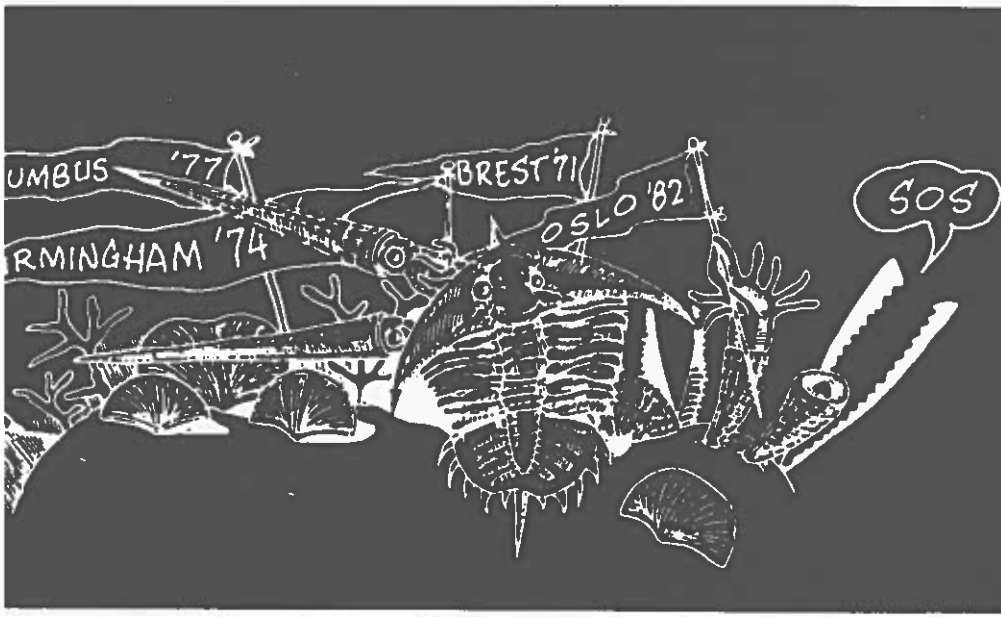
rdovician EWS



IUGS COMMISSION ON STRATIGRAPHY
COMMISSION ON ORDOVICIAN STRATIGRAPHY

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Cover design by Reuben J. Ross III and Len Hay

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NOTES FOR CONTRIBUTORS

Correspondence, reviews (and lists) of recent publications, brief summaries of current research, notices of relevant local, national and international meetings, and additions, deletions or changes to list of Ordovician workers will be welcomed.

Contributions should be in English, types single spaced (double space between paragraphs) on white paper - print area should not exceed 18.5 x 26 cm. Copy should be mailed flat (with cardboard protector) to Barry Webby, Department of Geology and Geophysics, University of Sydney, N.S.W. 2006, Australia.

Unless otherwise stated, Barry Webby is responsible for statements made in this issue of ORDOVICIAN NEWS.

ANNUAL REPORT OF THE SUBCOMMISSION ON ORDOVICIAN STRATIGRAPHY

The Subcommission on Ordovician Stratigraphy reports the following activities during 1985.

1. Ordovician Correlation Chart Series

The Subcommission continues to produce the series of correlation charts for Ordovician strata in major regions of the world aiming at establishing a data base for later global analysis of Ordovician events. R.J. Ross, Jr. is Editor of the Series.

One chart dealing with the regions of Kazakhstan and Middle Asia of the Soviet Union (I. Nikitin and colleagues) has been received by the Editor and is currently in press. Other charts in final stages of preparation include: South America (F.G. Acenolaza, B.A.J. Baldis and others), Central Europe (B.-D Erdtmann and others), Norway and Sweden (D.L. Bruton and V. Jaanusson), North Africa (P. Legrand and M.J. Destombes), Greenland (J. Peel) and the remaining parts of the Soviet Union (I. Nikitin and others).

2. Ordovician Chronostratigraphy Working Groups

The six regional Ordovician Chronostratigraphy Working Groups continue to focus on problems of correlation and use of the various internal divisions of the Ordovician. The most active groups in the past year have been those from China and Australasia.

(a) China

Members of the Chinese Ordovician Chronostratigraphy Working Group were able to have fruitful discussions about stages and series with W.T. Dean, Chairman of the British Chronostratigraphy Working Group during his visit to China in September. The need for separate 'regional' stages for different parts of the world was noted, and that for China, the Ordovician stages were best based on the graptolite sequence. Among the on-going projects, Chen Xu and Zhou Zhiyi are working on the divisions and definition of the Ordovician Series and stages in China. Others are carrying out detailed work on potential stratotypes of stages used in China, for example, based on the graptolite zonation of the Hanjiangian and Shikouan stages (Caradoc), and on the graptolitic and conodont-bearing successions of western Xinjiang and western Zhejiang. Conodonts are also being used to correlate between the graptolitic facies of western Zhejiang and the shelly sequences of the Yangtze and North China Platforms. Liu Yiren of the Geological Survey Team, Xiangtan, Hunan Province, a graptolite and trilobite worker, has been added to the list of member of the Working Group.

(b) Australasia

Replies to the questionnaire concerning Ordovician chronostratigraphic classification in Australasia circulated by the Co-chairmen of the Working Group, R.A. Cooper and A.H.M. VandenBerg in 1984 are now being collated, and a summary statement for the various regions

(shelly facies of the Tasman Fold Belt and the Australian Craton, and the graptolite facies of Australian and New Zealand) is now being prepared by Cooper, VandenBerg and Webby. Following the compilation we will send copies of the report together with its recommendations to all Ordovician workers in the region, to give them an opportunity to make additional comments, before it goes any further.

3. Subcommission Newsletter

The third issue of 'Ordovician News' was printed and circulated in May 1985. Like the first two issues published in 1983 and 1984, it was 32 pages long and distributed to approximately 420 specialists, with an additional 80 copies available for later distribution on request. The Secretary of the Subcommission continues to act as Editor of 'Ordovician News'.

4. Subcommission Membership

No new titular or corresponding members have been proposed in the last year. However, it is with much regret that we record the death of one of our titular members, Dr. Marina Chugaeva on 25 February 1985 in Moscow. Dr. Chugaeva's important contributions to the work of the Subcommission included her documentation with M.K. Apollonov of the very complete Late Cambrian to Early-Middle Ordovician Batyrbay section in Kazakhstan, her Ordovician trilobite studies, and her assistance and hospitality to all the Ordovician participants of the 27th International Geological Congress in 1984.

5. Participation in Cambro-Ordovician Boundary Working Group Meeting in Calgary, July 1985.

Many members of the Subcommission attended the Calgary meeting in July and contributed to the discussion which led to a series of recommendations for boundary definition. These include (a) that the stratotype section should be of low thermal maturity so that non-biological methods of correlation could be applied, (b) that conodonts should be the prime guide for selection of the boundary within a stratotype, and (c) that the boundary should be above the base of the proavus zone, but 'closely below' the sudden appearance of nematopherous graptolites. The choice of suitable sections for international stratotype was narrowed down to two prime candidates - north western Newfoundland (Green Point or Broom Point North) or the Dayangcha Section, Jilin Province, P.R. China. Further work is being carried out on the Chinese section.

6. Ordovician - Silurian Boundary - a final decision

The Ordovician-Silurian Boundary Working Group was disbanded in mid year following the ratification by the Commission of Stratigraphy and IUGS of the boundary at the base of the acuminatus zone at Dob's Linn, Scotland. A book edited by L.R.M. Cocks and R.B. Rickards providing a world-wide analysis of the boundary remains to be published.

7. Plans for work in 1986

Continued progress is expected to be made in the major programmes of work by the Subcommission, namely (a) in compiling Ordovician Correlation Charts under the Editorship of R.J. Ross, Jr., and (b) in focusing on problems of correlation and use of internal stratigraphic divisions within the Ordovician by the six chronostratigraphy Working Groups. Delays have been encountered in establishing Ordovician Geochronology and Geomagnetism Working Groups but it is hoped that these will become established with active programmes of work during 1986. A further issue of the newsletter 'Ordovician News' will be published and distributed early in 1986, and perhaps a second late in the year, if sufficient funds are available.

November 14, 1985.

MARINA CHUGAEVA - IN MEMORIAM

It is with deep regret that we record the death of Marina Chugaeva in Moscow on 25 February 1985. Many members maintained close contacts with her, especially those with common trilobite interests. They will feel a very considerable sense of loss, as do all of us who so much enjoyed her friendship and help during the IGC meetings in Moscow in August 1984, and subsequent field excursion to the Cambrian-Ordovician section of the Batyrbay ravine in Kazakhstan.

IUGS ORDOVICIAN CORRELATION CHARTS

Soviet Union, Part 1 (Kazakhstan and Middle Asia): The series Editor, Reuben Ross Jr., has now received copy of the Ordovician Chart and text for the region of Kazakhstan and Middle Asia. With the help of IUGS funding this part should soon be seen in print.

South America: The chart prepared by F.G. Aceñolaza, B.A.J. Baldis and others is also now with the Series Editor.

