SILURIAN TIMES
No. 10

A NEWSLETTER OF THE SUBCOMMISSION

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INTERNATIONAL COMMISSION ON STRATIGRAPHY
INTERNATIONAL UNION OF GEOLOGICAL SCIENCES

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SILURIAN FIELD MEETING AND 7TH INTERNATIONAL GRAPTOLITE CONFERENCE –
Dear Colleagues,

I take this opportunity to thank you all, the voting members and corresponding members of the SSS, and those who are interested in Silurian stratigraphy for your concern and support. Thanks to Mike Melchin for doing excellent job on the previous edition of the SILURIAN TIMES.

As you know, one of our major plans for 2000-2004 is to restudy some of the established Global Stratotype Sections and Points (GSSPs) for the Silurian System. The base of the Silurian System and the base of the Wenlock Series, two highlights have been selected and two relative working groups (led by Mike Melchin and Dave Loydell) established. This work does not mean we have only focused on the boundary. It will bring us better to study the biozones or assemblages of various fossil groups below and above the boundaries at the type sections with the others around the world, correlation of the different zonations, the systematic palaeontology of the different groups, and relative global events, geography, oceanography, and many other subjects.

The purpose of this plan does not mean that the achievements and contributions made by the SSS during the period of later 70's and early 80's have been negated. They established the first, uniform framework within a system and made a Common Language among the global stratigraphers. However, science is in progress and research on the Silurian stratigraphy is not an exception. For example, Mike Melchin and Henry Williams (2000) have made progress in the restudy of the graptolites from the basal Silurian strata at the Dob's Linn section. They have proposed a revision to the biostratigraphical definition of the GSSP, that the lower part of the *Parakidograptus acuminatus* Biozone of Williams (1983) are marked by a primitive form of *Akidograptus ascensus* and *Parakidograptus praematurus*. Thus the basal zone of the Silurian System is the *Akidograptus ascensus* Zone, which is overlain by the *acuminatus* Biozone. Further studies of stratigraphy and palaeontology, either from the stratotype or from other sections around the world, are encouraged.

The establishment of a global stratotype is not a final purpose. The restudy is to better understand the various boundaries, and better correlate the relative, recognizable boundary at the type locality with many other sections in the world. This work, therefore, will be of worth for study of global changes, evolution, palaeoecology, palaebiogeography, and many other subjects. This work also needs efficient international collaborations and harmonious coordination. I sincerely hope this study during the period of 2002-2004 will be successful.

I am looking forward to meeting you in Argentina in the August, 2003 (Field Meeting of the Subcommission on Silurian Stratigraphy link with the 9th International Symposium on the Ordovician System and 7th International Graptolite Conference).

All the best,

Rong Jia-yu, 20 May, 2002
EDITOR'S NOTES

This is my second issue of Silurian Times. Silurian Times 9 is still online and both it and ST 10 are directly accessible by links to each other. At some point I may set up a separate home page for the Silurian Subcommission which will contain links to all of the ST issues that can be posted, but that has not happened yet.

In response to one question that I received regarding long-term accessibility of these pages online, my plan is to keep each issue that I do accessible for at least as long as I am editor. Beyond that, access will depend on the choices made by the next editor and also, presumably, changes in the internet and the way such documents may be delivered in the future. If you wish to have a permanent copy of any of these issues of ST, the best bet is to either save them to your own computer or else to print them as a hard copy.

In response to another comment received, I have made the background for this issue somewhat "softer", so as to make the text easier to read. The picture is a trilobite that I collected while on one of the field trips of the James Hall Symposium in 1996. I obtained the image simply by scanning the specimen directly.

I wish to thank all of those who took the time and effort to contribute to this issue. My apologies to Barrie Rickards and Tony Wright for the length it took me to get their piece on the Homerian graptolite extinction on line.

Mike Melchin

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Annual Report of the Subcommission on Silurian Stratigraphy (SSS) of the International Commission on Stratigraphy for 2001

1. Title of constituent body

Subcommission on Silurian Stratigraphy (SSS)

2. Summary table of Silurian subdivisions

<table>
<thead>
<tr>
<th>System</th>
<th>Series</th>
<th>Stages</th>
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<tr>
<td>Silurian</td>
<td>Upper</td>
<td>Pridoli</td>
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<td>Ludlow</td>
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<td>Lower</td>
<td>Wenlock</td>
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<td>Llandovery</td>
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No changes or additions to this scheme have been made during the last seven years. As recently as the last biennial meeting of the SSS in Spain in 1998, the membership confirmed its majority support for the status quo. New officers of the subcommission did not take the decision to reopen nominclatural questions after July 2000 at the biennial meeting of the SSS in Australia, July 2000. However, they did agree that some boundary stratotypes required re-examination (see below).

3. Overall objectives

a) Elaboration and improvement of the standard global stratigraphical (SGS) scale for the Silurian System, including definition of boundaries and the selection of Global Stratotype Sections and Points (GSSP) under IUGS guidelines.

b) Refinement of international correlation within the Silurian System, with particular emphasis on development of a generalized scheme of zonal fossils (left-hand column) for global applications.

c) Stimulation of research and international cooperation, with particular emphasis on the coordination of working groups focused on various zonal fossils such as graptolites, conodonts, chitinozoans, etc.

d) Evaluation and integration of new approaches to the correlation of Silurian strata on a global scale.
4. Organization

The SSS is a subcommission of the International Commission on Stratigraphy, consisting of 15 Voting and 48 Corresponding members. Voting members are selected to achieve regional representation and a balanced stratigraphic expertise. Corresponding membership is open to all individuals demonstrating a commitment to scholarship in Silurian stratigraphy.

Officers:

Chairman: Rong Jia-yu (Nanjing Institute of Geology and Palaeontology, Academia Sinica, Nanjing 210008, People's Republic of China).

Vice-chairman: Tatjana N. Koren (All Russian Geological Research Institute - VSEGEI, Sredny pr. 74, 199026, St. Petersburg, Russia).

Secretary: Michael J. Melchin (Department of Geology, St. Francis Xavier University, P.O. Box 5000, Antigonish, Nova Scotia B2G 2W5, Canada).

The SSS Treasury is maintained as a separate organizational account at St. Francis Xavier University.

5. Extent of national/regional/global support of projects

Membership in the SSS is represented by specialists from 29 countries and from all continents except Antarctica. Most of the major regions of the world with extensive exposures of Silurian strata are covered, especially Eurasia, North America, South America, Australia, and Africa.

The 3rd and 2nd International Symposia on the Silurian System (convened in Rochester, N.Y. in August 1996 and in Orange, New South Wales (Australia) in July 2000 under sponsorship of the SSS) enjoyed significant financial support from educational institutions, private science foundations, and corporate sponsors. Institutional support will also be provided for the upcoming Silurian Field Meeting in Argentina (August, 2003). Ongoing grant support exists for symposia publications through the cooperation of the New York State Museum (Albany) and the Australian Museum (Sydney).


6. Interface with other international projects

SSS members are very active in the IPA international research groups on graptolites, conodonts, chitinozoans, and vertebrates. In addition, there is
considerable overlap of the activities of many SSS members with the Subcommission on Ordovician Stratigraphy, particularly regarding the events surrounding the Late Ordovician mass extinction event and subsequent biotic recovery. The SSS field conference held in Spain and Portugal in 1998 was arranged to coincide with the Sixth International Graptolite Conference. The 2003 SSS field conference is scheduled to be held in connection with the International Graptolite Conference and an International Symposium on the Ordovician System in Argentina.

7. Accomplishments and products generated in 2001

The ninth issue of *Silurian Times* - the official newsletter of the Silurian Subcommission (edited by Secretary Mike Melchin) was circulated in April 2001 to all subcommission members, as well as a broad constituency of Silurian researchers around the world. This is the first year that the newsletter was produced as a world-wide web document and it forms the main part of a new WWW Site for the SSS. Almost all SSS members were able to read the document in this way and relatively few copies needed to be circulated through the normal postal system. By this means, the SSS continues to realize substantial savings in postal costs. In addition, this form of transmission of Silurian Times means that all researchers and members of the general public who have an interest in the Silurian System can learn of the activities of the SSS. In addition, updates to the site can be posted at intervals other than the annual time of delivery so that the news can remain more current.

A decision was made that some the GSSPs of the Silurian System should be re-examined in light of the experience that researchers have had in using these GSSPs as well as new information that had become available since they were established. This decision was based on discussions that took place at the most recent meeting of the SSS in Australia (July 2000), and subsequently received the support of the majority of titular members. It was also decided that initially two stratotypes should be restudied, possibly with others to follow. The two that will be restudied are the Base of Silurian and Base of Wenlock. Full discussions of the rationale for conducting these restudies can be found in the Silurian Times web site at: http://iago.stfx.ca/people/mmelchin/os-gssp9.htm and: http://iago.stfx.ca/people/mmelchin/lw-gssp9.HTM.

Two SSS titular members have been asked to organize new boundary restudy working groups: Mike Melchin (Canada) for the Base of Silurian; and David Loydell (UK) for the Base of Wenlock. They have been given the mandate to organize a working group with broad representation internationally as well as among researchers in the various biostratigraphic and stratigraphic fields that bear upon problems of international correlation. The process of forming these working groups has begun.

