral and one to three outer umbilical lobes. The Moroccan Merzougites Korn and Klug (2002) is a subjective junior synonym of Naplesites.

Reference section: WCB 366 near McIntyre Knolls. At Horse Spring (WCB 364), the zone falls in a very condensed interval, which is difficult to separate from the next level.

Conodont correlation: Zone 7 in the reference section and at Horse Spring (within Bed 4). Meso. housei also occurs in Morocco, just above styliolinitic Rhinestreet Event beds, in Zone 7. This suggests correlation of the hypoxic interval within the Virgin Hills Formation at WCB 366 with the main pulse of the eustatic Rhinestreet Transgression (Becker and House, 1997).

Mesobeloceras thomasi Zone (UD I-G2b)

Definition: Entry of convolute Mesobeloceras thomasi with fully developed fourth and incipient fifth ventral lobe at maturity.

Other markers: Oldest new species of Costamanticoceras (related to Costa. tuberculatum) and Playfordites (with two pairs of spiral internal grooves), Carinoceras vagans (rare, first record for Australia), Manticoceras buchii, compressed, parallel-sided morphotype or subspecies of Mant. lamed. Slightly more advanced mesobeloceratids with five fully developed ventral lobes, as in Sinobeloceras Yatskov (1990), occur only rarely in the Canning Basin.

Reference section: Discontinuous and condensed slope section at the southern end of McWhae Ridge (Mesobeloceras Section). Also present in a very condensed interval at Horse Spring (WCB 364).

Conodont correlation: Zone 8 in the reference locality and at WCB 364. The closely related Meso. kayseri of Morocco also enters in Zone 8 (Becker and House, 2000b).

Beloceras tenuistriatum Zone (UD I-H)

Definition: Entry of the moderately involute Beloceras n. sp. (with six ventral lobes, some specimens with incipient seventh ventral lobes and seven umbilical lobes), or of the involute Beloceras tenuistriatum (early form with seven ventral lobes at maturity, as in forms assigned in other regions to Belo. bogoslovskyi, Belo. shidianensis, and Belo. gallicum; see Yang, 1984, and Yatskov, 1990).

Other markers: The relative rare, open umbilicate Manticoceras evolutum with characteristic wide flank saddle. Mant. ammon with compressed but very rotund whorls is also very rarely present.

Reference section: Horse Spring (WCB 364); also present in the Mesobeloceras Section (including an intermediate Beloceras n. sp. with incipient sixth ventral lobe) and in the lower part of the now filled trench at McWhae Ridge (WCB 372).

Conodont correlation: Upper part of Zone 8 to Zone 9 at Horse Spring and probably also in trench WCB 372. In Morocco, Beloceras faunas of UD I-H continue into Zone 10 (Becker and House, 2000b). The highest range of Mant. ammon in its Timan type region is Zone 9 (Becker et al., 2000).

Costamanticoceras koeneni Zone (UD I-I1)

Definition: Entry of various subspecies of the suboxyconic, and only very weakly ribbed Costamanticoceras koeneni.

Other markers: True Serramanticoceras serratum with flattened venter, the parallel-sided Manticoceras intumescens and Mant. latisellatum Groups, Aulatornoceras auris, and Linguatornoceras clausum. Beloceras still displays seven ventral lobes.

Remarks: Since the trench at McWhae Ridge has been filled, it is not possible any more to re-sample the oldest Canning Basin occurrence of Serramant. serratum, which was originally used to define the base of I-I in the region. Consequently, a different species is now used as index for the first Upper Frasnian ammonoid zone, which is well represented in outcrop in the basal Virgin Hills Formation in more northern parts of the Bugle Gap area.

Reference section: “Windy Knolls”, 1 km S of Waggon Pass (WCB 369).

Conodont correlation: Zone 11 with Palmatolepis semichatovae in the reference section; contemporaneous with the entry of Serramant. serratum, close relatives of Mant. latisellatum, and Pa. semichatovae in trench WCB 372. In the Timan (Becker et al., 2000), Mant. latisellatum and Linguat. clausum also enter together with Pa. semichatovae.

Playfordites tripartitus Zone (UD I-I2)

Definition: Entry of Playfordites tripartitus with one pair of internal spiral shell thickenings.

Other markers: Trimanticoceras aff. cinctum (more compressed and involute than cinctum), Serramanticoceras n. sp. 1 (= serratum ssp. A of Clausen, 1969 with rounded venter), and oldest relatives of Manticoceras drevermanni, a species which is normally more characteristic of the latest Frasnian of Germany (Wedekind, 1913, p. 31). Advanced Beloceras tenuistriatum with deep and narrow E7 lobe and incipient E8 lobe, for which the subspecies name glenisteri is available (see Becker et al., 2004), appear within I-I2.

Remarks: In the northern Bugle Gap area, the faunal composition of contemporaneous beds (controlled by conodont correlation) is different. Here relatives of "Maternoceras" prumiense, which represent an un-named genus with constrictions, are more characteristic. They are associated with serramanticoceratids.

Reference section: Horse Spring (WCB 364). The zone is also recognizable in the McWhae Ridge area (lower slope of WCB 371B).

Conodont correlation: By superposition, higher part of Zone 11 in the reference section and at WCB 369 ("Windy Knolls"), but Play. tripartitus faunas extend into Zone 12 at WCB 372. At Martenberg, Germany, faunas with Play. tripartitus (Lower cordatum fauna of House and Ziegler, 1977) correlate with Zone 11 (Klapper and Becker, 1999). This is also true for Play. cf. tripartitus from the top of the Rhinestreet Shale of New York (House and Kirchgasser, 1993).

Maternoceras retorquatum Zone and Subzone (UD I-J1)

Definition: Abundant occurrence of Maternoceras retorquatum.

Other markers: Trimanticoceras bullatum (new generic assignment based on furrowed early stages of German specimens); Beloceras tenuistriatum shows eight ventral lobes at maturity.

Remarks: Contemporaneous beds at Horse Spring are poor in goniatites. Maternoceras has a lower total range but earlier Canning Basin representatives are very rare forms. A single specimen from the koeneni Zone (Harpid Bed) of "Windy Knolls" is already very close to Mat. retorquatum.

Reference section: McWhae Ridge, section 371A/ϕ, 30 m NE of main section. The index species is not yet recorded from the northern Bugle Gap area ("Windy Knolls", WCB 369).

Conodont correlation: Not constrained in the transition from Zone 11 to 12. Trimant. cf. bullatum occurs at "Windy Knolls" (WCB 369) in the highest part of Zone 11. This suggests that the Zone 12 Playfordites faunas from the McWhae Ridge trench (WCB 372) correlate with Zone I-J. A similar high range of Playfordites is indicated in New York by specimens from the Angola Shale (House and Kirchgasser, 1993) which falls in Zone 12.

Virginoceras erraticum Subzone (UD I-J2)

Definition: Entry of Virginoceras erraticum whose lanceolate venter allows easy recognition.

Other markers: Clauseniceras scheldense, Claus. cf. expectatum, Trimanticoceras cinctum, Trimant. n. sp. B (more compressed than cinctum, spiral furrow weakens early), a rather involute Costamanticoceras, Manticoceras cf. solnzevi, Mant. aff. cordatum (more evolute and thicker), Serramanticoceras obliquesulcatum.