ORDOVICIAN CHRONOSTRATIGRAPHY WORKING GROUPS -

PROGRESS REPORTS

China

The following annual report of the Chinese Ordovician Chronostratigraphy working Group (COCWG) has been received from Drs. Chen Xu and Zhou Zhiyi (Nanjing Inst. Geol. Palaeont., Academia Sinica), dated 5 Oct., 1985:

The members of COCWG are organized by the Working Group and supported by the different units where they work to examine the sections, particularly those which will possibly be the stratotypes of the stages used in China.

1. Shuangjiakou section, Qidong County, SE Hunan Province, a complete graptolite zonation of the Hanjiangian to Shikouan stages (Caradocian) will probably be erected. Drs. Liu Yi-ren and Fu Han-ying have collected graptolites from this section layer by layer. In the spring of this year, Chen Xu was invited by them to visit this section.

2. The Ordovician in Western Xinjiang was investigated by Chen Xu, Xu Han-Kui and their colleagues. The conodonts from there were identified by another member of COCWG, Dr. Wang Zhi-hao.

3. The treatment of the rocks and identification of the conodonts from the graptolite bearing beds of W. Zhejiang have partially been completed by Dr. Yao Lun-qi. The result suggested that correlation between the graptolite sequence in W. Zhejiang and the shelly assemblages in the Yangtze and North China Platforms is possible. Some progress in the Ordovician conodonts sequence has recently been made by Dr. Wang Zhi-hao.

4. Dr. Chen Jun-yuan and his colleagues are working in the boundary between Cambrian and Ordovician at Dayangcha, Jilin Province, NE China.

5. A Chinese Ordovician brachiopod sequence is being prepared by Drs. Rong Jia-yu and Xu Han-kui.

6. Dr. Zhou Zhi-yi returned to China in June of this year. He will join Chen Xu in working on the division and definition of the Ordovician series and stages in China.

7. The COCWG was very glad to meet Prof. W.T. Dean, the Chairman of the British Ordovician Chronostratigraphy Working Group in Nanjing at the end of September. An interesting discussion was arranged. They recognized that different stages would be needed in the different regions or continents. However, the different scales of the Ordovician series between Britain (six series) and the other countries (two or three series) are noted.

8. The majority of the COCWG members prefer to establish the Chinese Ordovician stages based on the graptolite sequence. The stages and biozones established by Prof. Mu (1974, 1980) are as follows:

Britain	China		Graptolite biozones in China
Ashgillian	Wufengian	W6	Diplograptus bohemicus
		W5	Paraorthograptus uniformis
		W4	Diceratograptus mirus
		W3	Tangyagraptus typicus
		W2	Dicellograptus szechuanensis
		W1	Amplexograptus disjunctus yangtzensis
	Shikouan	Sh2	Dicellograptus johnstrupi
		Sh1	Orthograptus quadrimucronatus
Caradocian	Hanjiangian	Ha2	Dicranograptus clingani-Climacograptus spiniferus
		Ha1	Pseudazygograptus-Climacograptus wilsoni
Llandeilian	Huloan	Hu3	Dicranograptus sinensis
		Hu2	Nemagraptus gracilis
		Hu1	Glyptograptus teretiusculus
Llanvirnian	Ningkuoan	N9	Pterograptus elegans
		N8	Amplexograptus confertus
		N7	Glyptograptus austrodentatus
		N6	Cardiograptus amplus
		N5	Oncograptus magnus
Arenigian		N4	Azygograptus suecicus
		N3	Didymograptus "protobifidus"
		N2	Tetragraptus fruticosus
		N1	T. (Etagraptus) approximatus
Tremadocian	Xinchangian	X3	Adelograptus-Clonograptus
		X2	Aletograptus-Triograptus
		X1	Staurograptus-Anisograptus

North America

Drs. Tom Bolton and John Repetski were established as Co-chairmen of the North American Ordovician Chronostratigraphy Working Group at the meeting of Friends of the Ordovician held in Orlando on 29 October 1985. The meeting was attended by 21 people, and the following statement was circulated by the co-chairmen as a basis for further discussion:

The North American Ordovician Chronostratigraphy Working Group of the IUGS Subcommission on Ordovician Stratigraphy was formed to address, and recommend solutions to major long-standing problems in regional and international correlation of Ordovician rocks. Topics to be addressed include:

1. Reexamination of series terminology adopted in the area (and stages, if time permits).

2. Consideration of thick successions with diverse faunas (particularly those of zonal value) as candidates for alternative series definition.

3. Recognition of the levels of major faunal breaks/events that can be used for international correlation.

4. Establish, where possible, an intergration of zonal schemes and determine specific tie points between existing zonations.

5. Review the applicability of the British Standard Series to North America and determine if the lower boundary of each series can be recognized in North America.

6. Recommend what series classification(s) should be formally adopted for North America.

As a starting point for discussion vis a vis items 1, 5 and 6 (Ordovician Series), note that the three most recent comprehensive correlation charts differ in their treatment of Lower (Canadian vs Ibexian) and Middle (Whiterockian and Mohawkian vs Champlainian) Ordovician Series.

Should the Canadian Series be redefined, and a stratotype section formally proposed, to reflect long-time usage (and utility) as proposed by Teichert & Flower (1983; Newsl. Stratigr., v. 12, p. 162-165) and as used on the COSUNA and Canadian charts?

Are there compelling reasons to have a different Middle Ordovician Series in Canada and the United States? If not, what's the best solution that promotes intracontinental correlation?

From Blackriveran upward the North American Stage nomenclature is reasonably stable, but the Lower Ordovician Series still lacks a widely-accepted stadial subdivision. Can this subdivision be accomplished, or is it even needed (the Whiterockian Series or Stage apparently had a duration as long as or longer than the Canadian/Ibexian Series)?

Anyone wishing to comment in writing on any of these topics should contact one (or both) of the Working Group co-chairmen: John Repetski, USGS, Washington, D.C.; Tom Bolton, Canadian G.S., Ottawa.

We will summarise the comments received and circulate these to those interested (North American members and corresponding members of the Subcommission on Ordovician Stratigraphy and those who sign the sheet at this meeting).

There was also discussion about the use of the COSUNA Stratigraphic correlation charts of the United States and it was pointed out that the Ordovician Stages set out in the chart were already years out of date and the radiometric dates were way out. It was recommended that the IUGS charts prepared by Barnes et al. (1981) and Ross et al. (1982) should be used, and not the COSUNA chart.

ORDOVICIAN-SILURIAN BOUNDARY - A GLOBAL ANALYSIS

A volume is currently being compiled and edited by L.R.M. Cocks and R.B. Richards, and will be published as a substantial contribution to the British Museum (Nat. Hist.) Bulletin. The contents will include descriptions of Ordovician-Silurian boundary sections in Europe, Asia, Africa North America, South America and Australia, and of the more important biotas (such as the acritarchs, brachiopods, chitinozoa, conodonts, graptolites and trilobites).

CAMBRIAN-ORDOVICIAN BOUNDARY WORKING GROUP

A highly successful meeting of the Working Group was organized by Dr. Brian Norford (Chairman of the W.G.) at the University of Calgary from July 14-18, 1985. The meeting was attended by 21 participants, comprising the Chairman (Dr. Norford), Vice Chairman (Dr. J. Shergold), Secretary (Dr. Jim Miller) and other voting members (Drs. R.A. Cooper, Cowie, Erdtmann, Lu and Ross). Others included Drs. Bruton, Chen, Derby, Kennedy, Kirschvink, Landing, Palmer, Ludvigsen, Westrop and J. Wright, and Messrs Hoffknecht and Ripperdale. The following is a summary report of the meeting prepared by Brian Norford, and already circulated as Appendix I in Circular No.22 (May 1986) of the Working Group:

"The meeting consisted of two and a half days of discussions and business sessions at The University of Calgary, together with a mid-session day devoted to a field-trip to examine the boundary interval at Wilcox Pass, southwestern Alberta. The field trip provided an excellent opportunity for intensive informal discussions of topics raised within the earlier sessions. The meeting was well attended, with 8 of the 14 voting members present, together with 13 corresponding members and guests.

Presentations were made to update information on the prime stratotype candidate sections previously visited by the Working Group at Naersnes (Norway), Batyrbay (Kazakhstan), Bryn-llin-fawr (Wales), and the Broom Point-Green Point region (Newfoundland). Other stratotype sections visited previously by inspection teams of the Working Group were not presented at Calgary as candidates for the international stratotype. In addition, Drs. Lu and Chen made a detailed presentation of a newly discovered important stratigraphic section at Dayangcha (People's Republic of China) and recommended it for consideration as the international stratotype. The Dayangcha Section was not available for examination when a delegation from the Working Group visited China in 1983. Documentation consisted of a volume of detailed papers describing the Dayangcha Section together with an excellent video presentation, narrated by Dr. Erdtmann who visited the exposure in early 1985.