The other project that has begun in earnest in 2001 was the planning of the next field meeting of the SSS, in Argentina in 2003, in connection with an Internation Symposium on the Ordovician System and an Internation Graptolite Conference. Field trips itineraries are planned to include many well-known Silurian localities in the Argentine Precordillera. Mike Melchin has been asked to serve as
Technical Programme Co-ordinator for the in-house portion of the Silurian Field Meeting, with assistance from Argentine colleagues. Information pertaining to this conference can be found at: http://iago.stfx.ca/people/mmelchin/isos-igc-sss1.HTM.

8. Chief problems encountered in 2001

A decision was taken in 1998 to divide the keynote manuscripts from the 2nd International Symposium on the Silurian System into two volumes, based on the length of the early manuscripts submitted for editorial review. The last manuscript necessary for the volume on "Silurian Lands and Continental Margins, Exclusive of North America" was collected in March and has now gone through technical and peer reviews. As a result of delays in the review and revision process, the entire volume should be ready to go to press by the end of 2001 or early in 2002.

9. Work plan for 2002

As noted above, the boundary working groups are in the process of being established to restudy the GSSPs at the Base of Silurian and Base of Wenlock. The first step in the restudy process will be an examination of the current GSSP, to see if it adequately serves its purpose of providing a precise frame of reference for workers taking a variety of approaches in stratigraphic correlation. These studies will particularly consider information that has come to light since the establishment of these GSSPs. If such study finds that the current GSSP does not provide an adequately precise and useful point of reference for international correlation, then the task of seeking an alternative GSSP will be undertaken.

In addition to the work on GSSPs, the SSS executive is also concerned with the relative scarcity of reliable geochronological dates that are biostratigraphically well constrained within the Silurian System. At the present time, a small group of Ordovician and Silurian workers are compiling all available data on radiometric dates applicable to the calibration of the Silurian time scale as part of the production of the next edition of "The Geologic Time Scale" for Cambridge University Press. They have also been developing new means of integrating biostratigraphic and geochronologic data into a composite, linear time scale. Once this work has been completed, the SSS executive will consider ways to improve the situation by encouraging its members to collaborate in projects that provide new calibrations for Silurian time. This will also be one consideration of the working groups restudying GSSPs.

Another priority of the SSS is development of a more refined correlation between the graptolite zonation, which mainly represents the basinal facies, and the conodont, palynomorph, and shelly fossil zonations of the shallow marine strata. This is a continuing effort of the Subcommission.

Publication of "Silurian Lands and Continental Margins, Exclusive of North America" by the end of 2001 or early in 2002 will permit work to begin on the third volume from the James Hall Symposium, "Silurian Lands and Continental Margins of North America".
Planning will continue for the Silurian Field Meeting in Argentina, to be held in August, 2003.

The secretary plans to provide web-based archival access to previous issues of Silurian Times, once the new issue is released early in 2002. The plan is to have these available as PDF downloads from the Silurian Times web site.

10. Potential funding sources outside IUGS

A publication fund, based on revenues raised for the James Hall Meeting and ongoing grant contributions is established. These funds are being released to the New York Geological Survey in order to cover initial editing costs of symposium volumes. Other potential funds through the New York State Museum may facilitate publication based on anticipated reimbursement from sales of symposium volumes. The 1998 volume entitled "Silurian Cycles - Linkages of Dynamic Stratigraphy with Atmospheric, Oceanic, and Tectonic Changes" (New York State Museum Bulletin 491, 327 p.) has enjoyed a solid sales profile.

11. Financial statement for 1999

<table>
<thead>
<tr>
<th>Income (U.S. dollars)</th>
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<tbody>
<tr>
<td>1. Carryover from 1999</td>
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<td>2. 2000 ICS subvention</td>
</tr>
<tr>
<td>Total operating funds</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Newsletter production</td>
</tr>
<tr>
<td>2. Postage</td>
</tr>
<tr>
<td>3. Technical (student) assistance with setup of Silurian Times web page (15 hrs @ $8/h)</td>
</tr>
</tbody>
</table>

Total expenditures for 2001 $218.70

Net balance at the end of 2000 $22.27

12. Budget for 2001

<table>
<thead>
<tr>
<th>Budget for 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Production &amp; mailing of newsletter</td>
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<tr>
<td>2. Purchase of software (Adobe Acrobat, full version) for archival storage and delivery of Silurian Times</td>
</tr>
<tr>
<td>3. Student technical assistant for archival storage and delivery of Silurian Times (10 hrs @ $8/hr)</td>
</tr>
</tbody>
</table>

Total Budget for 2002 $230.00

ALLOTMENT REQUESTED FROM ICS FOR 2000 - $200.00
Name of Chairperson: Rong Jia-yu

Date: November 27, 2001

Address: Nanjing Institute of Geology and Palaeontology, Academia Sinica, Nanjing 210008, People's Republic of China

Telephone and Fax: 25-3282169
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Rong, Chairman (China)                                      Johnson (U.S.A)
Koren, Vice-chairman (Russia)                               Kaljo (Estonia)
Melchin, Secretary (Canada)                                 Kriz (Czech Rep.)
Brett (U.S.A.)                                                Lenz (Canada)
Caputo (Brazil)                                              Loydell (U.K.)
Cocks (UK)                                                   Serpagli (Italy)
Le Hérissé (France)                                        Verniers (Belgium)
Jell (Australia)

Corresponding members SSS

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Antoskhina (Russia)                                          Mannik (Estonia)
Baarli (USA)                                                  Marss (estonia)
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Bassett (UK)                                                  Mesteikis (Lithuania)
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Bjerrreskov (Denmark)                                         Norford (Canada)
Bleick (France)                                               Paris (France)
Boucot (US)                                                   Peralta (Argentina)
Chen (China)                                                  Picarra (Portugal)
Chlupac (Czech Rep.)                                         Bogolepova (Russia)
Dufka (Czech Rep.)                                           Predtechensky (Russia)
Einasto (Estonia)                                             Rickards (UK)
Ferretti (Italy)                                              Robardet (France)
Fu (China)                                                    Simpson (Australia)
Geng (China)                                                  Schonlaub (Austria)
Gutierrez-Marco (Spain)                                       Sennikov (Russia)
Hansch (Germany)                                             Storch (Czech Rep.)
Holland (Ireland)                                             Strusz (Australia)
Jeppsson (Sweden)                                            Su (China)
Jin (China)                                                   Teller (Poland)
Kozlowska-Dawidzuik (Poland)                                Tesakov (Russia)
Larsson (Sweden)                                             Walliser (Germany)
Laufeld (Sweden)                                             Yolkin (Russia)
Lawson (UK)                                                   Wang (China)
Legrand (France)                                             Zhang (China)
EVALUATING THE SERIES AND STAGES OF THE SILURIAN SYSTEM

by

Jorg Maletz, Manfred Menning, Thomas Heuse & Dietmar Leonhardt (In the name of the German Subcommission on Silurian Stratigraphy)

The Stratigraphic Commission of Germany is preparing a Stratigraphic Table of Germany 2002 as a reference scale for the lithostratigraphical units found in Germany to be presented as a first draft at the Meeting of the German Geoscientific Societies in Wuerzburg, October 2002. For this purpose the international chronostratigraphic scheme used for correlation of the units was discussed in some detail. It was felt that the Silurian subdivision was exceedingly uneven and the German Subcommission of Silurian stratigraphy was asked whether there are any attempts to modify the scheme to attain a more even spacing of chronostratigraphic units in the Silurian.

The major points of concern is the high number of Series in the Silurian System (4) and that the Pridoli is not differentiated into stages, as well as the extremely unequal length of the individual Series. All Phanerozoic systems consist of two respectively three series and six to 12 stages and all series are differentiated into stages. This fundamental principle of hierarchical balance should have priority and also be attempted for the Silurian System. Moreover, the Silurian is one of the shortest systems with a length estimated at about less than 30 Ma and the Pridoli is by far the shortest series, generally estimated at about 2 Ma to less than 5 Ma.

According to the recent chronostratigraphic scale of Gradstein & Ogg (1996) the Llandovery (15 Ma) alone is longer than the rest of the Silurian (11 Ma) with the Pridoli representing only about 2 Million years. In this respect it was suggested to include the Pridoli as a stage within the Ludlow (with a length of 4 Ma also being of relatively short duration), a step that would considerably enlarge the Ludlow to about 6 Ma in length. Instead of being the only unit in the Phanerozoic time scale with four series, the Silurian would then include the three series Llandovery, Wenlock and Ludlow. The Pridoli would become a stage in the Ludlow Series. This also would be a better alignment with the overlying and underlying Devonian and Ordovician Systems, both including three series and six to seven stages. Consequently the change would serve the purpose of gaining a more even spacing for the series and stages in the Paleozoic.

The time scale of the International Commission on Stratigraphy (ICS 2002) shows the Silurian to range from 440 Ma to 417 Ma. It allocated 12 Ma to the Llandovery, 5 Ma to the Wenlock, 4 Ma to the Ludlow, and 2 Ma to the Pridoli. The International Stratigraphic Chart of the IUGS (2002) shows the Subdivision of the Silurian somewhat differently. The base of the Silurian is taken at 430 Ma and the top is at 410 Ma. In this chart the Llandovery and the Wenlock are only 5 Ma long, but the Ludlow is estimated to be 10 Ma and the Pridoli again 5 Ma long. This is certainly not in accordance with data in Gradstein & Ogg (1996), but it is not our intent to solve these detailed problems.