Reference section: The Lower Beloceras Bed at McWhae Ridge, Section 371B. There are many rich collection spots on the eastern slope of McWhae Ridge ("Berigora Gully" and "Esko Gully") but collecting was rather poor at this level in the trench at McWhae Ridge (WCB 372) and at "Windy Knolls" (WCB 369). Other faunas are known from Horse Spring (lateral section to WCB 364).

Conodont correlation: The reference section did not provide a diagnostic conodont fauna. Zone 12 was found at Horse Spring and WCB 372. The German Upper cordatum Zone of House and Ziegler (1977), which contains Claus. expectatum, also correlates with Zone 12 (Klapper and Becker, 1999). Virginoceras ljaschenkoae from the Timan is older (UD I-I) than the Canning Basin index species (House et al., 2000a) of the same genus.

Clauseniceras n. sp. Subzone (UD I-J3)

Definition: Entry of a new, slowly expanding and rather involute species of Clauseniceras.

Other markers: "Maternoceras" sandbergeri may appear in flood occurrences and is probably regionally restricted to this level. There are also very advanced Beloceras tenuistriatum with fully developed eight ventral and nine umbilical lobes (resembling the lectotype of Goniatites sagittarius Sandberger and Sandberger, 1851, pl. IV, figs. 3, 3a, 3b, housed in the Museum für Naturkunde, Berlin, MB.C.4501) and intermediates between Manticoceras lamed and Mant. lyaiolense. Several common evolute manticoceratids of underlying beds (Costamanticoceras, Maternoceras s. str.) seem to be lacking but Serramanticoceras n. sp. 1 is common.

Reference section: McWhae Ridge (WCB 371B: faunas at or right above a white to yellowish-grey scutelluid marker Bed, here named as Esko Bed)); other rich faunas are from "Berigora Gully" E of McWhae Ridge, just above the widely exposed minor cliff of the Lower Beloceras Bed. Further on, at "Esko Gully", there are only sparse faunas with Beloceras.

Conodont correlation: Zone 12 in the reference section and in "Berigora Gully". Mant. lyaiolense is characteristic for Zone 12 goniatite faunas of the Timan (House et al., 2000a) but has a longer total range. According to new collections, "Mat." sandbergeri occurs at Martenberg (Germany) also in Zone 12.

Manticoceras n. sp. 5 Zone (UD I-K)

Definition: Entry of a very compressed, involute, suboxyconic and moderately large new Manticoceras (n. sp. 5), which somewhat resembles the much older Manticoceras n. sp. 1.

Other markers: The rare (only one fragment found) Aulatornoceras n. sp. (with angular flank lobe) that resembles an

undescribed species from the lower Hanover Shale of New York.

Remarks: Early relatives of "Mant". guppyi (n. sp. 4, with rather angular flank saddle) occur within a condensed interval topped by an algal bed at "Flare Hill" 1 km N of Waggon Pass, which seems to correlate in time with the Lower Kellwasser level of Europe and North Africa. The Lower Kellwasser Event, however, is not marked in the Canning Basin successions. The diverse late Frasnian faunas of UD I-J are always terminated by a regressive interval lacking ammonoids.

Reference section: "Phacopid Gully", Section A. At Horse Spring (WCB 364) there are only few long-ranging species. The "Windy Knolls" section (WCB 369) contains relatives of "Manticoceras" guppyi, followed by a peculiar, sparitic receptaculitid limestone, which perhaps correlates with the stromatolitic bed of "Flare Hill".

Conodont correlation: Zone 13a is recorded in the upper part of the zone in the reference section (the lower part has not been sampled for conodonts). The first Manticoceras n. sp. 4 of "Windy Knolls" start rather high in Zone 12. At "Flare Hill", Zone 13a starts within the condensed and solid goniatite and stromatolitic limestones.

Crickites lindneri Zone (UD I-L1a)

Definition: Entry of the large-sized and inflated Crickites lindneri.

Other markers: Trimanticoceras n. sp. A (rather large-sized), Idiobeloceras n. sp. (with at least ten outer umbilical but only seven ventral lobes).

Remarks: Re-sampling proved that widespread upper units with Beloceras (including the Upper Beloceras Bed of Becker et al., 1993) are the main level of Crick. lindneri, which, therefore, resulted in a re-assignment to the Crickites Genozone (Becker, 2000a). Advanced Beloceras continue in parallel with Idiobeloceras.

Reference section: "Phacopid Gully A". Other rich occurrences are at McWhae Ridge (lateral sections WCB 371A-D, just above WCB 372, upper part of Graben Section), at the base of Casey Falls, at "Calyx Corner", and at the top of "Windy Knolls" (WCB 369). Small faunas are known from the eastern end of Windjana Gorge and "Flare Hill" 1 km N of Waggon Pass (Bugle Gap area).

Conodont correlation: Starting somewhat above the base of Zone 13a in the reference section and at western McWhae Ridge (WCB 371B), probably also at Windjana Gorge East. At "Windy Knolls" (WCB 369), the level of oldest Crick. lindneri has not been sampled but Zone 13a is recorded from the next bed above. The last, condensed limestones with beloceratids may already fall in Zone 13b at "Flare Hill", McWhae Ridge (WCB 371D), and Horse Spring (WCB 364). Oldest Crickites faunas of the Montagne Noire, Belgium, and of New York also start within Zone 13a (House and Kirchgasser, 1993; House et al., 2000b).

"Manticoceras" guppyi Zone (UD I-Lb)

Definition: Flood occurrence of "Manticoceras" guppyi with narrow and very high flank saddle, asymmetric outer flank lobe, involute adult stages and characteristic ornament that allows generic distinction from Manticoceras.

Other markers: A new and more evolute species (n. sp. L) of "Manticoceras" with widely spaced lirae as in aulatornoceratids, relatives of "Mant." guppyi with thicker whorls or with more evolute and faster expanding adult stages, Archoceras varicosum, Archo. aff. schlosseri (lacking ventrolateral furrows), Trimanticoceras n. sp. C (with shallow furrows and peculiar ventral edges).

Remarks: The zone can be recognized by a change from beds rich in beloceratids to mass occurrences of "Mant." guppyi and of close relatives or subspecies. Similar shell form and ventral lobes occur earlier in the related Manticoceras n. sp. 4 but the other associated marker species, which are rarer but also widespread, aid the recognition of the zone. Beloceras continues as minor faunal element in shallow facies settings. Crick. lindneri is much rarer than "Mant." guppyi at this level. "Manticoceras" n. sp. L occurs in equivalents of the Upper Kellwasser Limestone of Germany (only one specimen known) and of SW Morocco (Becker et al., 2004) and allows correlation of the regional "Manticoceras" guppyi Marker Bed of Becker et al. (1991) with the early, transgressive part of the Upper Kellwasser Event.

Reference section: "Phacopid Gully A". Other rich occurrences are in the creek at the base of Casey Falls, at "Calyx Corner" (with Trimanticoceras and Archoceras), on the western side of McWhae Ridge (top of hill above trench WCB 372, lateral sections WCB 371A-D, top of Graben Section), and just above the Gastropod Bed (Becker and House, 1977; Cook et al., 2003) at Horse Spring.

Conodont correlation: Zone 13b (with Palmatolepis linguiformis) at "Phacopid Gully A", McWhae Ridge (WCB 371B and 371D), Casey Falls, and Horse Spring. The conodont evidence supports correlation with the lower part of the Upper Kellwasser level, which in the Canning Basin, however, is not developed as an interval of low-oxygen facies. Archoceras, which has a longer total range, is also typical for Upper Kellwasser beds.