Other presentations dealt with the effectiveness of trilobite biostratigraphy, conodont biostratigraphy and graptolite biostratigraphy for regional and intercontinental correlation and also the present usefulness for correlation of other groups of fossils. The philosophy was expounded of systemic boundaries and their documentation by stratotypes. Sea-level changes and sedimentological parameters were reviewed, as were magnetic stratigraphy, concentrations of trace elements and other geochemical characters. Paleomagnetic studies and trace element signatures were described as having excellent potentials for nonbiostratigraphic correlation but both require rocks of low post-depositional thermal histories because moderate temperatures modify the patterns established at the times of deposition.

All the presentations were characterized by frank and constructive discussion, with many of the participants having detailed first-hand knowledge of the specific stratigraphic sections and of the distributions, stratigraphic ranges and taxonomic difficulties of individual species and subspecies.

The meeting culminated with an extensive business session at which the strong points and the weak points of fossil groups and of specific stratigraphic sections were assessed and detailed. To each section the following parameters were applied to focus discussion.

1. Quality and completeness of exposure, its continuation vertically and laterally, weathering conditions of bedrock.

2. Lithological characters, facies represented, depositional environment, appropriateness of thickness of sequence.

3. Continuity of sedimentation, presence and significance of scours and disconformities.

4. Structural complexity of exposure, thermal maturity of rocks.

5. Accessibility of locality, in terms of climate factors, travel costs, political accessibility for bona fide scientists, feasibility for conservation measures to be established and applied to a locality, appropriate sampling procedures and volumes for bona fide scientists.

6. Fossil abundance, diversity and continuity within stratigraphic section.

7. Effectiveness for biostratigraphic correlation from stratigraphic section to other parts of the world.

8. Feasibility of stratigraphic section for magnetostratigraphic studies and geochemical analysies.

The discussion produced a number of recommendations (see below, listed A-D) to be presented as a formal ballot to the voting members. These suggest that conodonts should be the prime biological group used for correlation of a stratotype section and for the level should be closely below the first occurrence of nematophorous graptolites within the sequence. The rocks within the stratigraphic section should be of low thermal maturity. Concerning which locality would serve best as the stratotype, the participants agreed that no one locality could be expected to be perfect. The meeting did identify Dayangcha (Xiaoyangqiao) and Broom Point-Green Point as the two localities most appropriate to serve as the single international stratotype for the Cambrian-Ordovician Boundary. A vast amount of detailed information is available concerning the two sections at Broom Point, the section at Green Point, and neighbouring stratigraphic sections in northwestern Newfoundland. In contrast, details of the Dayangcha Section are not as well known and as thoroughly debated and the Chinese locality has been examined by only one foreign member of the Working Group. In the interests of achieving prompt resolution of the task of the Working Group, a motion was proposed that Broom Point-Green Point be chosen as the stratotype. The motion was defeated by vote of the people present at the meeting, but like all other decisions reached at Calgary, the recommendation is subject to ratification by formal ballot of the voting members.

The meetings closed with a sumptuous banquet of Canadian specialties, including char, codstongues, fiddleheads, maple syrup, pemmican and prairie-oysters."

The Chairman, Dr. Norford, has added that the 'following recommendations were achieved and will appear in a formal ballot of all voting members:

1. Stratotypes should be of suitably low thermal maturity to be useful for most known non-biological methods of correlation. According to the present status of palaeomagnetic studies, this means a conodont alteration index of 2 or less.

2. Conodonts should be the prime guide for selection of the boundary within a stratotype.

3. The boundary should be above the base of the proavus conodont zone and should be selected 'closely below' the evolutionary burst in graptolites documented by the appearance of nematophorous graptolites. This recommendation requires that such graptolites be well documented within the stratotype section.

4. No recommendation as to whether the base of the intermedius conodont zone or the base of the lindstromi conodont zone would be the most appropriate level.

5. Only two of the stratotype candidates considered at the meeting were considered to be prime candidates according to our specifications: northwestern Newfoundland (Green Point or Broom Point North) and the newly described Chinese section (Dayangcha Section, Jilin Province).

6. Deferred a recommendation on the selection of the international stratotype until details of the Dayangcha Section were better known. There was a motion to select Newfoundland now and not wait for the further details on Dayangcha but the motion did not pass'.

(B. Norford in litt. to B.D. Webby, dated August 6, 1985).

A ballot to be sent to voting members is seeking responses to the following resolutions:

A. 'The group basically wishes to adopt the simple principle of driving a "golden-spike" into a stratigraphic section as the method of selection of the boundary'.

B. 'We resolve that we will select conodonts as the primary guide for a horizon close to but below the first influx of nematophorous graptolites'.

C. 'It is desirable that the stratotype section have potential for future study of paleomagnetism, geochemistry and other non-biological correlation tools'.

D. 'Yes - we accept a decision now that the Newfoundland region gives an acceptable section to serve as the international stratotype. The precise section and level to be selected by the Newfoundland geologists and recommended to the Working Group'.

'No - we wish to defer a decision until we know much more about the Chinese Section at Dayangcha'.

Arrangements are now well in hand to publish the proceedings of Calgary meeting in a special issue of the Geological Magazine. It is hoped that contributions will include reviews of conodont, graptolite and trilobite biostratigraphy of the boundary interval by Miller, Erdtmann and Shergold, respectively, reviews of ocean geochemistry by Wright and palaeomagnetic data by Kirschvink, updates of the boundary sequences at Naersnes, Norway by Bruton, Batyrbay, Kazakhstan by Apollonov and others, Bryn-llin-fawr, Wales, by Rushton, the East Baltic region by Kaljo, the Dayangcha sections, P.R. China by Lu, Chen and others, north-western Newfoundland by Barnes and others, and a discussion of the philosophy for selection of an international stratotype by Norford.

As mentioned elsewhere in this issue of ORDOVICIAN NEWS, members of the Working Group have been invited to attend a final meeting to inspect the Dayangcha sections in the People's Republic of China in July 1986.

Further details of the activities of the Cambrian-Ordovician Boundary Working Group are included in Circulars No.21 (May 1985) and No.22 (May 1986) of the Working Group, compiled by the Secretary, Jim Miller.

Circular No.22 included the following items:

1. Results of the Plenary Meeting at University of Calgary, July 1985.

2. Working Group Meeting in China, July 1986.

3. New data about potential shato type sections in Jilin province, China.

4. New data about potential stratotype sections in Newfoundland, Canada.

5. New data about potential stratotype sections in Kazakhstan, U.S.S.R.

6. New guidlines and statutes of the International Commission on Stratigraphy.

7. Recent publications.

8. Members' comments.

'News of studies on Potential Cambrian-Ordovician Boundary Stratotypes in China'

Circular No.4 (August 1985) prepared by Dr. Chen Junyuan announces the Cambrian-Ordovician boundary field excursion at Dayangcha in Jilin Province during July 1986, and points out that there is an unbalanced composition of the IUGS Cambrian-Ordovician Boundary Working Group membership, with Europe (7 voters), North America (4 voters), Oceania (presumably Australasia) (2 voters) and Asia (1 voter).

The Chairman of the International Commission on Stratigraphy, Dr. John Cowie, has advised that the final submission of details for international stratotypes such as that for the Cambrian-Ordovician boundary will be required by August 1988 (see Episodes vol.8 p.86).

GUIDELINES AND STATUTES OF THE INTERNATIONAL COMMISSION ON STRATIGRAPHY

The part of this document prepared by John Cowie, Chairman of the Int. Comm. of Stratigraphy, in March 1986, which deals with boundary stratotypes is reproduced herein:

B.I. Introduction

1. Historical geology depends on positional relationships of rock and mineral bodies and identification of earth's evolutionary trends. "The importance of the boundary stratotype lies in its role as a future anchor to which all subsequent correlations can be tied, even if new palaeobiological or physical methods become available: and the importance of the boundary stratotype is because it is "the only place where we actually know (by definition) that time and rock coincide within our classification" (HOLLAND, 1984:149).

2. Global Boundary Stratotype Sections and Points (GSSP) allow maximum flexibility with the use of multiple hypotheses to give minimum ambiguity and the greatest likelihood of stability. It is essentially a unique and specific point in a specific sequence of rock strata in a unique and specific geographical location. This Boundary Stratotype Section and Point is the designated type of a stratigraphic boundary identified in published form and marked in the section as a specific point in a specific sequence of rock strata and constituting the standard for the definition and recognition of the stratigraphic boundary between two named global standard stratigraphic (chronostratigraphic) units.

The prefix Global is used to emphasise that the GSSP is a unique time signal for the world geological stratigraphic time scale.

Insistence on a Boundary Stratotype Point is in order to define without doubt an instant of geological time. A horizon will, at the GSSP locality, contain the Point but the horizon may, traced laterally, be diachronous (cutting across time-planes) and may drift away from the instant of time defined by the point thus vitiating the unique concept. The correctly selected GSSP gives an actual point in rock and is not an abstract concept - all other methods can prove to be diachronic. It will be expected to remain fixed in spite of discoveries stratigraphically above and/or below. The main criterion must be that any horizon and point selected must be capable of being correlated over wide areas by any or all available methods. In a world which is not ideal it is most unlikely that all selected stratotype points can meet all the ideal requirements and stratigraphy must be a practical subject and responsive to the needs of working geologists.