The time span of the Pridoli has been debated extensively and has been cited as long as 10 Ma (Kleffner 1989, 1995) and as short as 1.5 Ma (Fordham 1998), with a short age preferred in most newer references. Tucker & McKerrow (1995), Tucker et al. (1998) and McKerrow & van Staal (2000) suggest a length of 2 Ma for the Pridoli and Fordham (1998) allows only 1.5 Ma for this interval. As there is no stage shorter than 2 Ma in the entire Paleozoic, the Pridoli with a duration of around 2 Ma can conveniently be classified as a stage and hardly be kept as a stratigraphic unit of a higher rank. It appears to be too short to be recognized as a series in any international
standard and its usefulness might be questioned. It also represents the only series in the whole Phanerozoic without a stage division. According to the roles of the ICS (Salvador 1994) a stage should be correlatable globally, which is undoubtedly the case with the Pridoli.

Surprisingly the graptolite biozonation has been very tight and the Pridoli has been subdivided locally into at least 9 biozones (Urbanek & Teller 1997). This is the finest biozonation available for the whole Silurian interval, but its applicability on a larger, international scale is not proven. Thus, these graptolite biozones must be regarded as local zones without any relevance for a worldwide differentiation within the Pridoli.

There might be an argument to keep the Pridoli as a series due to the attempt to stabilize the international chronostratigraphic time scale. This, however, is in our opinion, not based on sound scientific grounds, but on historical reasoning and might not be a convincing argument.

We here propose to include the Pridoli as a stage in the Ludlow Series, thus restricting the number of Series in the Silurian System to three. We ask the members of the Subcommission on Silurian Stratigraphy and all interested Silurian workers for their comments and discussion.

References.

Thomas Heuse, Thuringer Landesanstalt fur Umwelt und Geologie, PF 24, D-07727 Jena, Germany, t.heuse@tlugjena.thueringen.de
Dietmar Leonhardt, Sachsisches Landesamt fur Umwelt und Geologie, Postfach 1341, D-09583 Freiberg, Germany, Dietmar.Leonhardt@lfg.smul.sachsen.de
In Silurian Times 9 (2001) I wrote an article noting that the Voting Members of the Subcommission on Silurian Stratigraphy agreed that the GSSP for the Base of the Silurian System requires restudy (click here to see this article). They asked me to organize a new Ordovician-Silurian Boundary Working Group to conduct this restudy. Accordingly, I asked all members of the SSS and SOS for expressions of interest in participation in this working group. The following members expressed varying degrees of interest:

Guillermo Albanesi - Argentina
Gladys Ortega - Argentina
Fons Vandenberg - Australia
Chen Xu - China
Rong Jiayu - China
Wang Xiaofeng - China
Tatiana Koren' - Russia
Svend Stouge - Denmark
David Harper - Denmark
Robin Cocks - UK
Howard Armstrong - UK
Alan Owen - UK

Ken Dorning - UK
Phillipe Legrand - France
Alain LeHerissé - France
Florentin Paris - France
Jacques Verniers - Belgium
Rob Ripperdan - Puerto Rico
Stan Finney - USA
Mike Murphy - USA
Brian Chatterton - Canada
Godfrey Nowlan - Canada
Paul Copper - Canada
Mike Melchin - Canada

Other commitments have prevented me from progressing very far with the organization of this group, but two proposals have been presented at this time. One is the proposal presented by Melchin and Williams (2000) for a biostratigraphic revision of the current GSSP, Dob's Linn. The second, which is included here as a separate article, is the proposal by Chen and Rong for consideration of the Wangjiawan Section, China. Paul Copper has also noted that a wealth of new data have become available from Anticosti Island and that further work is in progress and proposed for O/S boundary sections there.

Other expressions of interest and discussion of this matter are welcome.

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Fax: (902) 867-2457
Since the Dob's Linn section was ratified by the IUGS as the GSSP of the base of Silurian System 17 years ago, this stratotype has been the subject of debate. Recently, most of the titular members of the Silurian Subcommission agreed that the base of the Silurian System should be restudied. Melchin and Williams (2000) re-studied the Dob's Linn section and revised the definition of the base of the Silurian System. Based on the studies of the base of the Silurian from the Yangtze Gorges, in particular the Wangjiawan sections, Yichang, W Hubei, China, we propose here that the Wangjiawan South section may be considered to one of the candidate sections for re-studying of the base of the Silurian.

The Ordovician and Silurian rocks from the Yangtze Gorges were first investigated by Lee and Chao (1924) and the fossils described by Grabau (1924) and Sun (1933). The boundary between the Ordovician and Silurian and the related fossils have been studied by Yin (1949), Mu (1945, 1954, 1962), Ge, Rong et al. (1979), Mu et al. (1984), Rong (1984), Mu, Boucot et al. (1986), Wang (1987), Rong and Harper (1988), and Chen, Rong et al. (2000). An international research group, including Chen Xu, Rong Jia-yu, Fan Jun-xuan, Zhan Ren-bin, M.J. Melchin, D.A.T. Harper, and C.E. Mitchell, is working on the project since the last decade. The biostratigraphy through the Ordovician and Silurian transition (Chen et al., 2000), the distribution of the Hirnantia fauna (Rong et al., 2002, in press), the Hirnantian graptolite fauna and the extinction - survival - recovery bioevents through this time interval (Chen et al., in prep.) have been published or will be published in the coming years. The research group is working on the early Rhuddanian graptolites and the related shelly fossils from the Wangjiawan sections as well as from the other areas of the Yangtze region.

The Wangjiawan Ordovician-Silurian sections yield the Ashgillan Linhsiang Formation, Wufeng Formation, and Kuanyinchiao Beds as well as the Llandovery Lungmachi Formation in ascending order. Three continuous sections through the Ordovician-Silurian boundary, including the Wangjiawan South, Wangjiawan North and the Wangjiawan River side sections, have been studied. Two of these sections were also investigated by the Ordovician Subcommission delegation in 1978, by the participants of the International Symposium of the Ordovician-Silurian Boundary in 1983, of the Fourth International Graptolite Working Group in 1990, and of the IGCP 410 Project field meeting in 1998. During the past 20 years, these sections have also been studied by many colleagues from different countries. The Wangjiawan South section is recommended here as a candidate section of the base of the Silurian. We recognize the potential of the Wangjiawan South section and the nearby Wangjiawan North and Wangjiawan River side sections into the following aspects.

1. The continuity of sedimentation and biozonation. As we published in Chen et al. (2000) the Wangjiawan sections show continuous sedimentation through the perculptus - ascensus - acuminatus zonal interval. Also, it is clear that the sedimentation and the biozonation are continuous through the whole Ashgillian to early Llandovery strata in the Wangjiawan sections.

2. Completeness of exposures. The outcrop through Ordovician and Silurian at Wangjiawan extends 200 m along the roadside and about 100 m along the riverside. No unconformities exist in this interval. Similar strata across the Ordovician-Silurian boundary are exposed at
Huanghuachang, Fenxiang, Wangjiawan, and Tangya, north of the Yichang city along the local highway between Yichang and Nanzhang within a distance of 30 km.

3. Both the graptolites and the shelly fossils are well developed. The shelly Hirnantian fauna is known through middle extraordinarius-ojsuensis Zone to lower persculptus Zone. Trilobites (Zhu and Wu, 1983), nautiloids (Zou, 1985), and other microfossils (Chen et al., 2000; Wang et al., 1987) are also present.

4. Adequate thickness of sediments. At Wangjiawan South section, the Hirnantian extraordinarius-ojsuensis Zone is 0.46 m, the Kuanyinchiao Beds (Hirnantia beds) is 0.31 m, the persculptus Zone is 0.34 m, the ascensus Zone is 0.21 m, and the acuminatus Zone is 1.68 m. Compared with the other well-known graptolite-bearing sections, this is certainly a condensed section.

5. Abundance and variety of well-preserved fossils. Both of the graptolites and shelly fossils are well preserved, in particular, at the Wangjiawan South section. Unfortunately, conodonts are rare because of the absence of the carbonates through the Ordovician-Silurian boundary.

6. Favorable facies and widespread correlation. Both of the graptolite facies Ashgillian and Llandovery strata and the shelly Hirnantia beds are well developed. The graptolite biozones and the Hirnantia fauna possess good potential for global correlation (Chen et al., 2000).

7. Freedom from structural complication. There is no faulting or folding at Wangjiawan.

8. Metamorphism and other alteration. It is not high degree of metamorphism and thermal alteration. We are working on the palynological, magnetostratigraphic and chemostratigraphic studies. Wang Kun et al. (1993) have published their chemostratigraphic result from this area.

9. Amenability to isotopic age determination. A few bentonites through the Ordovician-Silurian transition provide the potential for determine the radiometric dates. A preliminary result has been published by Ross and Naeser (1984) based on the sample from the Wufeng Formation of Yichang. Samples from the Wufeng Formation and the lower Lungmachi Formation have been prepared from the Yangtze region recently.

10. Accessibility. The Wangjiawan South section and the other two, Wangjiawan north and Wangjiawan River side sections are all present on both side of the local high way between Yichang and Nanzhang. There is about one hour drive from the Yichang city to Wangjiawan. Daily local bus between Yichang and Wangjiawan is also available. The traveling, including airline, railway, buses, and ships along the Yangtze River between Yichang and big cities of China are available and comfortable. Tickets can be booked or ordered abroad or within China.