Manticoceras cordatum (upper range) Zone (UD I-L2)

Definition: Regional extinction of all ammonoid genera apart from Manticoceras and Tornoceras.

Remarks: The youngest Canning Basin manticoceratids mostly belong to the long-ranging Mant. cordatum but Mant. guppyi may also still be present. As with the associated conodonts, they represent a very low-diversity terminal Frasnian pelagic faunal interval and support evidence for a stepwise regional extinction pattern associated with the global Upper

Kellwasser Event. Manticoceras and Tornoceras seem to have survived longer in the region than all species of Beloceras, Crickites, Trimanticoceras, Linguatornoceras and Aulatornoceras. It is strange that Tornoceras re-appears in the final phase of the extinction interval since the genus is currently unknown from older Upper Frasnian strata of the basin.

Reference section: "Phacopid Gully A"; other terminal Frasnian goniatites occur on the western side of McWhae Ridge (WCB 371C), at Horse Spring (WCB 364), and in the Windjana Gorge.

Conodont correlation: Zone 13c at the reference locality and Horse Spring, probably also at Windjana Gorge East ("Red Cave") and East-Central (just upstream from the "classic face") sections.

Basal Famennian (UD II-A/?B)

Remarks: There is no evidence for any ammonoids in the lowest part of the Famennian which is also characterized by strong condensation in many successions, e.g., in the Bugle gap area. This does not imply that the goniatite-free period was of short duration. It seems that the Canning Basin needed to be re-populated by goniatites from Europe (Becker, 2000a), after a total wipe-out of all last manticoceratid species during the final phase of the global Upper Kellwasser mass extinction.

Conodont correlation: Lower triangularis Zone (re-defined by the entry of Palmatolepis subperlobata, Klapper et al., 2004) to Middle crepida Zone at McWhae Ridge (Nicoll & Playford 1993; Metzger, 1994) and Casey Falls.

"Falcitornoceras" n. sp. Zone (UD II-B/C)

Definition: Entry of a new species related to "Falcitornoceras" korni, included in Tornoceras simplex by Glenister and Klapper (1966) and Petersen (1975); both species fall in a new genus lacking the juvenile falcate ribbing of true Falcitornoceras.

Other markers: Several forms currently included in or close to Cheiloceras (Puncticeras) pompeckji (= Cheiloceras (Staffites) ovatum in Petersen, 1975, a taxon regarded by Becker, 1993 as a nomen dubium; probably also including corroded specimens previously assigned to Cheiloceras (Cheiloceras) circumflexum) and a second new species of "Falcitornoceras".

Reference section: Lateral section WCB 371B´ at McWhae Ridge, just above the Frutexites Marker Bed. Other occurrences are at "King Brown Hill" and "Kite Hill" in the Virgin Hills (see previous records from that region in Glenister & Klapper, 1966) and from "Cattle Creek" and Mount Pierre Creek (Old Airstrip Section) E of Mount Pierre.

Conodont correlation: Upper crepida Zone in the reference section. Previous records of cheiloceratids from the Lower crepida Zone (Glenister & Klapper, 1966; Petersen, 1975) probably represent faunas from the same interval in which index conodont species (e.g., Palmatolepis termini) are missing for biofacies reasons (see discussion in Becker, 1993). Similar problems with dating oldest cheiloceratid faunas have been encountered in Morocco. Currently there are no reliable records of cheiloceratids from beds older than the Middle crepida Zone on a global scale. In Morocco, Cheil. (Puncti.) pompeckji does not seem to enter earlier than UD II-D (Becker et al., 2002).

Oxytornoceras n. sp. Zone (UD II-D)

Definition: Entry of Oxytornoceras n. sp., assigned by Petersen (1975) to the homeomorphic latest Givetian to basal Frasnian Epitornoceras peracutum.

Other markers: Armatites planidorsatus, Cheiloceras (Staffites) curvispina, Cheil. (Puncticeras) lagowiense, Cheil. (Puncti.) schmidti, Cheil. (Puncti.) semiinversum (and new related forms), Cheil. (Puncti.) postinversum (including compressed forms assigned by Petersen, 1975, to Cheil. (Cheil.) sacculum), Cheil. (Puncticeras) n. sp. (with star-shaped constrictions), Torleyoceras oxyacantha, Linguatornoceras n. sp. (more compressed than the German Linguat. guestphalicum), and a third new "Falcitornoceras".

Remarks: This zone contains the most abundant and diverse Famennian ammonoid assemblage of the Canning Basin.

Reference section: "Ant Hill" SE of Bob´s Bore (Virgin Hills). Other rich occurrences are from "King Brown Hill", "Sprite Ridge I" (eastern end of ridge), "Cattle Creek", Mt. Pierre Creek, and McWhae Ridge (WCB 371B, extending to 371B´ and "Orthoceras Tump"). Small faunas come from the base of WAPET C and Casey Falls. Other records are in Petersen (1975).

Conodont correlation: The upper half falls in the Lower rhomboidea Zone at the reference section (no data available for the lower half); Uppermost crepida to Lower rhomboidea Zone at McWhae Ridge (WCB 371B, Metzger, 1994), Lower rhomboidea Zone at WCB 371B´ (nodular faunas from upper argillaceous interval, laterally continuous with faunas from "Orthoceras Tump"), base of WAPET C (Metzger, 1994), Casey Falls, and "Sprite Ridge I". The same conodont correlation has been established for UD II-D by Becker (1993) for Europe and North Africa.

Praemeroceras petterae Zone and Subzone (UD II-E1)

Definition: Entry of Praemeroceras petterae in a gradual lineage coming from Cheiloceras (Staffites) curvispina.

Other markers: Close relatives of Praem. globosoides, illustrated by Petersen (1975, text-fig. 18D, pl. 4, figs. 1-2) as Dimeroceras aff. D. mamilliferum.

Reference section: "Cattle Creek" E of Mount Pierre. Other faunas are known from Casey Falls and WAPET C (McWhae Ridge area), "Ant Hill" (Virgin Hills, compare section DP 4 in Petersen, 1974), and Mount Pierre Creek (Old Airstrip Section, see also sample Ta from near-by in Petersen, 1975).

Conodont correlation: By superposition, higher part of Lower rhomboidea Zone at the reference section, WAPET C, Casey Falls, and "Sprite Ridge I"; probably also at Mount Pierre Creek (compare sample UWA 26946c in Glenister and Klapper, 1966). The level of Praem. petterae is not yet well constrained within the rhomboidea Zone in Germany and Morocco (discussion in Becker, 1993).

Praemeroceras primaevum Subzone (UD II-E2)

Definition: Entry of the distinctive Praemeroceras primaevum with globose, widely umbilicate early stages (= Dimeroceras padbergense of Petersen, 1975).

Other markers: Two new Praemeroceras species, partly identified by Petersen (1975) as Dim. cf. D. bredelarense.

Reference section: "Cattle Creek" E of Mount Pierre (compare Petersen, 1975, sample Tb). Other occurrences are in microbialitic coquinas of WAPET C. Contemporaneous beds at Casey Falls and in the Virgin Hills are rather poor in goniatites.