The type locality of a GSSP is the specific unique geographic locality in which the stratotype is situated. A submission to ICS of a GSSP cannot be ratified on the basis of a recommended stratigraphic level only: the geographic locality must be exactly and precisely given.

The use of the prefixes holo-, para-, neo-, lecto-, hypo- to stratotype does little or nothing to assist in the definition of a GSSP for the purposes of international acceptance by ICS. Bodies of ICS may, for their own purposes wish to use prefix terminology but for the present at least ICS will not ratify it.

It is considered preferable not to use parabiological analogies which imply unsound analogies and cause confusion (e.g. holostratotype or parastratotype) but to confine nomenclature, for ICS candidates, to two categories of stratotype:

(a) global stratotype section and point (GSSP) and (b) auxiliary stratotype point (ASP) - the latter will be particularly useful in drawing upon stratigraphic correlation between markedly different facies, e.g. New Red Sandstone contrasted with marine Triassic or Devonian neritic facies contrasted with pelagic facies.

Supplementary sections furnishing additional elements of correlation will in any case be helpful and should be published but designations like "para-" or "hypostratotype" should be avoided as diluting and clouding the value of the GSSP. "It is not reasonable to expect the Commission on Stratigraphy presently to handle the matter of parastratotypes in a formal way. There is too much other urgent primary work on hand" (HOLLAND 1984:151).

The GSSP is unique and should not be subject to competition from these 'failed candidates' or 'syntypes' after a GSSP has been decided upon by ICS and IUGS. Otherwise international acceptance, prestige and respect for GSSPs will be delayed and may be diluted.

ICS still has a great volume of work to get through in the rest of this century and beyond and it will expedite matters if a plethora of lower status candidates are not submitted until the main GSSPs down to stage level are decided. Similarly regional stratotypes are the business of the region concerned and not relevant directly to the choice of a GSSP and the submission to ICS of a GSSP.

3. A Boundary Stratotype Point can be changed if a strong demand arises from further important research but will in the meantime give a stable point in time from an actual point in rock. For a change to be considered by ICS it would require support from 60% of the Voting Members of the ICS body responsible for the Boundary and a 50% + 1 majority of the Voting Members of ICS itself.

Boundary Stratotype Definition is a normative question which can be settled by a vote ... an operational boundary capable of being extended as a line on a map. (GLAESSNER 1984:139).

B.II

Summary requirements for Submission to ICS of a candidate for a Global Stratotype Section and Point (GSSP)

A summary of the requirements are:

1. An explicit motivation for the choice of the boundary level, especially with respect to its correlation potential.

2. A correlation table showing the position of the proposed boundary with respect to former usage and to the most important markers, also clarifying rank and relative position of the unit under question.

3. An explicit motivation for the choice of the stratotype locality, taking into account palaeogeography, facies, tectonic 'environment' and other relevant factors including facility of access.

4. Exact data about the location of the type section and point: coordinates on a detailed topographic map of large scale, explanatory maps, diagrams and photographs (including aerial) and remote sensing.

5. A detailed description of the type section and point with vertical section to a large scale with graphic and written details of all relevant stratigraphic data: lithology, rangechart of index fossils, magnetostratigraphy and geochronometry are very desirable.

6. Relationship of stratotype section and point sequence to globally significant marker horizons in the immediate and accessible region, e.g. faunal or floral zone assemblages stratigraphically above or below the stratotype point, climatic markers such as tillites and many other factors assisting long-range or preferable global correlation. Correlation must precede, and accompany, definition of a boundary. The choice of an appropriate boundary level for the point is only possible in the presence of a marker horizon which has proved to be isochronous within the limits of precision attainable by stratigraphic methods. Auxiliary marker horizons as close as possible to the boundary level will give good approximate stratigraphic positioning where and when the primary marker is missing.

B.III Detailed guidelines for requirements and discussion:

1. Lithological succession, thickness, mineralogy, structure, geomorphic expression and other features. Vertical and horizontal sections, structure sections, graphic presentation of relevant factors e.g. isopachs. Seismic stratigraphy should be utilised. Photographs are particularly helpful.

2. The details of the global boundary section and point and its relationshi- to adjacent units. Markers (isochronous within limit of precision, palaeo-biological, geochronometric, magnetostratigraphic, catastrophic, sedimentological, climatological etc.) near the GSSP and also correlatable with the GSSP succession in the region are of prime importance.

3. Clear and succinct reasons for the choice of the GSSP in both stratigraphic level and geographic location.

4. Methods used (or to be used if ratified) for the actual marking of the GSSP and particularly the actual stratotype point - "the golden spike". This should be a permanent artificial marker but described in position in words and visually by drawings and photographs so that removal by vandals or others does not prevent accurate restoration or replacement.

5. (a) Continuity of sedimentation through the boundary interval - preferably a marine succession without major facies change. A continuous monofacial (or with only rapidly alternating and repeating facies changes) will reduce possible errors resulting from stratigraphic gaps and biostratigraphic limitations due to the occurrence of facies fossils and appearances and disappearances associated with only environmental change and not to biological evolution of lineages.

(b) Completeness of exposure: not in an isolated position but with a succession which can be followed easily - above and below the GSSP and preferably laterally as well.

(c) Adequate thickness of sediments.

(d) Abundance and diversity of well-preserved fossils: appearances and disappearances of single fossil species can be expected to be diachronous and therefore a bad guide for the location of a GSSP. Multispecies fossil zones (e.g. faunal assemblages) may be preferable biostratigraphic signatures for GSSP guidance. Exclusion from consideration of taxa which are palaeoecologically tied to a facies would be the ideal although all fossils are to some extent facies fossils. In order to minimize possible effects of environmental controls on different fossil-groups, recognition of the boundary level should preferably be based on all available faunal and floral data.

The selection of appropriate fossils will vary greatly in different parts of the geological column. Ideally, selection of a point within an evolutionary lineage would be desirable but recognition of such lineages can be subjective and not necessarily more accurate than the recognition of a particular assemblage zone. Such decisions must be left to the experts in each case. The case for autochronology i.e. a single species taken out of a phylogenetic lineage (with its predecessor and successor known in detail) as the biological way of approaching a boundary free of ecological, facial or sedimentary disturbing effect was given by WEDDIGE & ZIEGLER (1979).

(e) Favourable facies for development of widespread reliable and time-significant correlation horizons: this requires that the GSSP should not be in or close to conglomerates, breccias, olistostromes, turbidites or remanie deposits. This should, as far as possible, exclude variation of chrono-stratigraphic or chronometric age within the stratotype section near the stratotype point. Even if at the present stage of research, for example, fossils in derived blocks and surrounding matrix appear to be of the same age the danger exists that new techniques or new finds (palaeobiological or physical such as magnetostratigraphy) might discriminate between the blocks and matrix introducing an unacceptable imprecision in the future. even the "model" decision on the Silurian-Devonian Boundary has had, retrospectively at least, its weakness - the GSSP was placed within a turbidite on the basis of the "first" occurrence of a species. Nevertheless it is the first and longest-lived GSSP and no diarespect can be levelled. The boundary decision is internationally accepted. In 1985 it was sampled for magnetostratigraphic studies.

(f) Freedom from structural complication, metamorphism or other alteration: currently the question of exotic accreted terrains is pressing but the problem of the relationship between present and past position may not adversely affect global stratigraphy. Speculation here, which affects all historical geology, does not need to lead to despair or defeatism.

(g) Freedom from unconformities: an obvious boundary should be suspect. Either it is too obvious because there is a marked change in lithology or because there is a marked change in fauna or flora. In either instance the change may imply a time break, and consequently an unsuitable horizon at which to fix any time definition; no disconformities, unconformities, cryptic paraconformities or time-breaks in sedimentation any longer than a brief diastem can be tolerated close to a GSSP.

(h) Amenability to magnetostratigraphy and geochronometry. Although these factors are mentioned last they are probably the most important for future work and some would argue that no GSSP should be accepted without one or both.

6. One of the main aims of the Boundary Stratotype procedure of ICS is to attain a common language of stratigraphy that will serve geologists worldwide and to avoid the dissipation of energy in petty argument and unproductive controversy. Development of a standard global stratigraphic scale which is stable for a considerable period of time is the objective here. Testing can then proceed. If new developments demand revision it will be set in motion by ICS if a majority (50% + 1) of the Voting Members of ICS support the setting up of a new Working Group. In any case only in very exceptional circumstances will this be entertained until the next International Geological Congress (IGC) but one after the ratification of a GSSP (at present at the 1992 IGC in Tokyo, Japan). Very exceptional circumstances could include: - (i) permanent destruction or inaccessibility of an established stratotype, (ii) violation of accepted stratigraphic principles as clearly agreed by ICS.