In summary, we propose that the Wangjiawan South section would be a good candidate for the re-study of the base of Silurian. We expect to submit a final report in the near future.

References


THE LLANDOVERY-WENLOCK BOUNDARY: SUMMARY OF VIEWS EXPRESSED

David K. Loydell, School of Earth and Environmental Sciences, University of Portsmouth, Burnaby Road, Portsmouth PO1 3QL, UK (David.Loydell@port.ac.uk)

Thank you to those of you who responded to my request in the Silurian Times for your views on the Llandovery-Wenlock boundary. These are summarised below, although I initially quote extensively from Professor Richard Aldridge's submission, the sentiments expressed being in accord with many that I received.

'General considerations

There is no doubt that from time to time boundary stratotypes defined by previous generations of scientists will prove to be unsatisfactory and a change will be desirable. However, it is imperative that when such changes are made they constitute an unequivocal and significant improvement on the previous situation and that they provide the promise of long-term stability in terms of a wide variety of correlation criteria (e.g. macrofossils, microfossils, palynomorphs, chemostratigraphy). It is essential that we do not generate a situation where boundaries are repeatedly redefined or the result will be chaos.

If the Silurian Subcommission is to be the first to revisit formally defined boundary stratotypes, then it has a singular responsibility to undertake any revisions with particular care and rigour. It must be demonstrable to the wider stratigraphical community that the changes (a) are absolutely essential, (b) are fully agreed by the interested scientific community, and (c) constitute a significantly improved and patently stable definition. Any change must not just satisfy current concerns, but must look forward to all foreseeable uses of the stratotype.

I, therefore, urge the members of the Silurian Subcommission to be extremely cautious about making changes - they are setting precedents that will be followed by those working on other systems (or, if it is done badly, criticised by them as examples of bad practice).

(Prof. R. J. Aldridge, 28/6/01)

'At what level should the base of the Wenlock be placed?'

To this question I received the following responses.

From graptolite workers - from a stability viewpoint most favoured the base of the Cyrtograptus centrifugus Biozone, with the Cyrtograptus insectus Biozone preferred where it had traditionally been the basal Wenlock graptolite biozone.

From conodont workers - using the Irerviken Event Datum Points, Datum Points 2, 3, 4 and 6 have been suggested as possibilities. Of these Datum Point 2 (approximately the level of the existing 'Golden Spike') was most popular, followed by Datum Point 3.

From a chitinozoan worker - either the base of the Margachitina banwyensis Biozone or the base of the Margachitina margaritana Biozone.

From an acritarch worker - the base of the Deunffia brevispinosa acritarch Biozone.
The GSSP for the Base of the Wenlock Series

Several research projects are under way that may enable a decision to be made in the future regarding whether Hughley Brook should be retained or whether a superior replacement is available. It is clear that at the current state of knowledge it would be very difficult (i.e. foolish) to make any decision.

Projects that will have a bearing on the future decision-making process include those of

Gary Mullins (University of Leicester) - chitinozoans from Hughley Brook (Gary is also looking for any identifiable graptolites in the palynological residues).

David Gelsthorpe (University of Leicester) - acritarchs through the Ireviken Event on Gotland.

David Loydell (University of Portsmouth) and Lennart Jeppsson (University of Lund) - graptolites from the Lower and Upper Visby Beds of Gotland.

David Loydell (University of Portsmouth), Peep Männik and Viiu Nestor (Tallinn Technical University) - integrated stratigraphy of cores from Latvia and Estonia.

Mike Melchin (St Francis Xavier University, Antigonish) - leading a team looking at the integrated stratigraphy through the Llandovery-Wenlock boundary in the Canadian Arctic.

Petr Štorch (Institute of Geology, Czech Academy of Sciences), Juan Carlos Gutiérrez-Marco (Instituto de Geología Económica CSIC-UCM), Graciela Sarmiento (Universidad Complutense e Instituto de Geología Económica CSIC-UCM) and David Loydell (University of Portsmouth) - integrated graptolite and conodont biostratigraphy in Spain.

If all, or most, of these and other relevant projects currently being undertaken are sufficiently completed, then perhaps it would be appropriate to devote a session to the Llandovery-Wenlock boundary at the next Silurian Subcommission Meeting. For the present it is clear that it is research that is required, not discussions or meetings.

THE LUNDGRENI BIOZONE MASS EXTINCTION: NOT SO TIDY

BY

R. B. Rickards & A.J. Wright

In a recent issue of Silurian Times (no 9, 2001, p. 44) Lenz and Kozlowska-Dawidziuk discuss what they consider to be two anomalies in the otherwise tidy mass extinction at the end of the lundgreni Biozone. The first "anomaly" concerns our 1995 record from Quarry Creek, NSW of Monograptus sp. ex. gr. flemingii in the ludensis Biozone. This they dismiss as "some type of badly deformed pristiograptid", which is quite wrong. We understand that they did not examine all the specimens we figured; nevertheless if one examines Rickards et al. (1995, especially but not only Figure 30A) the retroverted hooks are clearly visible. We are in no doubt that these admittedly badly preserved forms are robust Monograptus s.s. They also ask for a re-examination
of the Rickards (1970) record of *M. flemingii elegans* Elles from the *ludensis* Biozone. This record was based on a number of findings by the British Geological Survey, so all the collections can be re-examined by anybody. We have already done so. The information was later published by BGS (Warren *et al.*, 1984) where they modified the identification to *M. flemingii* aff. *elegans*. There is, therefore, no doubt that in North Wales (Denbigh) a robust *flemingii* - like *Monograptus* occurs in the *ludensis* Biozone. It should also be noted that Warren *et al.* (1984) recorded *P. pseudodubius* (= *P. parvus*; see Rickards *et al.*, 1995) from the *rigidus* Biozone to the *ludensis* Biozone; *P. aff. jaegeri* from the *lundgreni* - *ludensis* biozones; *P. jaegeri* from the *nassau-ludensis* biozones; and *P. sp. nov.? aff. curtus* from the *lundgreni-nilssoni* biozones. One cannot simply ignore these inconveniences. We should also mention that Kozlowska-Dawidziuk (1995, Fig. 7) recorded *Paraplectograptus* and *Eisenackograptus* as ranging through much of the Wenlock and just into the Ludlow. Furthermore Lenz (1993) recorded *Agastograptus clathrospinus* from the *lundgreni* Biozone into the Ludlow, and *Gothograptus eisenacki* from the *lundgreni* Biozone to the top of the *ludensis* Biozone. None of these records supports the statement in the second sentence of the recent Lenz and Koslowska-Dawidziuk contribution to Silurian Times. It may be that the ranges of their forms referred to above have been more recently revised, but if so the Silurian Times article would have been a good place to summarise the changes, given the overall context of their paper. Furthermore, Jenkins (1977) records *M. flemingii* with *M. ludensis* in the Panuara district of NSW: in fact he assures us (pers. comm.) that *M. flemingii* and *M. ludensis* occur on the same slabs in the Ulah district of NSW. In the Lake District/Howgill Fells *Monograptus flemingii* does not occur in the *ludensis* Biozone, but it certainly overlaps with *G. nassa* s.s. Lenz and Kozlowska-Dawidziuk do not discuss *Monoclaimacis ludlowensis*, a Wenlock-like *Monoclaimacis* which also occurs in the *nilssoni* Biozone of Quarry Creek and elsewhere in NSW. And then there is the matter of *Monograptus moorsi* described by Rickards and Wright (1997) from Cobblers Creek in NSW. This is an undoubted *Monograptus* s.s. occurring with *M. ludensis*, *M. sherrardae* and other species. The remarks by Lenz and Kozlowska-Dawidziuk did not deal with other "anomalies". For example Rickards *et al.* (1995) also recorded rare *Testograptus testis* (Barrande) in the *ludensis* Biozone (a species which Rickards and Wright have recently found, rarely, in the *nilssoni* Biozone of NSW, alongside *B. bohemicus*). It is also widely stated (e.g. in the Silurian Times article) that the mass extinction bade farewell to *Cyrtograptus*. This would ignore the record by Rickards *et al.* (1995) of that genus in the *nilssoni* Biozone of Quarry Creek. We have recently found excellently preserved *Cyrtograptus* material in a rich *nilssoni* Biozone assemblage of Bulls Camp Creek (also NSW) confirming our records in Quarry Creek: these forms are almost indistinguishable from some *lundgreni* Biozone cyrtograptids which occur in NSW, as well as on other continents. We should also like to quote from Kozlowska-Dawidziuk, Lenz and Š torch (2001, 162) where they say: "Rickards and Wright (1997) described material from a single collection in New South Wales, Australia, showing morphologic variations ranging from morphs typical of *C. praedeubeli*, to those typical of *C. ludensis*, and, finally to those typical of *C. gerhardi*. Based on these observations they suggested that the three "species" are, in fact, variations within a single species, "*Monograptus ludensis"." This is quite erroneous. The morphological sequence to which they refer, ranging on the one slab from *M. "praedeubeli"* through *M. "ludensis"* to *M. "gerhardi"* is NOT from a single collection in NSW but from Murchison's type slab of *M. ludensis*! Our illustrations clearly state this (Rickards & Wright, 1997, p. 236, Fig. 4 explanation). Whilst there are undoubtedly some sections around the world where these three morphotypes follow each other in time (though not always easy to define or distinguish one from the other; or get the horizons with certainty) there are other sections where all the morphotypes occur as a growth series - young to old - in the one place and the one stratigraphic level. These latter sections appear to be the more offshore, off-shelf, above-slope, or deeper sequences. It is a distinct possibility that early in the *ludensis* Biozone (say *sherrardae* level) *M. "praedeubeli"* - early growth morphotypes - occurs in shallow seas, whereas the full suite of morphotypes occurs off-shelf.
Perhaps then there is greater longevity of the species in off-shelf environments. How then does one explain the apparent sequence of the three morphotypes on the shelf? Well, the recovery from the *lundgreni* Biozone so-called mass extinction was accompanied by a global marine transgression peaking in the *nilssoni* Biozone, so the original shelf seas were deepening through time: hence the occurrence of first two, then three morphotypes occurred. Of course, it must also be remembered that when *M. gerhardi* is recorded - usually toward the end of the *ludensis* Biozone - the *M. praedeubeli* morphotype should occur in the same place because it is the earlier growth stage. All in all it seems to us that the *lundgreni* event and the recovery therefrom is not quite as tidy as Lenz and Kozlowska-Dawidziuk hope for. And why should it be: we have Lazarus taxa and refugia. And, after all, why is it such a big deal to have *M. flemingii* going extinct in the *lundgreni* Biozone, because robust monograptids such as *M. unguiferus* and *M. uncinatus* were present in the *nilssoni* Biozone and presumably evolved from somewhere. Some of these matters are further expanded in a paper Rickards and Wright have submitted on Lazarus taxa, refugia and relict faunas. This should appear in due course.