Conodont correlation: Probably Upper rhomboidea Zone, which is generally difficult to recognize, at WAPET C where Metzger (1994) noted Palmatolepis rhomboidea without the Lower rhomboidea Zone index species Pa. poolei in a primaevum coquina Bed (Bed 5). The same age was given by Price (1982) for specimens from the Beul (Germany, identified as Gen. nov. aff. Dimeroceras sp. nov.; see Becker, 1993, p. 293).

Paratornoceras polonicum Zone and Subzone (UD II-F1)

Definition: Entry of oldest morphotypes of Paratornoceras polonicum with a very late sharpening of the venter during ontogeny (possibly only a subspecies of Parat. lentiforme).

Remarks: Parat. lentiforme in the sense of its neotype (Ebbighausen et al., 2002), with early sharpening of the venter whilst the umbilicus is still widely open, enters at a higher level within the subzone. The succession of Paratornoceratinae allows a fine time discrimination within UD II-F and seems to represent a regional chronomorphocline.

Reference section: WAPET C south of McWhae Ridge (compare GSWA 1029 samples in Glenister and Klapper, 1966). Other rich faunas (leg. P. E. Playford) occur at "Cave Hill" around Bob´s Bore and at "Cattle Creek". Contemporaneous beds at Casey Falls and "Sprite Ridge I" are poor in goniatites. Faunas with Parat. lentiforme in Petersen (1975) may either fall in this or in the next subzone.

Conodont correlation: Uppermost part of rhomboidea Zone with Palmatolepis stoppeli at the reference section (Glenister and Klapper, 1966; Metzger, 1994); also dated as rhomboidea Zone at the Beul (Germany) by Price (1982).

Acrimeroceras clarkei Subzone (UD II-F2)

Definition: Entry of strongly compressed, oxyconic Acrimeroceras without constrictions, here provisionally identified as Acri. clarkei (see original species diagnosis of Delepine, 1935); included as a morphotype within Paratornoceras lentiforme by Glenister and Klapper (1966) and Petersen (1975). It does not overlap stratigraphically with the somewhat homeomorphic Oxytornoceras n. sp.

Reference section: WAPET C. Another rich fauna occurs at "King Brown Hill" near Virgin Creek Bore (Virgin Hills) but faults have cut out contemporaneous beds in parts the Mount Pierre area (e.g., at "Cattle Creek") where the species was first found by Delepine (1935).

Conodont correlation: Starting at the base of the Lower marginifera Zone in the reference section (Metzger, 1994; compare older data in Glenister and Klapper, 1966, tab. 5). This correlation fits the entry of the genus in a marker bed near the base of the Lower marginifera Zone of Germany, southern France, northern Spain, and northern Morocco (Becker, 1993).

Maeneceras meridionale Zone and Subzone (UD II-G1)

Definition: Entry of Maeneceras meridionale, a senior synonym of Maene. subvaricatum (see Korn and Ziegler, 2002); assigned by Petersen (1975) to Sporadoceras biferum, which revision (Bockwinkel et al., 2002), however, showed that it is not a Maeneceras but a junior synonym of the much younger sporadoceratid Erfoudites ungeri.

Other markers: Subglobular sporadoceratids previously (Petersen, 1975) assigned to Maeneceras rotundum, which German type (Becker, 1993; Bockwinkel et al., 2002), however, may in fact belong to the younger spradoceratid genus Xenosporadoceras. The Canning Basin form seems to represent a new species of Maeneceras or Lagowites.

Reference section: WAPET C (compare Petersen, 1975). Other rich faunas come from "Red Rubble Island" (continuation of WAPET C to the East), "King Brown Hill", "Sprite Ridge I and II", from near Bob´s Bore (collections of P. E. Playford, Virgin Hills), and from the base of "Syncline Gully" between Mount Pierre and Needle Eye Rocks. Contemporaneous beds at Casey Falls lack goniatites. Small faunas occur in sandstones at "Ayers Rocklet" (Virgin Hills) and WNW of Outcamp Hill (Petersen, 1975, sample T37/D17).

Conodont correlation: By superposition, starting at a middle level in the Lower marginifera Zone in the reference section

(Metzger, 1994) and at "Sprite Ridge I"; for identical correlation in Europe and North Africa see Becker (1993).

Maeneceras latilobatum Subzone (UD II-G2)

Definition: Entry of early morphotypes of Maeneceras latilobatum (outer flank A2 lobe reaches only 35-45 % of mid-flank A1 lobe, identified as new subspecies of Maene. biferum in Becker and House, 1997; see taxonomic discussion in Bockwinkel et al., 2002).

Remarks: There is probably a morphological continuum between advanced Maene. meridionale and early Maene. latilobatum. Since typical morphotypes of Maene. meridionale with much smaller A2 lobe continue in some sections as well and without intermediates, this, however, is a case of true speciation, not just an intraspecific chronomorphocline. Advanced Maene. latilobatum with deeper A2 lobe are not common in the Canning Basin.

Other markers: A new, rare species of Maeneceras with raised ventral saddle.

Reference section: "Syncline Gully" (Mount Pierre area). Also recognized near-by at "Straight Gully", WAPET H1-2 and other sections of Petersen (1975), "Red Rubble Island" S of McWhae Ridge (in continuation with WAPET C and section GSWA 1029; see Glenister and Klapper, 1966), WNW of Outcamp Hill (Petersen, 1975, sample T37/D18), and at "Ayers Rocklet" (Virgin Hills).

Conodont correlation: By superposition, higher part of Lower marginifera Zone, based on samples GSWA 1029-C11, WAPET H/1 and WAPET C/C66-88´ in Glenister and Klapper (1966).

Sporadoceras teicherti Zone (UD II-H)

Definition: Entry of the oldest true Sporadoceras (species with two pointed flank lobes), Sp. teicherti.

Other markers: The large-sized Maeneceras milleri (see Becker, 2000a, figs. 3D-E) and Posttornoceras glenisteri.

Reference section: "Syncline Gully" N of Mount Pierre. Also recognized at neighbouring "Straight Gully", WAPET H3 (Petersen, 1975), Casey Falls, above "Red Rubble Island" just S of McWhae Ridge (compare highest part of WAPET C and top of section DP 2 in Petersen, 1975), and questionably WNW of Outcamp Hill (Petersen, 1975, sample T37/D19).

Conodont correlation: Starting near the base of the Upper marginifera Zone at Casey Falls, based on the entry of Palmatolepis marginifera utahensis that is well within the upper range of Pa. quadrantinodosa inflexoidea. Regionally, the Upper marginifera Zone is not recognized by the extinction of the latter species, as originally suggested by Sandberg and Ziegler (1973); both taxa are normally thought not to overlap (e.g., Ziegler and Sandberg, 1984; Korn and Ziegler, 2002). The same correlation applies to the reference section, to the lower part of WAPET H (Glenister and Klapper, 1966), and to samples from S of McWhae Ridge (Glenister and Klapper, 1966, WAPET C/176-198´). Posttornoceras enters in Germany (Becker, 1993) also near the base of the Upper marginifera Zone.

Dimeroceras n. sp. aff. padbergense Zone and Subzone (UD II-I1)

Definition: Entry of a large-sized, compressed new species of Dimeroceras, somewhat resembling the German Dim. padbergense.

Other markers: Compressed relatives of Sporadoceras inflexum (see Petersen, 1975, pl. 5, fig. 10).

Reference section: Casey Falls. Also known in lateral continuation at "Calyx Creek". Currently, evidence is lacking from contemporaneous beds around Mount Pierre.