Correlation of GSSP with elsewhere: the prefix global means, of course, that intercontinental correlation and with different facies must have been achieved. Choice of GSSP by working groups may involve an interrelated series of decisions in order to achieve optimum acceptability. In the overwhelming majority of cases in the Phanerozoic Eon (ICS is concerned with all Eons) correlation must precede the definition of a boundary but unless preliminary choices are made it may be that progress will be slow as the process of testing a candidate or the competition between candidates may be the required stimulus for the desirable improvement of needed correlation techniques and correlation itself. Correlation must precede the selection of boundary stratotype candidates to a considerable extent but in practice the sequence may be reversed. The finding of the best level and geographical site may have to go on side by side for a time. The choice between two more or less equally suitable boundary levels may be influenced by the availability of a better GSSP for one of them. Correlation to a satisfactory degree is necessary but improvements in correlation should continue after a boundary stratotype has been selected. In this context of correlation (actual at present and with future potential) an ideal GSSP would have the maximum possible correlation by magnetostratigraphic and geochronometric methods: this is of increasing importance for future work. In reality there is probably no GSSP in existence which can satisfy all desired criteria. Compromise seems inevitable if progress is to be made with the global stratigraphic scale. In the Phanerozoic Eon (and with the Precambrian-Cambrian Boundary also) the prime polarity factor being biological evolution, boundaries will normally be guided in their definition by chronostratigraphy (mainly biostratigraphy) but in the Proterozoic and Archean Eons the guidance will be chronometric at the present stage of research. Chronostratigraphy can be expected to be used increasingly for boundaries late within the Precambrian successions.

Because of the multiplicity of criteria involved and the variation in circumstances through the geological time scale it would be unwise (or impossible) to specify which criteria are essential and which are desirable

up and down the scale. Expert assessment must be the responsibility of the appropriate experts in that field of study. It is unlikely that all boundary stratotypes will possess all criteria and some compromise must be expected.

7. Accessibility and Conservation: these two topics are contrasting but complementary factors (two sides of the same coin). Recent experience has shown that if access to an important outcrop is too easy and unrestricted then excessive collecting, even vandalism and plunder, may destroy the outcrop. Conservation and some restriction is therefore necessary in developed regions. Conservation in more remote regions may be easier but this depends on regional geological activity (with helicopters maybe) by outsiders. A stratotype in a large disused quarry may seem ideal until planning permission is given in its urban area for garbage-dumping. In some countries large holes in the ground are at a premium for the growing mountains of garbage which are a costly disposal problem to authorities.

A problem for conservation/access may be weathering which in some cases may be rapid and caused by heavy rainfall forming rapid mud-flows from, for example, a marly sequence. Frost may form screes which can soon cover an outcrop. Outcrops on sea coasts may be subject to very rapid erosion. All are factors which must be considered when choosing a GSSP.

There must be no insuperable physical and/or political obstacles for access by geologists of any nation; without great expense and ideally without much bureaucracy. At the International Geological Congress in Moscow (1984) the plenary session of ICS agreed that a reasonable amount of collecting must be possible at a stratotype section. Although it is difficult for any group of geologists to commit any nation or organization to guarantee access and conservation for the indefinite future, total accessibility must assume considerable importance. One important safeguard is that if there is some prestige and responsibility in being "host" to a Global Stratotype Section and Point (GSSP) then that may in itself guarantee access and conservation. If a GSSP is found not to be accessible in the future this would be a very powerful argument for a reassessment of the geographic location. In a Submission of a GSSP to ICS all these factors should be discussed in detail as far as is feasible.

8. There is a metamorphosis once a GSSP has been ratified by IUGS: -

(i) beforehand all methods of correlation are enlisted to define a globally valid boundary stratotype section and point between what is decided should belong to System X or System Y.

(ii) After the decision the GSSP can be used to indicate without ambiguity what constitutes earliest System X and latest System Y. Correlation has in any case to precede the definition of a GSSP. Possibilities of correlation should be, of course, tested simultaneously at different levels close to the boundary being defined. The most suitable level would then be chosen as the boundary level and strictly defined by a GSSP, becoming thus the only standard of reference.

There is no conflict between the global boundary stratotype concept and global, isochronous, event stratigraphy. The combination of global environmental change and major biotic changes (which may be caused by biological evolution) brings together lithostratigraphy and biostratigraphy to provide event stratigraphy. Stratotypes bring stability through an agreed point in rock representing a unique instant of time (cf. BERRY 1984). The ultimate reference is to rock and not to abstractions.

In this work in the past decade or two much inspiration and guidance has been derived by the international geological community from the brilliantly-expressed published results of the Silurian-Devonian Boundary Committee (McLAREN, 1977), which have the great virtue of being based on practical experience in actually defining a GSSP. One recommendation made by this committee was that, in the case of the Silurian-Devonian Boundary, the "horizon chosen defines the base of the Devonian, and not necessarily the top of the Silurian. Should it subsequently be shown that the selected horizon is at the level of an undetected time break or hiatus, unrepresented by sedimentation in the section, then the time missing would, by definition, belong to the Silurian". (McLAREN, 1977:20).

Although there is no scientific principle involved in considering the base of a unit any more important than the top of a stratigraphic unit, ICS bodies (e.g. Subcommissions) are responsible by convention for the base of their units.

Boundary Working Groups set up by ICS or its constituent bodies must, however, include experts on the unit below as well as experts on the unit above. Hence the appellation of intersystem working groups is the composite term e.g. Silurian-Devonian, Jurassic-Cretaceous etc. The convention that chronostratigraphic units are defined by their lower boundary (which automatically becomes the upper boundary of the underlying unit) is intended to guarantee the creation of a time scale of contiguous units with no man-made gaps or overlaps. This is also one of the justifications for the preference for boundary stratotypes and not unit or composite stratotypes (HEDBERG et al. 1976).

After ratification of the Silurian-Devonian Boundary stratotype in 1972 a period of great activity by ICS and its bodies has resulted in the ratification in 1985 by ICS and-IUGS of a number of boundary stratotypes (Ordovician-Silurian; Series and Stages of the Silurian System; Series of the Devonian System; Pliocene-Pleistocene) (BASSETT 1985).

The submissions to ICS for these and other stratigraphic boundaries illustrate well the substantial progress which has been made during the past 13 years, but there is an undeniable heterogeneity in the format and quality of the presentations and hence the need for the formulation of these guidelines. Guidelines have to reconcile conflicting demands: freedom of scientific opinion and free choice of methods of correlation on one side and a reasonably unified procedure which ensures that the basic questions are answered. It is essential that the general geologist is helped and not just the specialist stratigrapher. The method of ratification by the Voting Members of ICS (representing the whole field of stratigraphy) and by the IUGS Executive (representing all aspects of the geological sciences) means a submission to ICS should clearly summarise all relevant points and be expressed in a cogently organised format. The vital minimum of agreement concerning general problems of procedure is here given with a set of rather precise technical recommendations about how to present submissions of stratotypes.

It is essential that, although there is a geographic component in all opinions, agreement under ICS is sought in an international manner, excluding considerations tied to a region or, in the main, other than those which are scientific. It is therefore strongly stressed that in the work of ICS members are scientists who are involved in an individual capacity.

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Appendix I

Brief CHECK-LIST for criteria used in selection of a GLOBAL STRATOTYPE SECTION AND POINT (GSSP) under ICS Guidelines

1. Explicit motivation for the preference
2. Correlation on a global scale
3. Completeness of exposure
4. Adequate thickness of sediments
5. Abundance and diversity of well-preserved fossils
6. Favourable facies for widespread correlation
7. Freedom from structural complication and metamorphism
8. Amenability to magnetostratigraphy and geochronometry
9. Accessibility and conservation

INTERNATIONAL AND OTHER RELEVANT SYMPOSIA

V International Symposium on the Ordovician System, 1988

Regarding the next Ordovician System Symposium, the Chairman and Secretary propose a meeting in St. John's, Newfoundland, for August (or July) 1988. The meeting would involve about three days of papers followed by a transect across Iapetus (East to West Newfoundland). Other possible field trips could be to Anticosti Island, Meguma Zone Terrane in Nova Scotia and one day local trips from departure airports of Toronto, Montreal and Ottawa.

The main theme will be toward a standard Ordovician chronostratigraphy but with papers on a full range of other Ordovician topics. Reports from Working Groups and Subcommission meetings will be included.

It is noted that there will be other international meetings during the July-August period of 1988. For example the 5th International Symposium on Fossil Cnidaria, including Archaeocyatha and Spongiomorphs to be held in Brisbane from 25 to 29 July (with field trips in first week of August), and the 7th International Palynological Conference to be held also in Brisbane from 28 August to 2 September.

It is therefore tentatively proposed that the symposium be held in the week commencing 15 August 1988. Further details will shortly be provided by the Chairman, Chris Barnes.

International Cambrian-Ordovician Boundary field excursion and conference, Hunjiang, Jilin Province, P.R. China, July 1986

The Nanjing Institute of Geology & Palaeontology of Academia Sinica has sponsored a meeting of the IUGS Cambro-Ordovician Boundary Working Group to examine the Dayangcha sections and assess their potential in establishing a boundary stratotype. Members of the Working Group have been invited to attend from 25-31 July 1986. Chen Junyuan of the Nanjing Institute is the main organiser of this meeting. A book co-authored by Chen Junyuan, Qian Yiyuan, Lin Yaokun, Zhang Junming, Wang Zhihao, Yin Leiming and Bernd-D. Erdtmann, and entitled 'Study on Cambrian-Ordovician Boundary Strata and its Biota in Dayangcha, Hunjiang, Jilin, China has already been published in May 1985 (see Bibliography).