REFERENCES


A RESPONSE TO
"THE LUNDGRENI BIOZONE MASS EXTINCTION: NOT SO TIDY"

BY

Alfred Lenz and Anna Kozłowska-Dawdziuk

Barrie Rickards very kindly gave us a copy of his and Tony Wright's response some months ago, so in the interests of clarification, and to keep this interesting discussion going, we propose to make a further response. As a first comment, however, we fully realize that in some observations and opinions, we will have to "agree to disagree" and hope that future discoveries will clarify matters.

As a way of approaching this, we will begin with a background to the studies leading to our (some might say 'sweeping!') conclusions. Either one or both of us have, at various times, and in collaboration with several fellow graptolite workers, collected in great detail and literally BED-BY-BED across the lower and upper Homerian interval in Arctic Canada, Poland (borehole cores), Czech Republic, Spain, Portugal, and to a lesser extent, China. In every case, the change from lower to upper Homerian is startling. Furthermore, Koren has collected, in great detail, from a number of very fine sections in Central Asia and we have been privileged to examine this beautifully preserved material. Finally, we have had access to detailed unpublished data generously provided by the late Hermann Jaeger. Based on all these data, all derived from exceedingly well-sampled sections, and all yielding very good to superbly preserved (i.e., isolated, full relief) material, we think it is safe to say that the lundgreni extinction event was a profound and traumatic event for the graptolites, and probably equal to that across the Ordovician-Silurian boundary! For example, a comparison of the lower Homerian lundgreni Biozone fauna described in Lenz and Kozłowska-Dawdziuk (2001) paper with that of the upper Homerian graptolites described in Lenz and Kozłowska-Dawdziuk (2002) will, we think, convince anyone of the profound differences. Moreover, in NONE of the above regions, and all yielding excellent fossil material, has true Monograptus (i.e., those with Monograptus priodon-like thecae) been recovered from upper Homerian strata. So, that leaves us with UK and Australia.

As we were very careful to point out in our comments, we have not seen the UK material, and so cannot directly comment on any of the so-called Monograptus in the upper Homerian there. That then leaves Australia, where the profound differences in opinions lie. While in the Australian National Museum, we examined material from the Quarry Creek district described in Rickards et al. (1995), especially the so-called Monograptus flemingii type, and concluded that it was not true Monograptus, but some kind of strangely deformed pristiograptid. Rickards and Wright obviously disagree with us, and comment that the illustrations clearly show retroverted thecae. But, ironically, that is the very point! Yes we readily agree, their photographs, especially that in Rickards et al., (1995, fig. 30A), show a form that appears to possess retroverted thecae. However, when we examined the actual specimens of the illustrated types (and we naturally assume that only the best material was illustrated), we were and still are, fully convinced that this is NOT a 'real' Monograptus. So here, we must agree to disagree.

We cannot comment on other reported occurrences of Monograptus in upper Homerian beds of Australia, except to say that we are dubious, especially in the case of Monograptus moorsi that shows obvious strong tectonic deformation such that the thecae are considerably stretched in the
ventral direction (and presumably again, the illustrated specimens are the best available from the collection).

Having said this, it is of course, logical and reasonable to suggest that somewhere in the Silurian world, *Monograptus* must have lived on into the late Homerian. For one thing, as Rickards and Wright point out (and we fully agree), a taxon that (basically) reappears in the Ludlow must have had a late Homerian antecedent (in) some place(s) in the world. So maybe Australia and UK were such refugia for *Monograptus*, and are therefore, the exceptions to the 'rule!' Nevertheless, we would strongly argue that this in no way detracts from the severity of the *lundgreni* extinction event. By way of comparison, let us assume that some dinosaur stragglers did range into the Paleocene. Would that make the record and ramifications of the K-T extinction event any less profound? We think not!

As for *Monograptus flemingii* occurring with *G. nassa* in the Lake District, can they be sure what this really means? To be sure, recent studies of Kozłowska-Dawdziuk (1990 and subsequent studies), as well as unpublished work by Jaeger, both on isolated and uncompressed material from the Baltic region, record *G. nassa* only from the upper Homerian, whereas they document DIFFERENT, but very closely related species of *Gothograptus* from the underlying *lundgreni* Biozone. Significantly, the older forms also possess solid apertural hoods, and herein arises the problem. In the absence of either isolated material, or possibly of extremely well preserved flattened material, recognition of the various species of true *Gothograptus* is extremely difficult if not impossible. Two questions then remain: is the form associated with the so-called *M. flemingii* really *G. nassa* and, beyond that, do we know the global biostratigraphic range of true *G. nassa* and of the other closely related species of *Gothograptus*?

The supposed upper ranges of *Paraplectograptus*, *Eisenackogaptus* and the lowest occurrence of *Spinograptus clathrospinosus*, as reported by us at various times earlier, are we readily admit, in error, in part because of a drafting error, but mostly because identificationos were based on flattened specimens leading to some misidentifications. A perusal of Lenz and Kozłowska-Dawdziuk (2001 and 2002) will readily demonstrate the more probable ranges of these taxa; namely, *Paraplectograptus*, *Eisenackogaptus* do NOT range above the lower Homerian, whereas *Spinograptus clathrospinosus* first appears only in the upper Homerian, *praedeubeli-deubeli* Biozone.

Finally, two minor issues. We see absolutely no contradiction in the ranges of *Pristiograptus dubius*, *P. jaegeri* and *P. parvus* crossing the extinction boundary. In fact, we have commented on this several times elsewhere, as have for example, Jaeger, Koren and Urbanek. That this small and tightly knit clade is present on both sides of the boundary is quite reasonable and, in fact to be expected, in view of the fact that they are the purported ancestors of (almost!) all subsequent monograptids. Likewise, we are not the slightest perturbed that a so-called *Cyrtograptus* with complex thecae occurs in the Ludlow. More importantly from our viewpoint, is the fact that it is NOT in the upper Homerian strata! Perhaps this is another example of a lazarus taxon? We do, however, question the advisability of a non-cladium bearing form being called *Cyrtograptus*, a practice akin to calling a unicycle a bicycle!

We have not addressed all of Rickards and Wright's issues but, hopefully, such useful and friendly discussions and exchanges of information can be continued in future newsletters. Finally, we would like to say that the above discussion in no way detracts from the immense and invaluable contribution that Rickards and his Australian colleagues have made in their many recent studies of the Silurian graptolites of southeastern Australia. They are to be congratulated!


**SILURIAN RESEARCH - 2001-2002**

Dick Aldridge (UK) - The last year has been rather quieter than the previous one in terms of Silurian activity, but Gary Mullins and David Gelsthorpe keep me entertained with draft text on acritarchs, and a new research student, David Gladwell (jointly supervised with David Siveter) has started work on the unusual faunas from submarine Ludlow channels in South Shropshire. A small paper on Llandovery conodonts from the Skomer Volcanic Group of SW Wales has also been accepted for publication.

Anna Antoshkina (Russia) - I am continuing work on the Lower Palaeozoic stratigraphy and Palaeozoic reefs of the northern part of the Urals. A detailed lithological investigation of the Silurian rocks has started, and some new result has become.

Howard A. Armstrong (UK) - Over the past couple of years I have been more involved with Ordovician projects. The only papers with direct relevance to the Silurian are listed below. My paper with Pearson and Greselin on single conodont element geochemistry has wider implications and applications. A new project on the end-Ordovician glaciation in Jordan (high latitude Gondwana) has crept into the Silurian with interesting implications for deglaciation and perhaps continued glaciation into the Silurian.