Conodont correlation: By superposition, still lower part of Upper marginifera Zone in the reference section; probably also in Germany (Enkeberg).

Cycloclymenia n. sp. Subzone (UD II-I2)

Definition: Entry of a new, constricted species of the normally rare goniatite genus Cycloclymenia.

Remarks: The marker species is associated with globally youngest Armatites planidorsatus in a narrow faunal band, which allows a local subdivision of UD II-I. The marker genus has a strange re-occurrence in much younger, Upper Famennian, beds of Germany.

Reference section: Only known from Casey Falls.

Conodont correlation: By superposition, middle part of Upper marginifera Zone (overlapping with the highest range of Palmatolepis quadrantinodosa inflexoidea). Matrix from two German Cycloclymenia specimens also yielded conodonts of the Upper marginifera Zone (Price, 1982).

Sporadoceras equalis Zone and Subzone (UD III-A1)

Definition: Entry of Sporadoceras equalis, assigned by Petersen (1975) to Sp. muensteri which, however, is a younger and widely misunderstood German species (taxonomic revision in Becker et al., 2002).

Other markers: Other sporadoceratids with equally deep adventitious lobes, Protornoceras cf. simplicius (previously used as a zonal marker but most species of the genus need revision), and a new species of Tornia that is more involute than

described Polish species of the rare genus. The large-sized Maeneceras milleri disappears at the base of the zone. The strongly plicate rhynchonellid Hypseloterorhynchus pennatus Sartenaer (1971) is also typical for the subzone.

Reference section: Casey Falls. Also present in the Mount Pierre area (Petersen, 1975, sample To); first recognized in southern Morocco (Becker et al., 2002).

Conodont correlation: By superposition, middle part of Upper marginifera Zone above the last Pa. quadrantinodosa inflexoidea in the reference section; compare correlation of oldest "Sp. muensteri" with the Upper marginifera Zone in Germany (also above last Palmatolepis quadrantinosa inflexoidea; Ziegler, 1962; Korn and Ziegler, 2002).

Pernoceras delepinei Subzone (UD III-A2, possibly ranging into III-B)

Definition: Entry of Pernoceras delepinei or of slightly more evolute related forms (aff. delepinei); also characterized by the regional extinction of Dimeroceras.

Other markers: Perhaps the relative rare Maeneceras descendens.

Reference section: Casey Falls where it is also characterized by the large marker rhynchonellid Polyptychorhynchus cavernosus Sartenaer (1999). Also recognized laterally at "Calyx Creek", in the Mount Pierre area at WAPET H4-7, other sections (Petersen, 1975), and above the fault zone at "Cattle Creek"; perhaps at "Sprite Ridge II" (Virgin Hills) and in "Straight Gully".

Conodont correlation: By superposition, higher part of Upper marginifera Zone in the reference section (compare age of WAPET H4-7 in Glenister and Klapper, 1966), but perhaps ranging into the Uppermost marginifera Zone (= Lower velifer Zone) at "Sprite Ridge II" and "Straight Gully". The corresponding Perno. dorsatum Zone of Germany also falls in the upper half of the Upper marginifera Zone (Becker, 1993; Korn and Ziegler, 2002; Korn, 2004)

Sporadoceras angustisellatum Subzone (UD III-B1)

Definition: Entry of Sporadoceras angustisellatum, identified in David (1950, pl. 25, fig. a) and Petersen (1975) as Sp. posthumum (see Becker, 2002, p. 65) which, however, is not a sporadoceratid but a younger, advanced Posttornoceras.

Reference section: "Straight Gully"; also known at other sections in the Mount Pierre area (Glenister and Klapper, 1966; Petersen, 1975), and perhaps at the NW end of the Virgin Hills (Petersen, 1975, section T40).

Conodont correlation: Uppermost marginifera Zone in the reference section (compare spot sample K495 in Glenister and Klapper, 1966); Upper marginifera Zone to Uppermost marginifera Zone in WAPET H8-11 (Glenister and Klapper, 1966). At the famous Enkeberg in Germany (Korn and Ziegler, 2002) and in Trench II at Seßacker (Ziegler, 1962), the oldest pseudoclymenids enter earlier than Scaphignathus velifer in the highest part of the Upper marginifera Zone. This suggests that the base of the Pseudoclymenia Genozone (UD III-B) correlates with a lower level in the Canning Basin than was thought previously (Becker and House, 1997). Consequently, the angustisellatum Subzone is re-assigned to UD III-B1 which fits the correlation in Morocco (Becker et al., 2002).

Pseudoclymenia australis Zone and Subzone (UD III-B2)

Definition: Entry of Pseudoclymenia australis, a more evolute (see original diagnosis of Delepine, 1935) close relative of the German Ps. dillensis, which both have slightly more advanced sutures and conches than the German marker species of UD III-B, Ps. pseudogoniatites.

Other markers: Relatives of Pernoceras delepinei with lingulate flank lobe, the regionally rare but widespread (Germany, Morocco; Becker et al., 2002) index form Planitornoceras euryomphalum, and a compressed new Falcitornoceras related to Falcit. bilobatum, which was first recognized by Delepine (1935) as Tornoceras sp. nov.? Sporadoceras angustisellatum has its regional acme in this subzone.

Reference section: "Straight Gully"; very fossiliferous at WAPET H and around Needle Eye Rocks (compare Petersen, 1975); perhaps (questionable specimens) recognizable at "Sprite Ridge II" (Virgin Hills).

Conodont correlation: Uppermost marginifera Zone in the reference section and in WAPET H (Glenister and Klapper, 1966). German Pseudoclymenia faunas range from highest parts of the Upper marginifera Zone to the Uppermost marginifera Zone (Price, 1982; Korn and Ziegler, 2002). The conodont correlation of Spanish pseudoclymeniids is unknown (Sanz-López et al., 1999).

Falcitornoceras n. sp. M (upper range) Subzone (UD III-B3)

Definition: Sudden extinction of the very distinctive, evolute pseudoclymenids, well below the entry of oldest clymenids.

Remarks: The extinction of the Pseudoclymeniidae before the appearance of first clymenids was a widespread phenomenon in the palaeotropics, affecting roughly simultaneously Germany, Russia, and Australia. This unexplained small scale global extinction event can be used to distinguish a final subzone of UD III-B which has abundant Falcit. n. sp. M (a relative of Falcit. bilobatum), other longer ranging goniatites, and a still un-named (Sartenaer, 2004) marker rhynchonellid homeomorph of Rozmanaria.

Reference section: So far only recognized in WAPET H.

Conodont correlation: By superposition, higher part of Uppermost marginifera Zone to Lower trachytera Zone; the latter zones cannot be discriminated in the reference section since Palmatolepis rugosa trachytera is lacking in the Canning Basin. In Germany, beds at the top of the Uppermost marginifera Zone and of the Lower trachytera Zone (Kronberg et al., 1960; Ziegler, 1962; Korn and Ziegler, 2002; Schülke et al., 2003; new unpublished data of M. Piecha) contain already oldest faunas of UD III-C (= former do IIIß).

Protactoclymenia euryomphala Zone (UD III-C)

Definition: Regional first entry of clymenids, especially of compressed close relatives of Protactoclymenia euryomphala, which type, however, is younger (UD IV-A; Wedekind, 1914).

Other markers: A new prolobitid genus without constrictions and rare involute clymenids which resemble the poorly known Prot. krasnopolski from Russia.