The proposed program of activities for the Dayangcha field excursion and conference involves arrival in Dayangcha Village on 24 or 25 July, field studies of Dayangcha sections on 25-26 July, and study of the Muxiautougou and Qinggou Section on the morning of 27 July, with conference proceedings to commence in the afternoon, and to continue on the 28-29 July, leaving a day for sightseeing to the Pond of Heaven at the conclusion of the meeting.

Working Group on Ordovician Geology of Baltoscandia - (WOGOGOB) Field Meeting Ostersund, 27-30 May 1986

Main theme: Paleodepth and provenance of sediments

One objective of this first meeting was to see and discuss Ordovician facies in Jämtland, particularly focussing on paleodepth indicators and provenance. Jämtland was chosen because this province lay in the critical zone between Baltica and the Caledonides, and because much recent work had focussed on this region.

The organisers of the meeting were: Maurits Lindström, Kent Larsson, Anita Löfgren, Valdemar Poulsen and Nils Spjeldnaes.

Silurian Subcommission excursion and meeting to South-eastern Australia, August 1986.

Plans are now well in hand for the field meeting to be held in Victoria and New South Wales from 16-28 August 1986. The programme commences in Melbourne on 16 August, and involves visits to important Victorian Silurian Sections at Heathcote, Kinglake and Darraweit Guim to 19 August. Then visits will be made to key Silurian sections throughout southern and central New South Wales before ending in Sydney on 28 August with a colloquium organized by John Pickett of the N.S.W. Geological Survey. For further information contact Chris Jenkins, Ocean Sciences Institute, University of Sydney, N.S.W., 2006, Australia - telephone 02 - 692 4068, telex AA20056.

IV Congress of Paleontology and Biostratigraphy of Argentina, November 1986.

Symposia will be held on the topics 'Biostratigraphy of the Lower Palaeozoic' and on 'Conodonts' at the IV Congress in Mendoza from 23-27 November 1986. Contact F.G. Aceñolaza, Miguel Lillo 205, RA-4000 S. M.DE TUCUMÁN, Argentina, for further details.

X Geological Congress of Argentina, September 1986

A symposium on the Lower Palaeozoics will be held at the X Geological Congress in San Miguel de Tucuman from 14-18 September 1986. Also contact F.G. Aceñolaza for details.

The Canadian Palaeontology and Biostratigraphy Seminar, Albany, New York State, September 1986

A Workshop on the chronostratigraphic subdivision of the North American Ordovician will be held in Albany N.Y., during the 1986 Canadian Paleontology and Biostratigraphy Seminar from 26-29 September 1986, as a part of the activities of the North American Ordovician Chronostratigraphy Working Group (co-chaired by John Repestski and Tom Bolton). 'Position papers' have been called for by the organiser of the Workshop, Ed Landing (N.Y. State Geological Survey, The State Education Dept., Albany, NY 12230) - the deadline was 10 April 1986. Written contributions will

provide a summary of the 'state of the art' for some or all North American Ordovician chronostratigraphy and a basis for future discussions of the Working Group. The 'position papers' will be published as pre-prints prior to the Workshop in the NYSM Circulars. A field trip to the Cambrian-Ordovician of the Taconic allochthon, eastern New York, is also being arranged by Ed Landing for 26 September.

Geological Society of America, North Central Section, St. Paul, Minnesota, April-May 1987

Drs. Robert E. Sloan (Dept. of Geology & Geophysics, 310 Pillsbury Drive S.E., University of Minnesota, Minneapolis MN 55455) and Dennis R. Kolata (Illinois State Geological Survey, 615 East Peabody, Champaign, IL, 61820) announce the early plans for the 1987 North Central Section of the Geological Society of America meeting in St. Paul, Minnesota. In connection with this meeting, there will be a two day symposium and three days of field trips on aspects of the Middle and Late Ordovician. The symposia and field trips will be sponsored jointly by the North Central Section of the Paleontological Society and the Great Lakes Section of the Society of Economic Paleontologists and Mineralogists. The sympsoia will be held in the St. Paul Hotel in downtown St. Paul on Thursday, April 30, and Friday, May 1. The field trips will be Wednesday, April 29, and Saturday and Sunday, May 2 and 3. They will stress the tectonic reasons for the differences in stratigraphy between Minnesota and adjacent states, and will offer ample opportunities for collection of zoned fossils.

Symposia:

We invite papers for the Paleontological Society Symposium on detailed zonation of Middle and Late Ordovician fossils, quantitative rates of evolution, paleoecology, and related topics. For the S.E.P.M. symposium we invite papers on lithostratigraphy, sedimentation, environments of deposition, diagenesis, and related topics. The two symposia will not overlap in time of presentation. Neither symposium is limited in scope to the Upper Mississippi Valley region.

In the interest of uniformity of calculation of rates of evolution, sedimentation and other phenomena, for the purpose of these symposia may we ask that all rates be based on Kunk and Sutter's (1984) estimate of 454 m.y. (^{40} Ar/^{39}Ar age spectrum dating of biotite from K-bentonite beds in eastern North America) for the interval of North American Midcontinent Conodont Faunas 7 and 8 (late Blackriveran to early Kirkfieldian). For the Ordovician-Silurian boundary we suggest using 438 m.y. based on the GSA 1983 and Cambridge 1982 Time Scales, unless you have more recent data. Rates of sedimentation should be expressed in bubnoffs, the standard term for meters per million years (abbreviated b).

One purpose of this early warning is to alert graduate students to relevant thesis topics that could be presented in the symposia. We remind everyone that North Central GSA gives two $100 prizes for the best wholly student authored papers presented, one for oral presentation and one for poster presentation.

Field trips:

The Wednesday, April 29, field trip will be confined to the St. Paul area. This trip will feature at least one of the three localities where macrofossils (primarily molluscs) can be collected from the St. Peter Sandstone, a complete and accessible section of the Platteville Limestone (Shadow Falls Section), and

an extended trip to the St. Paul brickyard pitwhere the thickest section (28 m) of Decorah Shale is exposed. The brickyard section will be staked out at Sardeson's bed boundaries and in 3 m intervals. Ample opportunity will be had for collecting. Hard hats are required at the brickyard.

The Saturday, May 2, field trip will start in St. Paul with morning stops in the Cannon Falls-Sogn area. During this part of the trip, stops will be made to see the base of the St. Peter Sandstone as well as excellent exposures of Platteville, Decorah, and Galena rocks. A stop is also planned at a well known Prosser/Sherwood locality near Wanamingo, Minnesota, where an unusually abundant and well preserved echinoderm fauna (solutan carpoid, rhombiferan crystoid, crinoids, and starfish) has been described from the Prosser Member of the Galena Formation. The fauna is the result of a catastrophic kill and is comprised of 55% brachiopods, 14% Bryozoa, 10% echinoderms, 7% gastropods, 6% trilobites and 3% cephalopds.

Saturday afternoon will be spent in the Rochester-Fillmore County area with some four or five stops. The first will be the Rochester South Quarry near Marion for the Platteville Limestone. The second stop is the type section of the Cummingsville with complete Decorah (13.5 m), complete Cummingsville, and basal Prosser exposures. The third stop will be Mystery Cave near Spring Valley with surface collection in the basal Maquoketa, and examination of clean cave exposures of Stewartville, Dubuque, and basal Maquoketa. These exposures show no depauperate zone or unconformity between Dubuque and Maquoketa, just continuous deposition, quite unlike the exposures in northeast Iowa and adjacent Illinois and Wisconsin! The fourth stop will be nearby Rifle Hill to show the Prosser, Stewartville, and Dubuque. If time remains a Maquoketa outcrop near Granger and/or the Platteville/Decorah outcrop at Spring Grove underpass will be visited for collecting. The evening will be spent in Decorah.

On Sunday morning, we will examine exposures of Decorah Shale near its type section in Decorah, Iowa. During the remainder of the morning and early afternoon stops will be made at several excellent exposures of St. Peter through Galena rocks at McGregor and Guttenberg, Iowa, and near Dickeyville, Wisconsin. Emphasis will be on lithostratigraphy and depositional environments. At all pertinent outcrops during the three days of field trips, K-bentonite beds will be pointed out and their correlation within the Mississippi Valley and beyond will be discussed.

While the field trip will be by bus, a limited number of cars and vans will be permitted to accompany the trip.

The guidebook will include summaries of the detailed lithostratigraphy and biostratigraphy. At present the detailed biostratigraphy of these Minnesota rocks includes zonation based on bryozoa, brachiopods, conodonts, crinoids, ostracodes and trilobites. Less precise zonation, to the level of Sardeson's beds, includes the balance of the marine fossils, for Minnesota at least. A copy of the St. Paul Sheet, 1:250,000 geologic map of all of southeastern Minnesota will be included. Minnesota Geological Survey publications on ostracoda, conodont, bryozoa and we hope brachiopod zonation will be for sale at the meeting.