Chris Barnes (Canada) - I continue to complete recent field-based Lower Paleozoic conodont studies in the Canadian Cordillera. Detailed platform to basin transects have been sampled in the southern, central and northern Rocky Mountains (with Leanne Pyle as current PDF). Several papers and a major monograph have appeared recently, are in press or are in preparation. Shunxin Zhang is continuing her Research Associate project using my extensive conodont database to relate conodont biostratigraphy, biofacies and biogeography to the pattern of eustasy and tectonism that affected northern Laurentia in the early Paleozoic, with much of the remaining work dealing with Anticosti Island faunas now completed. Papers in press deal with conodont paleoecology and the response of the conodont communities to eustatic change; another paper is nearing completion on cladisitic analyses.

Richard A. Batchelor (UK) was awarded a Leverhulme Research Fellowship in 2000-2001 to carry out REE, and Sr and Nd isotope analyses on apatite microphenocrysts from Ordovician and Silurian metabentonites. Preliminary results indicate that two separate unique volcanic eruptions in Llandovery times spread over Sweden and Ireland. Isotopic data show that the source of Silurian metabentonites is totally different from that of middle Ordovician metabentonites, and has implications for plate tectonic reconstructions for the Lower Palaeozoic of northern Europe.

Alain Blieck (France) - I continue research in collaboration with Dr. V.N. Talimaa (Lithuanian
Institute of Geology, Vilnius) on Silurian and Devonian heterostracans (vertebrates) from Severnaya Zemlya, Timan-Pechora and other regions of Russia.

Ol'ga K. Bogolepova (Sweden) continues to work in the high Arctic areas of Russia. With regard to a new INTAS project, expeditions to Novaya Zemlya and the New Siberian Islands are planned in the nearest three years. This work, of course, will include the Silurian biostratigraphic, palaeoenvironmental and palaeogeographic aspects. My work in the Silurian is limited at the moment, as we focus mainly on the Cambrian-Ordovician stratigraphy of the lowermost formations overlying the Timanian Orogen complex (TIMPEBAR project, EUROPROBE), however, a paper on the Telychian machaeridians from Severnaya Zemlya (with Annette Hogstrom and Alexander Gubanov) has been prepared and submitted. A paper on the Bohemian type bivalvia from Severnaya Zemlya (presented on PalAss 2000 in Copenhagen) is nearly completed, as well as a manuscript on the Silurian faunas of this area.

Carole Burrow (Australia) - My Ph D was conferred in May 2001, and I spent much of 2001 writing up work covered in the thesis. I attended the Obruchev Symposium 'fishfest' in Moscow (March 2001), and was among the small but diverse gathering at CAVEPS in Christchurch NZ (December 2001). My redescription of the Silurian gnathostomes from the Silverband Formation, the Grampians, Victoria is in press with Alcheringa, and I have submitted a paper to the Journal of Vertebrate Paleontology on a limited acanthodian fauna from the Roberts Mountains Formation (Pridoli), Nevada. My efforts to locate Early Silurian acanthodian fin spines reported from Pennsylvania have come to nought - if anyone out there knows where such beasts might be, I'd love to hear from you! For 2002, my work with a partly Silurian focus includes an attempt to sort out the relationships of acanthodians with dentigerous jaw bones.

Chen Xu (China) - I have two current research projects. 1. Late Ordovician to early Silurian mass extinction and recovery. The working group includes Rong Jia-yu, Fan Jun-xuan, Mike Melchin and Chuck Mitchell 2. Ordovician stratotype sections (including the restudy of the base of Silurian). The working group includes the mentioned persons as well as Stig Bergström, Zhang Yan-dong and others.

Robin Cocks (UK) - 2001 has been a busy year, with work on (i) an invited review (with Richard Fortey) on palaeontological evidence for continental reconstructions in the Ordovician and Silurian, this has included a detailed review of the relationships through time between the various terranes which make up Asia today, particularly North and South China, Sibumasu and the Kazakh terranes, (ii) work with Trond Torsvik (Trondheim, Norway) on the palaeomagnetism and faunal constraints on global biogeography from 500 Ma (the late Cambrian) to 400 Ma (the early Devonian); this work is now in press in the Journal of the Geological Society, (iii) the Malopolska and Lysogory terranes, which together make up the Holy Cross Mountains of Poland, and their continental affinities in the Lower Palaeozoic - in fact they are both an integral part of the main Baltica terrane, despite being south-east of the Trans-European Suture Zone today. (iv) systematic brachiopod studies in press and continuing on the Chu-Ili terrane, Kazakhstan (with Leonid Popov, Cardiff, and Igor Nikitin, Almaty). (v) continuing work on the Ordovician to Devonian stratigraphy of north-west Malaysia and adjacent southern Thailand (with Richard Fortey and Lee Chai Peng, Kuala Lumpur).

Elias, Bob (Canada) - I'm studying various aspects of corals and environmental change during the Ordovician radiation, mass extinction, and Early Silurian recovery. Research with Graham Young focuses on the diversity, paleoecology, community structure, and morphologic trends of coral faunas. A collaborative project is underway with Graham, Godfrey Nowlan, Dave Rudkin and
others on a spectacular Late Ordovician-Early Silurian archipelago with rocky shorelines, exposed in the Churchill area of northern Manitoba. Adam Melzak (Ph.D. student) is working on the Late Ordovician to earliest Silurian rugose corals of Anticosti Island, Quebec. M.Sc. and Ph.D. projects are available (please see http://www.umanitoba.ca/geoscience/faculty/elias/elias.html).

David Gelsthorpe (UK) - I am currently in the writing up stage of my Ph.D. entitled "Microplankton changes through a mass extinction: the early Silurian Ireviken Event", working with Dick Aldridge, Lennart Jeppsson, Ken Dorning, Stewart Molyneux and Alain Le Hérissé. I have presented my Gotland research at Pal Ass in Copenhagen and have been asked to present at the IPC in Sydney in June 2002. My first paper (Testing of palynological processing techniques: an example using Silurian palynomorphs from Gotland) has been accepted for the next issue of the journal Micropalaeontology. I intend to publish the rest of my thesis later this year.

Yngve Grahn (Brazil) - At present I am involved in Silurian and Devonian studies of the Parnaíba and Solimões basins, northern Brazil. A special study of the Silurian (Tianguá Formation) and lower Devonian is on the way from the Parnaiba Basin. Questionable Silurian beds are also known from the lower Jutaí Formation in the Solimões Basin, and this study will be included in a monograph of the Silurian-Devonian, integrated chitinozoan-miospore biozonation in that basin. A paper dealing with late Silurian chitinozoans from south-central Bolivia (Kirusillas and lower Tarabuco formations) will hopefully be published later this year.

Charles Holland (Ireland) – I am continuing to work on nautiloid cephalopods. A paper on the cephalopods from the Lower Hill Farm borehole in the Type Wenlock is now in press. I am nearing the end of work on a large amount of material from Anticosti.

Lennart Jeppsson (Sweden) continues studying the details of Silurian events. It is now evident that these events are the key to a more detailed and more precise Silurian stratigraphy. Not only the conodonts but many other major clades, sediments, and stable isotopes were affected by these events. Two manuscripts together with Mikael Calner about the Mulde Event are being refereed. Lots of data for the Lau Event has been assembled in co-operation with several colleagues. A paper about bias in collecting is in an advanced stage.

Jisuo Jin (Canada) is studying the community structures of the reef-dwelling brachiopods of the Lower Silurian Attawapiskat Formation, Hudson Bay Lowlands. Christopher Stott (PhD student) and Jisuo Jin are examining the faunal turnover across the Ordovician-Silurian boundary, Manitoulin Island and the Bruce Peninsula, Ontario. Paul Glasser (MSc student) and Jisuo Jin are conducting a biometric analysis of the Early Silurian Pentamerus-Pentameroides evolutionary lineage.

Mark Kleffner (USA) - I am currently finally completing a the manuscript on the latest revision of a conodont-, graptolite-, and chitinozoa-based Silurian chronostratigraphy (with James Barrick). I would like to thank everyone who has been kind enough to send me reprints of their recent work, even unpublished or soon-to-be-published information, on conodonts, graptolites, and chitinozoa. Your generosity has made it possible for me to greatly increase range-data on those groups in the Silurian Composite and to accomplish the major revision of the Silurian chronostratigraphy based on those data. The figures are all completed, now all I have to do is finish the text. For any of you who have seen the previous versions of the conodont- and graptolite-based Silurian chronostratigraphy I published (with the extremely lengthy Pridoli and very short Wenlock), you might be surprised at the calibration of the newly revised Silurian
chronostratigraphy. The Pridoli has a duration of 2.8 my, the Ludlow a duration of 3.7 my and the Wenlock a duration of 4.6 my, which is much more in line with the spacing of those Series shown in the standard left-hand column developed by the Subcommission on Silurian Stratigraphy and published in Silurian Times #3 in 1995. The other project occupying my current research time is a study of the Lower Silurian strata of Ohio and Kentucky.

Tatiana Koren (Russia) - I am completing my joint work with Anna Sujarkova on systematic description (18 species), biozonation and phylogenetic implications the Ludlow cucullo- and neocucullograptids from the South Tien Shan'. The work with Otto Walliser on the graptolite-conodont zonal ties from the Upper Silurian sections of Central Asia is in progress. Currently I investigate the taxonomy and stratigraphic ranges of the Ordovician-Silurian boundary diplograptids (the *persculptus* to *acuminatus* Zones) from Röstånga-1 and Lonstorp-1 cores in Scania and Billegrav-1 core in Bornholm. Most of my activity during the first part of the year is dedicated to the struggle with the Ministry of Natural Resources, Moscow, for money for paleontological and stratigraphic investigations in our Institute and in the other organizations within Russia. Since the end of the last year the drastic changes took place with branch geology within the country, and our Institute has no financial support starting from January.