Reference section: Only recognized at WAPET H. A Cyrtoclymenia sp. indet. reported by Glenister and Klapper (1966) from the Bugle Gap area was not described subsequently and its unusually old conodont age (older than velifer Zone) places doubt on the identification; confusion of convolute tornoceratids with a cyrtoclymenid is possible.

Conodont correlation: Lower to Upper trachytera Zone but there are no distinctive conodont faunas from the reference section. At the Enkeberg in Germany (Korn and Ziegler, 2002), Protactoclymenia enters at a level in the middle part of UD III-C (upper part of Prolobites delphinus Subzone). It may range even lower into the Lower trachytera Zone at Beringhauser Tunnel (Schülke et al., 2003).

Protactoclymenia eurylobica Zone (UD IV-A)

Definition: Entry of Protactoclymenia eurylobica that was originally described by Petersen (1975) as a Platyclymenia (Pleuroclymenia); see generic revision by Becker (2000a).

Other markers: Raymondiceras inceptum and poorly preserved Platyclymenia s. str.

Remarks: The sudden incursion of hypoxic and mixed neritic-pelagic faunas with many cyrtospiriferids and true Platyclymenia in the lower Piker Hills Formation suggests correlation with the global and transgressive Annulata Event (Becker and House, 1997; Becker, 2004a). A similar faunal assemblage with true Raymondiceras is typical for the far distant Trident Member of the Three Forks Formation of Montana.

Reference section: Piker Hills, section B.

Conodont correlation: Probably Upper trachytera Zone (= level of Annulata Event and of oldest true Platyclymenia in Germany, Korn and Luppold, 1987) to Lower postera Zone (upper part of annulata Zone of Germany; Korn and Ziegler, 2002; Schülke et al., 2003). Conodont faunas from the reference section are zonally undiagnostic but lack index forms of younger zones. Po. collinsoni is first recorded somewhat above the base of the reference section and may indicate the postera (Belka in Ginter et al., 2002) or Lower to Middle styriacus Zone (Druce, 1976, p. 184). However, the range of the species is not really correlated with the deeper-water conodont succession. The Trident Member of Montana falls in the Upper trachytera Zone (Klapper, 1966; Sandberg and Klapper, 1967).

Protoxyclymenia sp. Zone (UD IV-B/C)

Definition: Entry of Protoxyclymenia, probably including Laevigites ? sp. indet. mentioned from the "Productella Zone" by Teichert (1949), which included the Piker Hills Formation.

Reference section: Only known from Piker Hills (Petersen, 1975). Re-sampling did not provide new material of this important marker genus. However, higher beds of Section B have large calcareous cyrtoclymenids, assigned by Petersen (1975) to Cyrto. cf. stenomphala, which need closer study and which may fall in higher parts of the Platyclymenia Stufe. There is also a rather large Platyclymenia fragment; similar giants enter in Morocco (Korn, 1999; Becker et al., 2002) above the Annulata Event.

Conodont correlation: In Thuringia (section Alte Heerstraße, goniatites in Müller, 1956; conodonts in Brügge, 1973), Protoxyclymenia occurs first in limestone nodules that range, by superposition, from a high part of the Lower postera Zone to the Upper postera Zone. However, the genus is also known from the next younger ammonoid zone (UD IV-C), which correlates with the Upper postera (Schülke et al., 2003) and with the Lower expansa Zones (Wäschholz, conodonts in Korn and Luppold, 1987).

Endosiphonites n. sp. Zone (UD V-A1)

Definition: Entry of a new species of Endosiphonites with very shallow lobe on inner flanks that is closely related to Endo. muensteri from SW England and Morocco and to Endo. bowsheri from New Mexico.

Remarks: Endosiphonites (including Costaclymenia as a subjective junior synonym, Becker et al., 2002) is the international marker genus of UD V-A1 and enters in the Dasberg Event beds of Morocco (see also Korn et al., 2000; Ginter et al., 2002), the Montagne Noire, and Germany. The first record of the genus in the Caning Basin shows that the youngest influx of ammonoids in marginal slope deposits of the reef complex was caused by the global Dasberg Transgression. Close rela-

tionships of Falciclymenia bowsheri Miller and Collinson (1951) from the Box Member of the Percha Shale of New Mexico with the type species, Endo. muensteri, were first recognized by Price (1982). True Falciclymenia (see revision in Becker et al., 2002) are more involute and have a lobe centered on the umbilical sean.

The single clymenid described by Glenister (1962) and Petersen (1975) from the subsurface Clanmeyer Siltstone could either belong to the Rodeckiinae (protoxyclymenids and relatives) or Clymeniidae, which gives an age range from UD IV-B to UD V-B. It is not possible to refer this important specimen to one of the two youngest Canning Basin ammonoid levels.

Reference section: Dingo Gap, Section A (youngest marginal slope facies of Napier Formation).

Conodont correlation: The Dasberg Event beds of Morocco start at the boundary between the Lower and Middle expansa Zone (unpublished new data provided by S. Kaiser, Bochum; Ginter et al., 2002). Correlation of the basal part of the Dasbergian with the Middle expansa Zone is now also indicated for the Rhenish Massif (transgressive Upper Knoppenbissen Formation, Piecha, 2004). The Box Member of the Percha Shale has been dated as Lower expansa Zone (Sandberg et al., 1989) but the conodonts recorded by Sandberg (1976, sample 8, lacking Polygnathus styriacus) are not in conflict with a slightly younger age.

Facies distribution of Canning Basin ammonoids

Ammonoids occur in a wide range of micro- and biofacies in the Canning Basin reef complexes but are normally lacking in true reefal and platform limestones. A bedding-plane assemblage of Beloceras in platform facies N of Galeru Gorge is a rare exception that was swept in during a storm. Dead Devonian ammonoids normally became quickly water-logged, which prevented long post-mortem floating. Since most shells were rather thin, reworking normally led to crushing, resulting in poor preservation in high-energy depositional settings. However, there are some faunas from basin-floor sandstone fans and rather coarse detrital and crinoidal limestones in the Virgin Hills area. The calculated maximum implosion depths (Hewitt, 1996) of most goniatites was less than 200 m with the lowest value for Beloceras (108 m), and the highest for Tornoceras (ca. 300 m). This suggests that exposed parts of the inter-reefal basins did not exceed more than 300 m of water depth, with the majority of ammonoids living in outer shelf slope environments, which is supported by their wide distribution in marginal slope environments.

The basinal, Lower to Middle Frasnian Gogo Formation is characterized by low-diversity ammonoid assemblages preserved in limestone or in siliceous concretions, which are rich in styliolinids and radiolarians. Single concretions may contain monospecific mass occurrences or associations of two or three species. The youngest goniatites of the Gogo Formation at Outcamp Hill fall in the Prochorites alveolatus Zone (UD I-F1) and are characterized by joint occurrences with orthoconic cephalopods and various pelagic bivalve genera, such as Buchiola and Ontaria.