Paleontological Society Symposium, St. Paul, Minnesota, April 1987

A Symposium will be held on the topic 'Ordovician radiations and faunal gradients in St. Paul, Minnesota on 30 April 1987. The Symposium is being organised in conjunction with the 1987 meeting of the North Central Section of the Geological Society of America. Companion symposia are being held on

other aspects of Ordovician paleontology, stratigraphy and sedimentation, and will be complemented by Ordovician field trips before and after the meeting.

Papers are solicited dealing with the radiations and/or faunal gradients of all groups of Ordovician organisms, including the origin and establishment of evolutionary novelties, patterns of faunal replacement or displacement, onshore-offshore gradients, and patterns of biogeographic dispersal.

Submit title (by 1 October 1986) and abstract (by 1 December 1986) to the Symposium organiser, Robert L. Anstey, Dept. of Geological Sciences, Michigan State University, East Lansing, MI, 48824-1115.

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CURRENT RESEARCH AND PUBLICATIONS OF ORDOVICIAN SPECIALISTS
(additional to those included in ORDOVICIAN NEWS Nos 2 and 3)

BRITISH ISLES

Richard Fortey (British Museum, Natural History, London) has contributed the following account of his recent activities:

1. The Arenig Series in Wales

R.M. Owens and I have completed and submitted for publication a generous tome on the development on the Arenig Series in Wales, with special reference to southern Wales, with a view to clarifying the biostratigraphy in what is, after all, the type development of the Series. The correlation of the rocks within Wales is discussed in detail, a new biostratigraphic scheme proposed, and a new and extensive trilobite and graptolite fauna is described, which forms the basis for biozonation. Our palynological colleague from the British Geological Survey, Stewart Molyneaux, has provided the first description of acritarchs from the full Arenig sequence. The development of the Series in Wales is much fuller than has been appreciated (Elles' old division into extensus and hirundo Zones greatly underestimated the diversity within the Series) - in fact we can recognise no less than seven biozones. The Arenig in Wales looks after all to be a match for its development elsewhere, but as you might expect in such a 'marginal' site, continuous sections through such a thick succession are very rare. We have, however, a good, continuously fossiliferous section through the Arenig-Llanvirn boundary. At the 'type section' - Arennig Fawr in North Wales - much of the Series is apparently missing, this being the middle and upper parts!

We hope that this large work will appear as a 'Bulletin' of the British Museum by the end of 1986.

2. Cambrian-Ordovician boundary

Bernie Erdtmann and I are examining the detailed record of early nematophorous graptoloid evolution in western Newfoundland.

3. Graptolite classification

Roger Cooper and I have submitted a long paper on graptolite classification to Palaeontology. We have attempted to tackle some of the long-standing problems over 'grade group' as opposed to phylogenetic classification. This may prove to raise temperatures a bit in certain parts of the world!

4. Recent papers

Fortey, R.A. 1985. Pelagic trilobites as an example of deducing the life habits of extinct arthropods. Trans. R. Soc. Edinburgh 76, 219-230.

Fortey, R.A. 1985. Gradualism and punctuated equilibria as competing and complementary theories. Spec. Pap. Palaeont., 33, 17-28.

Fortey, R.A. & Cocks, L.R.M. 1986. Marginal faunal belts and their structural implications, with examples from the Lower Palaeozoic. J. Geol. Soc. London, 143, 151-160.

WEST GERMANY

Bernd Erdtmann (Göttingen) forwarded the following account of his studies:

1. Graptolite based correlation of Cambrian-Ordovician boundary sections in western Newfoundland:

Second period of field work concentrated on lower to 'middle' Tremadoc beds and upper Tremadoc (La2) to lower Arenig (La3) of Green Point between June 25 and July 5, 1985. Also first nematophorous graptolite occurrences at St. Paul's Quarry and at Broom Point North were recollected. During late 1985 all material collected from the €/O boundary sections of the Cow Head Group (1969, 1981, 1984 and 1985) were registered, photographed and 'surveyed'. Prior to a full taxonomic investigation a 'survey report' based on the first careful inspection of all material was prepared in January 1986 and critical matters discussed with Dr. Richard A. Fortey (London) during his visit to Göttingen in early February 1986. Copies of this 'Survey Report' can be obtained from the author (B.-D. Erdtmann).

2. Ordovician Correlation Chart for Central Europe:

Several recent publications are to be incorporated into data base. Extensive contributions on Czechoslovakia have been submitted by V. Havlíček and L. Marek, on Poland by Z. Modlinski and E. Tomczykova, and on Belgium by M. Vanguestaine and P. Michot. Still outstanding are contributions from Austria and by West German colleagues. Cooperation with GDR colleagues has been difficult so far. A first comprehensive print-out of lithostratigraphical units will be done before late 1986.

3. Recent publications and papers in print:

Erdtmann, B.-D. & VandenBerg, A.H.M., 1985: Araneograptus gen. nov. and its two species from the late Tremadocian (Lancefieldian, La2) of Victoria - Alcheringa, 9, 49-63.

Erdtmann, B.-D., 1985a: Ordovician black shale maxima, graptolite evolution and event-controlled watermass patterns of the Iapetus. - Terra Cognita, 5(2/3), 109-110.

Erdtmann, B.-D., 1985b: Dendroid to graptoloid transition: Polyphyletic gradualism or punctuated equilibrium? - 3rd Int. Graptolite Conf., Copenhagen, Abstracts, 19-20.

Erdtmann, B.-D., 1985c: The earliest nematophorous graptolite succession (early Tremadoc) of the Cow Head Group, western Newfoundland. - 3rd Int. Graptolite Conf., Copenhagen, Abstracts, 21-22.

Erdtmann, B.-D. & Gutierrez Marco, J.C., 1985: The post-Tremadoc (La2-Be2?) graptolite fauna of Venta del Ciervo in SW Spain and its bearing on paleoenvironments in the peri-Gondwana 'Mediterranean Province'. - 3rd Int. Graptolite Conf., Copenhagen, Abstracts, 23-24.

Erdtmann, B.-D., Hoffknecht, A. & Riegel, W., 1985: Coalified graptolites as indices of organic maturity. - 3rd Int. Graptolite Conf., Copenhagen, Abstracts, 25.

Erdtmann, B.-D. & Maletz, J., 1985: 'Clonograptus' tenellus (LINNARSSON, 1871), its varieties, and Adelograptus hunnebergenis (MOBERG, 1892): Type material, stratigraphical position, astogenetic variations, and taxonomic implications. - 3rd Int. Graptolite Conf., Copenhagen, Abstracts, 27-28 (Full ms submitted to Geol. Soc. Denmark).

Wang, Xiaofeng & Erdtmann, B.-D., 1985: The earliest Ordovician graptolite sequence from Hunjiang, Jijin Province, China. - 3rd Int. Graptolite Conf., Copenhagen, Abstracts. (Full ms submitted to Geol. S. Denmk).

Chen, Junyuan, Qian Yi-yuan, Lin Yaokun, Zhang Junming, Wang Zhihao, Yin Leiming & Erdtmann, B.-D., 1985: Study on Cambrian-Ordovician boundary strata and its biota in Dayangcha, Hunjiang, Jilin, China. - China Prospect Publishing House: 138 pp, 39 pls.

Papers in press:

Erdtmann, B.-D. & Sherwin, L.: A new graptolite faunule of Lancefieldian age (La3) from Parkes, N.S.W. - Alcheringa.

Ertmann, B.-D.: Ordovician black shales of the Iapetus margins: Glaciations, eustasy, and event-controlled graptolite evolution. - Palaios.

Ertmann, B.-D. & Botsford, J.W.: A Lancefieldian (La1) graptolite fauna and its biofacies correlation from Eagle Island, Bay of Islands, western Newfoundland. - Canadian Journal of Earth Sciences.

Erdtmann, B.-D., Maletz, J. & Gutierrez Marco, J.S.: The new Early Ordovician (Tremadoc-Arenig Hunneberg Stage) graptolite genus Paradelograptus, its constituent species, phyletic relations, and stratigraphic correlation. - Paläontologische Zeitschrift.

4. Proposals, suggestions:

As initially proposed by V. Jaanusson, Stockholm (Business meeting Ordovician IV Meeting, Oslo, Norway) a working group should be formed with the task to clarify the chronostratigraphic problem of a Tremadoc/Arenig "transition". From a graptolitic perspective the Australasian La2 and, strictly speaking, La3 do not belong to the Tremadoc (nor to the typical Arenig), likewise the Paroistodus proteus zone is neither Tremadoc nor Arenig in age. What is to be done with this (Hunneberg Stage of Tjernvik, 1956) interval?

5. Preliminary 'news'

A bilateral cooperation project has been submitted to Academia Sinica, Beijing and 'Max-Planck-Gesellschaft", Munich by Drs. Chen Junyuan and Bern-D. Erdtmann for investigation of 'Comparative litho- and biofacies, palaeooceanology, and event stratigraphy of plate-marginal Cambro-Ordovician sections in the P.R. China'. Estimated duration: 3-4 years.