Phillippe Legrand (France) - I am working on the Lower Silurian graptolites in Algerian Sahara and the Palaeogeography of Silurian in Algerian Sahara

Alain Le Hérissé (France) - The main research is focused on the period of the Upper Ordovician to Upper Devonian, with an interest to establish the precise relationship of paleoenvironmental and global paleoclimatic conditions to radiations and extinctions of acritarchs in the primitive oceans. I am engaged on the study of impact of Ordovician glaciation on phytoplanctonic associations in Baltica and North Africa (collaboration with A. Bourahroux, F. Paris and A. Munnecke), on the interpretation of phytoplanktonic signal in relation to isotope excursions, facies and climatic changes in the Silurian of Gotland, Sweden, detailed analysis on acritarch assemblages form the Silurian of Saudi Arabia, Brazil and late Silurian of Libya (paper in press in RPP). I am also working on the applicability of acritarchs (mainly resting cysts of planktonic producers) to the paleogeographical reconstructions, and on upper Devonian acritarchs and other microalgae from the Amazon Basin Brazil, with proposition of a zonation scheme, with measurement of the influence of Frasnian anoxic episodes on the phytoplanktonic associations, and with some precision on the evolution of assemblages before the Carboniferous. (in collaboration with J.H.G. Melo, J. Rodriguez from Petrobras).

Alfred Lenz (Canada) - My main research focus continues to center around Wenlock and younger graptolites of Arctic Canada. Currently, and in collaboration with A. Kozlowska-Dawidziuk (Poland), a large project involving the study of both flattened, and isolated and uncompressed Ludlow and Pridoli graptolites is well underway. Further collecting for this project will continue in the summer of 2002, during which time samples will be taken for palynology (analysis by M. Masiak, Poland), radiolarians (analysis by P. Noble, USA), and geochemistry (analysis by S. Poulson, USA). A second and ongoing project involves a very detailed study of the stratigraphic ranges and diversity changes of graptolites, radiolarians, and palynomorphs, integrated with changes in geochemistry through the lower-upper Homerian boundary (the "lundgreni extinction event" boundary) to the upper Homerian-Ludlow boundary interval. The above four researchers are also involved in this project. Further detailed sampling of this interval will be carried out in the summer of 2002. Smaller projects include the study of a small, but biostratigraphically important Early Silurian graptolite fauna in Argentina in collaboration with A. Cuerda and S. Peralta (Argentina), and Upper Silurian and Lower Devonian gastropods from northern Yukon,
Canada, in collaboration with R. Blodgett (USA) and J. Fryda (Czech Republic). A study of all Silurian retiolitids in relation to the revision of the graptolite Treatise is slowly taking form. The study is being carried out primarily by A. Kozlowska-Dawidziuk, D. Bates (UK), M. Melchin (Canada) and me. Sherrill Senior (University of Western Ontario, Canada) continues her PhD studies on the taxonomy, biostratigraphy and phylogeny of the graptolite *Cyrtograptus* from Arctic Canada.

David Loydell (UK) - Last year saw the completion of the integrated biostratigraphical work on the Aizpute-41 (Latvia) core with Peep Männik and Viiu Nestor. This has been submitted for publication. Foot-and-mouth disease prevented fieldwork being undertaken in the UK, so work on the trace fossil project mentioned in last year's Silurian Times has been postponed to the summer of 2002. Other projects completed in 2001 included the dating of the Thornton (Illinois) *Konservat-Lagerstätte* (with Gary Mullins, Peep Männik, Joanne Kluesendorf and Don Mikulic - in press) and a follow-up to the work on the Banwy River section, an integrated biostratigraphical study of the Telychian-lower Sheinwoodian of Buttington Brick Pit (with Gary Mullins). Both Kate Saunders (Silurian dendroids, especially from Illinois and Waukesha - jointly supervised by Joanne Kluesendorf and Don Mikulic) and Judi Thorogood (Silurian bentonites - jointly supervised by Nick Pearce and Dick Cave) successfully defended their Ph.D.s. Preparation of publications from their theses will take place this summer. Andrew Mallett (jointly supervised by Mark Williams and Maxine Axhurst) is continuing his work on the Hawick Group graptolites of Scotland - his room is filling up with boxes of specimens. Anthony Butcher is making good progress with his work on Silurian chitinozoan biostratigraphy in Illinois. Current research is focusing on Llandovery graptolites from Sweden (writing up work undertaken jointly with Jörg Maletz), Estonia and Latvia (taxonomic work on species identified during work with Viiu Nestor and Peep Männik) and Spain (joint work with Petr Štorch and Juan Carlos Gutiérrez-Marco).

Jörg Maletz (USA) - I am still working mostly on Ordovician graptolite faunas, but have shifted more and more towards the Silurian, especially as the Silurian is more widely distributed in Germany and there was some interest from the German Subkommission on Silurian Stratigraphy. I am staying in Buffalo, N.Y., working with Chuck Mitchell for the next two years and will be focussing more on the taxonomy of Ordovician Dichograptacea. My work on Silurian graptolites includes tracing and re-identifying the huge collections of material described by German workers in the last century, most of which is actually preserved in German museum collections (collections of Hundt, Eisel, Geinitz, Hemmann, Maneck, Muench etc.). I am also working on isolated material of Llandovery graptolites from the *Coronograptus cyphus* to *Streptograptus sartorius* biozones of Dalarna (Sweden). I spent 6 month last year in Portsmouth working with David Loydell, especially concentrating on structural details and evolution in a number of *Streptograptus* species found in the Osmundsberget and Kallholn sections. A paper on isolated faunas from the *Lituigraptus (?) convolutus* biozone is in progress.

Andy Mallett (UK) - Work continues on my project to erect a high-resolution graptolite biostratigraphy for the Hawick Group, Southern Uplands, Scotland. An investigation will also be undertaken into the possible use of chitinozoan biostratigraphy within the area.

Peep Männik (Estonia) - I am actively working on the evolution, ecology and taxonomy of Ordovician and Silurian conodonts from the Baltic, Arctic regions, and Siberia, and on conodont-based, high-resolution stratigraphy. Several joint studies (composition, distribution and evolution of Silurian conodont faunas - with L. Jeppsson from Lund University; "Collaborative research: comparing Upper Ordovician-Lower Silurian carbonate platform in Estonia and Great Basin: a test of the synchrony of sequences and faunal changes" - with Mark T. Harris from the Wisconsin-
Milwaukee University and Peter M. Sheehan from the Milwaukee Public Museum; evolution and high-resolution stratigraphy of the Early Palaeozoic sedimentary basins in northern Baltica and Siberia palaeocontinents - with colleagues from Lund, Vilnius, StPetersburg, Syktyvkar, Ukhta and Novosibirsk; taxonomy, distribution and evolution of Walliserodus - with James E. Barrick from Texas Tech University; etc.) are going on.

Tiiu Marss (Estonia) - My work on the Russian and Canadian agnathans and fishes is continuing. The short version on the Canadian thelodonts and possible chondrichthyans is out, and the monograph itself is nearly ready (we will submit it this year). Three papers on thelodonts from Severnaya Zemlya and on anaspids of northern hemisphere will be published soon.

Michael Melchin (Canada) - I am continuing to focus my research efforts, with a number of students and colleagues, on the biostratigraphy, phylogeny, and biodiversity changes of Late Ordovician and Early Silurian graptolites. I am currently working mainly on Hirnantian and Llandovery faunas from Arctic Canada, China (with Chen Xu, Fan Juanxuan, and Chuck Mitchell), and Scotland (with Henry Williams and Fan Juanxuan). Jennifer Russel recently completed her PhD thesis on the taphonomy of Llandovery graptolites from Arctic Canada. Eugene MacDonald is nearing completion of his PhD thesis on Late Ordovician and Early Silurian Radiolaria from Arctic Canada. Work also continues on co-ordination and writing of the next volume of the graptolite Treatise.

Tatiana Modzalevskaya (Russia) - I'm actively working on preparing of Atlas for publication with Silurian and Early Devonian brachiopods of Severnaya Zemlya Archipelagos. The Silurian athyrisinins from Russia were revised and will be published with co-authors Rong Jia-yu, Fernando Alvarez and Zhang Jau in the paper: "Revision of the Athyrisininae, Siluro-Devonian brachiopods from China and Russia".

Gary Mullins (UK) - I continue to work on a joint project with Dick Aldridge, David Siveter, Ken Dorning, Stewart Molyneux, Alain Le Hérissé, Ruth Richards, Paul Hill, Paul Swire and Jane Washington-Evans on the acritarchs of the Wenlock and Ludlow Series of the respective type areas. A Monograph of the Palaeontographical Society on the acritarchs of the lower Gorstian Stage has recently been published, and a paper on the acritarchs of the lower Ludfordian Stage has been accepted for publication. We also continue to work on projects relating the temporal changes in the abundance, species composition and diversity of the acritarchs with the proposed large scale palaeoenvironmental fluctuations. I am also examining the chitinozoans recovered by John Mabillard and Dick Aldridge from the stratotype section for the base of the Wenlock Series (Hughley Brook, Shropshire). The diversity is higher than described in their paper (Mabillard & Aldridge 1981) and several biostratigraphically diagnostic taxa have been observed which should allow more accurate correlation with this section.