Hypoxic Lower to Middle Frasnian tongues within the Sadler and Virgin Hills Formation contain originally pyritic, secondarily haematitic or goethitic, low to moderately diverse ammonoid faunas. The youngest faunas fall in the Mesobeloceras housei Zone (UD I-G2a) at WCB 366. The regionally oldest goniatites (basal UD I-B) from near Siphon Spring are monospecific and part of a mixed neritic-pelagic association dominated by brachiopods. This composition suggests that the topographic relief of the reef complexes was still relative low in the basal Upper Devonian, increasing, however, rapidly during the Lower Frasnian. Middle Frasnian faunas from around McIntyre Knolls have only restricted and accessory benthic faunal elements, including Buchiola, and some gastropods. A brachiopod-dominated, mixed neritic-pelagic and low-oxygen biofacies, but rich in plant remains, re-appeared in the Upper Famennian (UD IV-A/C) Piker Hills Formation, at a time when the exposed parts of the basin had become too shallow for fully pelagic faunas. This is also evidenced by the complete lack of the deeper shelf Palmatolepis biofacies at that time.

The best preserved and richest ammonoid assemblages are from reddish, condensed, and micritic cephalopod limestones of the Virgin Hills Formation, which represents a rather oligotrophic biofacies. Examples are the Middle and Upper Frasnian beloceratid beds, which transgressed reef slopes. The typical assemblage also contains small bivalves, such as Buchiola, weakly ornamented ostracods, trilobites, small gastropods, crinoids, solitary deeper-water corals, subordinate fish remains, nautiloids, and rare rhynchonellids. As in the Montagne Noire (House et al., 2000b, p. 68) and Morocco (e.g., Becker and House, 2000b), the lack of Beloceras in Upper Frasnian faunas, for example in the local equivalent of the Upper Kellwasser Beds ("Manticoceras" guppyi Bed), suggests changes in trophic conditions. Other moderately diverse faunas occur in argillaceous or bioclastic limestones of the Upper Frasnian and Famennian. A somewhat shallower setting is indicated by associations with diverse sponges, receptaculitids, large-sized gastropods and bivalves, and large-sized rhynchonellids. During transgressions and times of sediment starvation, low-diversity or monospecific goniatite associations can be found in stromatolites (e.g., at Casey Falls and in the Virgin Hills) or other microbialitic limestones (e.g., at WAPET C). Even shallower water depths are indicated by the incoming of typical neritic brachiopod groups, such as atrypids (only in the Frasnian, e.g., at "Flare Hill") or spiriferids (e.g., in the Middle Famennian at "Sprite Ridge"). Successions of more proximal reef talus, consisting of breccias, slump beds, debris flows and proximal turbidites, which are often dolomitized, contain only few or no goniatites. This applies, for example, to the massive limestones in the top part of the Virgin Hills Formation in the Bugle Gap, to most parts of the Frasnian Sadler Formation, and to the Famennian Napier Formation. The youngest clymenids from the Napier Formation at Dingo Gap suggest a very brief re-immigration of ammonoids into a more proximal slope succession with a transgressive pulse.

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Fig. 1. Geological map of the area of ammonoid investigation E of Fitzroy Crossing, showing the topographical sheet boundaries and position of ammonoid localities, including used WCB reference numbers (based of Geological Survey of Western Australia maps, drawing by MRH).

Fig. 2. Geology of the McWhae Ridge area showing the position of several localities referred to in the text. Biostratigraphical marker units were mapped by MRH and RTB; the pre-Virgin Hills geology was mostly taken from Playford (e.g., 1981).

Fig. 3. Correlation of ammonoid and conodont zonation in the Canning Basin (conodont data supplied by G. Klapper, see Klapper, this vol.).

Fig. 4. Stratigraphical ranges of main ammonoid localities, plotted againms both the regional ammonoid and conodont scales (conodont data supplied by G. Klapper).

Fig. 5. Stratigraphical ranges of important Canning Basin marker ammonoids, plotted against the regional ammonoid biozonation.

Fig. 6. Frasnian marker goniatites of the Canning Basin.

a. Koenenites n. sp. B, GSWA, S of Siphon Spring, x

b. "Hoeninghausia" pons, DSWA, Sadler Ridge, x

c. Timanites angustus, GSWA, Timanites Hill, x

d. Probeloceras lutheri lutheri, DSWA, WCB 365, x

e. Gogoceras nicolli, GSWA, WCB 366, x

f. Mesobeloceras housei, GSWA, WCB 366, Bed 5°, x

g. Manticoceras koeneni, GSWA, WCB 369, Bed, x

h. Playfordites tripartitus, GSWA, WCB, Bed, x

i. Clauseniceras n. sp., GSWA, x

j. Gen. nov. n. sp., GSWA, Phacopid Gully, Section C, Bed, x

Fig. 7. Famennian marker goniatites of the Canning Basin.

a. "Falcitornoceras" n. sp., GSWA, Casey Falls, Bed, x

b. Oxytornoceras n. sp., GSWA, x

c. Praemeroceras primaevum, GSWA, WAPET C, x

d. Paratornoceras polonicum, GSWA, WAPET C, x

e. Acrimeroceras n. sp., GSWA, WAPET C, x

f. Posttornoceras glenisteri, x

g. Cycloclymenia n. sp., Casey Falls, x

h. Pseudoclymenia australis, WAPET H. x

i. Protactoclymenia euryomphala, WAPET H, x

j. Falciclymenia n. sp., Dingo Gap, x

ON THE POSITION OF STANDARD BOUNDARY D_1/D_2 AND D_2/D_3 LEVELS IN THE SECTIONS OF THE PECHORA PLATE AND THE URALS

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The detailed subdivision of the Devonian of the Pechora plate including the Timan, Pechora syneclise and the western slope of the North Urals reached great success by the end of the last century. It is proved by the existence of appropriate parts of the unified and correlation stratigraphic scheme of the Devonian of the Russian plate and the Urals accepted in 1988 and 1990 (Rzhonsnitskaya & Kulikova 1990 ; Antsygin et al. 1993). Though a number of important problems of stratigraphy and correlation of the section of the region are still unsolved.

In the unified part of the stratigraphic scheme of the Devonian of the Urals the international standard boundary between the Emsian and Eifelian stages (=boundary D_1/D_2) in the base of the conodont zone *partitus* is located in the upper part of the Biya horizon (Antsygin et al. 1993). The same opinion is hold by the authors of the last paper on this subject (Abramova & Artjushkova 2004). However this position represents a logical paradox as two stratigraphyc (isochrone) boundaries of different ranges – horizons and stages – coexist. Providing that Emsian/Eifelian boundary corresponds to standard conodont boundary *patulus/partitus* it requires correcting the Biya/Afonin boundary in the Urals. Earlier in the stratigraphic scheme of the Urals the latter together with the Kojva horizon was corresponded to the regional zone *Anarcestes, Megastrophia uralensis, Zdimir pseudobaschkirica* (M.Breivel' et al. 1980). It should be noted that the suggested

certain **volume change is related just to the Biya and the Afonin horizons but not to local formations which volume should be left permanent in the appropriate sections.** In the Ural stratotypes they are Biya and Afonin suites (=formations).

Another problem level – the boundary between the Givetian and Frasnian corresponding to the boundary between the Middle and Upper series of Devonian. Most Russian researchers agree that its level should be raised comparing to its position at the end of the 80s. However opinions on the boundary position in specific sections of regions and subregions are greatly different. For the Urals and the Russian Plate the opinions scatter greatly: from the base of the Timan and Kyn horizons to the base of the Sargaevo horizon.

The boundary point in the stratotype in Montan-Nuar is chosen according to the first appearance of not a typical form *Ancyrodella rotundiloba* but its older variation inside zone *Lowermost asymmetrica* (Sandberg, Ziegler & Bultynck 1988). After the revision of polygnathides and ancyrodels conducted in 1989 this level was in the middle of the lower subzone of zone *Mesotaxis falsiovalis* (Sandberg, Ziegler & Bultynck 1989). In practice it is a question of position of boundary D_2/D_3 according to the earliest appearance of Ancyrodella - *A. pristina, A. soluta* and *A. binodosa*. However these forms, together with the zonal species *M.falsiovalis*, are found very rarely or far upward the section alongside with more advanced forms. Especially it is applied to the sections composed of shallow-water deposits. On the area of the Russian Plate the most representative and well studied sections of the interval at question are spread in the South Timan within the Ukhta anticline. They are the Timan and Sargaev deposits, the first of them is represented by the suite of the same name, and the second – by the Ust'-Yarega suite. Their well studied sections are exposed in the core of the Ukhta anticline by the Ukhta River and its tributaries and also by a number of wells (Tsyganko & Bogatsky 2002; Yudina & Moskalenko 1997).

In the present time there is no doubt that the Ust'-Yarega suita sensu (Yudina & Moskalenko 1997) corresponds to the Frasnian. The Timan formation in stratotypes are represented by the lower and upper subsuite which age is interpreted differently (Kuz'min 1995; Yudina & Moskalenko 1997). The invertebrate residuals in the lower subsuite are mainly represented by brachiopods and ostracodes (Yudina & Moskalenko 1997). Judging their spreading the brachiopods are endemics or forms with confined vertical and areal spreading. It is true also for a characteristic species *Uchtospirifer nalivkini*, known beyond the South Timan just in the east (the Volga-Ural anteclise), the south-east (the Tatar and Bashkir arches) and the north-west (Poland) of the Russian Plate. In Poland the deposits with *U.nalivkini* residues are related to the Givetian (Racki 1992). "Purer" endemics are *Devonoproductus karasikae, «Leiorhynchus» uchtensis*. The vertical spreading of *Pseudoatrypa velikaja* and *Cyrtospirifer echinosus* are more extended. They are revealed also in the Upper Timan subsuite and in the basal part of the Ust'-Yarega suite. More ostracods found here are adherent just to the lower subsuite. Conodonts are represented by indifferent form complex known in the knowingly Givetian. The determined palinospectrum is related to the subzone *Perotriletes vermiculatus* of the zone *Acanthotriletes bucerus – Archaeozonotriletes variabilis insignis*. According to T.G.Obukchovskaya et al. (2003) the Givetian age of this subsuite is more probable.

The organic rests distribution in the sections of the Upper Timan subsuite is more complex. In the lower part (outcrop 18 in the Ukhta River), total thickness is more 15 m, numerous residues of brachiopods are present which are dominated by representatives of *Uchtospirifer: U.timanicus, U.rotundus, U.menneri, U.angulosus* (Oleneva 2001). The major part of these species are endemics. Out of them just *U.menneri* is close to *U.nalivkini* by its areal spreading. Also endemics are brachiopods: *Schizophoria uchtensis, Devonoproductus karasikae, Pseudoatrypa nefedovae, Spinocyrtia uchtensis*. It should be noted in advance that in the middle and upper part of the Upper Timan subsuite sensu Yudina & Moskalenko (1997) brachiopods are represented predominantly by endemic forms not transforming into the deposits of the Ust'-Yarega suite. First of all it is related to representatives of *Uchtospirifer*. Among other invertebrate residues occurred in the lower part of the Upper Timan subsuite the corals of Rugosa and ostracods should be mentioned. Rugosa corals are represented by isolated fragments of two types of colonies *Disphyllum: D. virgatum* and *D. paschiense*. The first of them is known in Australia and the Western Europe from the deposits which were previously related to the lower part of the Frasnian (Tsien 1970). In the present time they are related to the Givetian (in Belgium it is an upper part of formation Fromelennes). The species *D. paschiense* was first determined in the Pashia suite of the Middle Urals (Ivanovsky & Shurygina 1980). Now it is widely known in the Urals and Russian Plate in the Pashia and the lower part of Kyn suites. It is rarely found in argillaceous-carbonate rocks of Cheslav horizon (Givetian). Among ostracods both local, endemic forms and the species, determined upward the section too, including the Ust'-Yarega suite, and widely spread in area, are present. Both in the Lower Timan and in the lower part of the Upper Timan subsuites conodonts are represented by indifferent complex with the predominance of the Middle Devonian elements (Kuz'min 1995; Yudina & Moskalenko 1997). The species *Polygnathus lanei* is new here which are traced also in the Frasnian. The presence of this species sets the boundary D_2/D_3 according to A.V.Kuz'min (1995). More considerable renewal of conodont fauna is determined just in the upper part of the subsuite (Fig.1). In particular in the outcrop 13A in the Ukhta River, in bed 3, such species are determined and traced upward the section as *Mehlina gradata, Polygnathus ljaschenkoi, P. pizhmensis.* At the same time forms, according to which the boundary D_1/D_2 in a standard conodont scale (*Ancyrodella binodosa, A.soluta*) is set, are determined in the outcrop 14 in the interval which undoubtedly belongs to Ust'-Yarega suite. The vertebrate complex is considerably increased and renewed on this level comparing to the lower part of the Upper Timan subsuite. According to A.A.Lyarskaya & A.O.Ivanov (Yudina & Moskalenko 1997) the representatives of Bothriolepis and Psammosteus are determined here.

The examination of stratotypes of the Timan and the base of Ust'-Yarega suites results in the conclusion about two most appropriate levels of the boundary D_2/D_3: 1) in the middle part of the Upper Timan subsuite (the base of bed 3 in the out-

crop 13A); 2) on the base of the Ust'-Yarega suite sensu Yu.A.Yudina & M.N.Moskalenko(1997). The second level is undoubtedly more obvious, representative and reliable concerning its validity by macro- and micropaleontologic residues. However the international standard of the boundary at question is met to a greater extent by the level inside the Upper Timan subsuite. If we follow the SDS decisions this very boundary D_2/D_3 should be accepted for the whole region. In this connection, as well as with the Biya horizon, the boundary between the Timan and Sargaevo horizons should be corrected.

In the pre-Ural fore deep and in the western slope of the North Urals the Kyn and Sargaevo horizons thickness is greatly decreased. In the Chernyshev high the major part of the former is corresponded by the Kedzydshor suite, and the Sargaevo horizon is represented by the peritop part of the latter and the lower part of the Vorota suite (Tsyganko et al 1985; A.Yudina 1995). In the Kedzydshor interval of the Sargaevo orizon in the Dershor stream *Ancyrodella solute* are determined. Thus the lower boundary of the horizon in the Chernyshev high is corresponded to the level of a standard boundary D_2/D_3. The situation in the Peripolar Urals is similar. Here in the Syv'yu River in the upper part of the Kedzydshor suite *A. soluta* (A.Yudina 1999) is found(Fig.2); and in the Kozhym River by L.I.Kononova *Polygnathus ljaschenkoi* is determined. In Pay-Khoy the boundary is drawn in the middle of the Put'yu suite by the appearance of *A.rotundiloba* (Kolesnik 2002). However the presence of *A.binodosa* downward the section allows also here to draw the boundary D_2/D_3 on the standard scale level.

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Fig. 1. Sediments of boundary Timan and Ust'Yarega suites(formations) in Ukhta River (South Timan) (by