Godfrey Nowlan (Canada) - I am working jointly with Bob Elias (University of Manitoba), Dave Rudkin (Royal Ontario Museum), Graham Young (Manitoba Museum of Man and Nature) on the Ordovician - Silurian rock shoreline near Churchill, Manitoba. Field work is planned for 2002. I am also working on northeastern Ellesmere Island on conodont faunas from Cambrian to Devonian age (some Silurian) - final write-up phase of a large field study. Most other work at the moment is on Cambrian and Ordovician material.

Gladys Ortega (Argentina) - I am working with Guillermo Albanesi on Silurian graptolite and conodont faunas (taxonomy, biostratigraphy, biofacies) from a number of sections of the La Chilea and Los Espejos formations (Late Ordovician - Late Silurian), Precordillera, western
Argentina. I continue working with Silurian graptolite faunas from the Subandean Ranges of Jujuy Province, NW Argentina.

José Manuel Piçarra (Portugal) - Lower Paleozoic stratigraphy of South Portugal (Ossa Morena Zone). Silurian graptolites from Portugal (with cooperation of J.C. Gutiérrez-Marco) and Armorican Massif (Portuguese-French cooperation, project "O Devónico em Portugal e no Maciço Armoricano: estratigrafia de alta resolução, bioestratigrafia e paleogeografia. Implicações na parte sudoeste europeia da Cadeia Variscana", with R. Gourvennec, J. Le Menn, M. Robardet, T. Oliveira and Z. Pereira). 410 and 421 IGCP projects.

Rong Jia-yu (China) is continuing to work on the Silurian brachiopod taxonomy, community, and biogeography, chiefly from China. He is also working on mass extinctions and subsequent biotic recovery in South China. He works together with Xu Hankui, Zhan Renbin and others on the diversity changes of brachiopods through Rhuddanian to Pridoli based on the data derived from China.

Claudia Viviana Rubinstein (Argentina) - I continue working on Lower Paleozoic palynomorphs (acritarchs, cryptospores, spores and chitinozoans) from Argentina. Studies focused on northwestern Argentina include: 1) the Ordovician-Silurian boundary of the Puna. This involves a manuscript I have recently completed together with N. E. Vaccari (CONICET- Univ. N. de Jujuy); 2) the Silurian of the Eastern Cordillera; 3) a continuous and palynologically-rich section comprising the Ordovician-Silurian transition and the Silurian from the Subandean Ranges. The aim of this research in cooperation with R. Astini (CONICET- Univ. N. de Cordoba) is to precise the extension and effects of the Hirnantian glaciation and the Ordovician-Silurian boundary in northwestern Argentina.

Lawrence Sherwin (Australia) continued with mapping of Silurian (not always very fossiliferous) units in the Goulburn district of New South Wales. He co-produced a paper on late Llandovery trilobites from the Cotton Formation, near Forbes, with Greg Edgecombe. This describes three new species, Odontopleura (Sinespinaspis) markhami, Aulacopleura pogsoni and Raphiophorus sandfordi.

Andrew Simpson (Australia) - Work continues with Silurian colleagues Ruth Mawson & John Talent (MUCEP), Lennart Jeppsson (Lund), Anita Andrew & Dave Whitford (CSIRO) on documenting the lithological, conodont biostratigraphy and isotopic data through the Late Silurian Lau Event in the Jack Formation North Queensland. Initial comparisons with the Gotland sequence are revealing some intriguing similarities. Some data will be presented at the IPC2002 meeting in Sydney and the Goldschmidt conference later this year. A brief paper describing a new subspecies of Ozarkodina from the Late Silurian and its correlative value has been submitted. The acid baths at Macquarie continue to yield a corpus of conodont data from sequences throughout eastern Australia for a variety of student projects.

Carl W. Stock (USA) - Heldur Nestor and I continue our investigation of the Llandovery recovery of stromatoporoids following the end-Ordovician mass extinction. In particular, we are now looking at the stromatoporoids from the Aeronian-age Hendricks Formation of northern Michigan. In addition we are collaborating with Paul Copper in a study of the Llandovery-age stromatoporoids from Anticosti Island, Quebec. Several new genera are present in the Anticosti Island Llandovery, and at least one new genus is present in Michigan.
Des Strusz (Australia) has been concentrating on the brachiopods of the long-known Silurian succession at Yass, northwest of Canberra. In the first report, due out in May 2002, the orthides and proterohides are described (for the first time!). This report also has a lengthy discussion on correlation of the various stratigraphic units in the light of conodont and graptolite work done over the last decade or so, and an account (based in part on Link's largely unpublished thesis) of the changes in sedimentation, communities and palaeogeography through the sequence. A second paper, revising (and adding to) the strophomenatan species has been submitted to Alcheringa. Work has now started on the rather limited pentameride fauna. There was also more general discussion of Silurian brachiopod palaeobiogeography in a review paper presented to a meeting on Australian palaeobiogeography in Wollongong in 1997 and published in 2000. Ongoing, but at a rather slow pace, is collaboration with Tim Munson (now in Darwin, with the Northern Territory Geological Survey) on Silurian coral faunas. One review paper has been published, with John Pickett, on tabulate (and chaetetid) biostratigraphy, and work has started on a revision of Etheridge's tryplasmatid species. A study of the fauna from the Micalong Limestone, west of Canberra, was started before Tim left for Darwin, but is temporarily in abeyance.

Susan Turner (Australia) - Analysis of records of Cambrian and Ordovician vertebrate, so-called vertebrate and vertebrate-like remains has led also to consideration by Alain Blieck (UST Lille, Godfrey Nowlan (GSC Calgary) and myself of the earliest Silurian record also (see refs below). I am at work on Early and late Silurian microvertebrate assemblages from arctic Canada - material from Devon Island with Chris Barnes (UVic), and one from Somerset Island (with Dr Jim Savelle, McGill). With Carole Burrow I began working on microvertebrate material from the Helderberg Group of New York State collected by Dr Jim Ebert (Earth Sciences Department, SUNY College at Oneonta); acanthodian remains support a Pridoli date.

Jo Vergoossen (Netherlands) - Main present research themes are: Late Silurian fish faunas (microvertebrates) from the Öved Sandstone Formation, Scania, southern Sweden; Late Silurian fish faunas (microvertebrates) from Baltic-derived erratics from the Netherlands; microvertebrates from Ludfordian (Thelodus sculptilis Zone) fish/conodont faunas from (Baltic-derived) algal (Sphaerocodium) limestones; Late Silurian (inter)regional microvertebrate correlation within the Baltic area; Late Silurian fish faunas (microvertebrates) from the Oslo basin, Norway; Late Silurian - Early Devonian fish faunas (microvertebrates) from the UK; Revision of the late Silurian poracanthoid acanthodians (microvertebrates) from the Baltic region; Late Silurian Nostolepis taxa from Laurussia. Other research themes are: Late Silurian fish faunas (microvertebrates) from eastern Canada (Nova Scotia); Late Silurian - Early Devonian microvertebrate correlation within Laurussia.

Jacques Verniers and students (BELGIUM) (Lab. Palaeontology, Ghent University) - Much attention was paid to Ordovician and only little on the Silurian this year. Thijs Vandenbroucke finished his preliminary study of Chitinozoans of the Upper Ordovician and lower Silurian of the Girvan area, Schotland (Vandenbrouche et al. in press). can Jacques Verniers and co-workers could finish the revision of all existing formal and informal formations and members of the Lower Palaeozoic of Belgium. The Chitinozoan study on samples from seven Silurian formations of the Brabant Massif (Ronquières and the Monstreux areas) is in press. Within the PACE network and EUROPROBE we synthesised the knowledge on the eastern part of Avalonia and in a part to the east coined far-Eastern Avalonia (between Belgium and Ruegen-Pomerania). It contains also a model for the Lower Palaeozoic evolution and collision history of these two microcontinents (Verniers et al. In press). We will continue on the publications on Chitinozoa and lithostratigraphy of the Silurian and Ordovician outcrop areas or boreholes of the Brabant Massif, Condroz ridge, Romania, etc.
Viive Viira (Estonia) - Work continues on late Wenlock and Ludlow conodonts and biofacies from northern East Baltic.

Graham Young (Canada) - I'm working on various aspects of Paleozoic paleoecology, and on coral diversity and distribution before and after the Late Ordovician extinction event. Collaborations with Bob Elias examine diversity, community structure, and morphology of Late Ordovician and Early Silurian coral faunas. A large field project with Bob, Dave Rudkin, Godfrey Nowlan, and others assesses a paleoenvironments around a unique Late Ordovician-Early Silurian archipelago, in the Churchill area of northern Manitoba. Stephen Kershaw (Brunel University, England) and I are completing a manuscript on growth banding in Paleozoic corals and stromatoporoids, comparing Ordovician material from Manitoba with Silurian fossils from Gotland.

RECENT PUBLICATIONS OF SILURIAN INTEREST


Kříž, J. 2001. Enantiomorphous dimorphism in Silurian and Devonian bivalves; Maminka BARRANDE, 1881 (Lunulacardiidae, Silurian) - the oldest known example .- Lethaia, 34:309-322, Oslo.


Strusz, D.L., in press 2002 - Brachiopods of the orders Protorthida and Orthida from the silurian of the Yass Syncline, southern New South Wales. Alcheringa


NEW NAMES AND ADDRESS CHANGES

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