BALTOSCANDIA

The organisers of the first field meeting of WOGOGOB* have provided the following list of current Ordovician research in Baltoscandia:

Lund University

Kent LARSSON: sedimentologic and biostratigraphic (ostracodes) studies on the Ordovician of Jämtland.

Anita LÖFGREN: biostratigraphic/taxonomic studies on Arenig/Llanvirn conodonts in Jämtland including Häggenås, Arenig conodonts in Dalarna and Västergötland (Hunneberg-Billingen Stages with Kristina Lindholm), and Arenig/Llanvirn on N. Öland, and the Finngrundet core. Supervises a student working on the "Limbata Limestone" of Stenbrottet (Orreholmen, Västergötland).

Per AHLBERG: Arenig/Llanvirn Agnostidea from Öland and Skane. Kristina LINDHOLM: graptolites from the Arenig of Skane (principally Krapperup core) and Västergötland, as well as material for comparison from localities in the Oslo area.

Sveriges Geologiska Undersökning, Uppsala

Lars KARIS: Cambrian and Ordovician macrofossils from Jämtland. Ordovician carbonate rocks from central Sweden. Åke BRUUN: Ordovician ostracodes from Ostergötland. The Granby (circular) structure.

Yngve GRAHN: Correlation of the Harjuan between Estonia and Sweden with the aid of chitinozoa (project in cooperation with Jaak Nõlvak, Tallinn). Correlation of problematic parts of the upper Viruan between Estonia and Sweden. Chitinozoan correlation over the Ordovician/Silurian boundary for L.R.M. Cocks & R.B. Richards (eds.) "A global analysis of the Ordovician-Silurian boundary".

Uppsala University

Lars HOLMER: work on inarticulate brachiopods, particularly Middle Ordovician, and particularly acrotretids, is nearing completion.

For other Ordovician students at Uppsala, see under Project Hälludden.

University of Oslo

Nils SPJELDNAES has communicated the following list of his running projects:

A. Regional/stratigraphic/sedimentologic projects: Middle Ordovician of the Oslo-Asker area; the Mjøsa Limestone and equivalents; the Ordovician-Silurian boundary. These are projects that are waiting for the final manuscript version.

B. Paleontologic projects: Lower, Middle, and Upper Ordovician bryozoa; Klitambonitids, and a few minor groups of brachipods from the Oslo area.

C. New projects: Calcareous algae (with M.H. Nitecki) (dasyclads from all of Baltoscandia, and the whole Ordovician; the entire Middle Ordovician flora of the Oslo area). Conodont stratigraphy of the Lower and Middle Ordovician of the Oslo area. Review of the Ordovician paleogeography of the Oslo and surrounding areas. Bentonites (for radiometric ages and as ecological/sedimentological indicators).

*see page 23

He adds that he is open to cooperation at all levels. This applies in particular to projects under C.

Knut BJORLYKKE: Geochemistry and stable isotope composition of Lower Paleozoic carbonates in the Oslo region.

University of Tromsø

Nils-Martin HANKEN: Upper Ordovician (5b) sediments in Ringerike (carbonate sedimentology and petrology). Dividal Group in northern Norway (between Alta and Altevann) (trace fossils with Richard Bromley).

University of Bergen

Björn NEUMAN: Ordovician corals of Baltica and the Caledonides; a manuscript on the Rugosa of the Hulterstad Limestone of Öland is complete. 4b-6 corals of Oslo area. Nils AARHUS: Tabulata of Vestlandet Caledonides. Christian MAGNUS: corals of Vestlandet Caledonides (roughly 5a age).

Stockholm University

Maurits LINDSTRÖM: Stratigraphy (mainly conodonts) and sedimentary petrology of several sections through the Lower and Middle Ordovician of south and central Sweden (Ottenby, Degerhamn, Gillberga, Horns Udde, Byxelkrok, Lanna, Hällabrottet, Borghamn, Osterplana, Sjurberg, Brunflo, Kalkberget). Maps 1:10,000 and stratigraphy of Ordovician of several areas as thesis projects (see under University of Marburg). Sedimentation and diagenetic history of Orthoceratite Limstone.

University of Copenhagen

Work on the Ordovician was presented at a meeting of Palaeontolgisk Klub on May 31, 1985. Scandinavian projects presented were:

Bjørn BUCHARDI & Erik THOMSEN: Lower Palaeozoic deposits in southeast Scandinavia; thermal diagenesis.

Svend STOUGE: Species of Prioniodus PANDER. In a previous lecture current work on Ordovician conodont stratigraphy throughout Öland was presented.

Arne THORSHØJ: Komstad Limestone - "Orthoceratite Limestone" in Skåne and on Bornholm (detailed stratigraphy based on extensive and intensive collecting of trilobites is being carried out in Ordovician provinces in southern Scandinavia and yields information on relative fluctuations of proportions of carbonate and terrigenic mud - as a by-product of refined knowledge on megistaspid and other trilobite evolution).

Merete BJERRESKOV: The Ordovician/Silurian boundary, in particular on Bornholm (the boundary, at the base of the Parakidograptus acuminatus Zone, is represented on Bornholm, but not exposed in outcrops).

University of Göttingen

Bernd-Dietrich ERDTMANN: Supervises/supervised the following thesis projects:

M.L. WINDOLPH: Middle and Upper Cambrian Kistedal, lower Tremadoc Berlogaissa Formations, Digermul Peninsula, N.Norway (Diss. Feb. 1985).

M. WELSCH: Acritarch succession of the Kistedal and Berlogaissa Formations (Diss. Feb. 1985).

A. HOFFKNECHT: Thermal maturity of Cambro-Silurian graptolites from Baltoscandia, Newfoundland, Utah and Nevada.

Jörg MALETZ: Palaeontology and detailed stratigraphy of the Lower Ordovician of Hunneberg (with map).

Peter MEYER: Comparative lithostratigraphy of the Lower Ordovician of Hunneberg (with map).

Jutta WÖLTJE: Comparative lithostratigraphy of the Lower Ordovician of Hunneberg (with map).

Michael BARTHEL: Microfossil succession in the Modum area (with map).

University of Marburg

Stephan SIMON: Stratigraphy, petrology, and conditions of ofigin of coarse clastics in the autochthonous, Ordovician succession of Jämtland (Diss., 1984, due published by S.G.U. 1986).

Orthan OLGUN: The Lower Ordovician limestones of Falbygden (Västergötland, Central Sweden): Their stratigraphy conodont fauna and sedimentology (Diss., 1985, due published by S.G.U. in 1986).

Joachim HEUWINKEL: The Follinge turbidites of the Storsjon area, Jämtland (Diss. due in 1986).

Gerhard HAHN: Geology of northern Kinnekulle.

Axel DÖRR: Geology of eastern Kinnekulle.

Rüdiger MÖLLER: Geology of western Kinnekulle

Rüdiger TEVES: Geology of southern Kinnekulle, with emphasis on earliest Ordovician collapse structures at Brattefore (completed 1985).

Petra PFAFF: Geology of the southern Östersund and Odensala area.

Abdolmajid MOSAVINIA: Geology of the area S.W. of Lövsåsen, Lockne area.

Harald KUNKEL: Geology of the area between Målingen and Fåker (completed 1986).

Frank SCHWIND: Geology of the area north of Hackås.

Horst GUDEMANN: Geology of the Bjärme area (completed 1985).

Walter VORTISCH: Mineralogy and petrology of the Orthoceratite Limestone, with emphasis on the non-carbonates.

Riksmuseum, Stockholm

Valdar JAANUSSON: Orthambonites and related brachiopod genera (with M.G. BASSETT; to be published in Palaeontology). Stromatactis mounds in Dalarna. Ordovician correlations in Sweden, for IUGS series.

Harry MUTVEI: Cephalopods.

Krister BROOD: Conularida and Bryozoa.

The Riksmuseum staff leads Projects Fjäcka and Hälludden (q.v.).

SOVIET UNION

E.A. Yolkin (Institute of Geology & Geophysics, Siberian Branch, Academy of Sciences USSR 630090, Novosibirsk -90) advises that his colleague N.V. Sennikov is preparing a framework of the Ordovician correlation chart for the western part of the Altai-Sayan region, and he hopes that the preparation will be finished before the middle of the year. Dr. Yolkin also kindly provides details of Dr. Sennikov's current research and publications, as follows:

1. Current research: Lower and upper boundaries of the Ordovician; zonal subdivisions of the Ordovician of Mountain Altay and Salair. Upper Cambrian, Ordovician and Silurian graptolites of Siberia (biostratigraphy, palaeontology and phylogeny).

2. Publications:

Obut A.M., Sennikov N.V., Zaslavskaya N.M. 1984. Sibirskiye komplexy graptolitov i chitinozoy na rubezhe kembriya i ordovika. Geologiya i Geofizika 3, 3-8.

Obut A.M., Sennikov N.V. 1984. Graptolity i zonalnoye rastchleneniye nizhnego ordovika Gornogo Altaya. In Stratigrafiya i fauna nizhnego ordovika Gornogo Altaya. Nauka, Moskva, 53-106.

Obut A.M., Sennikov N.V. 1984. Tip Hemichordata. Podtip Graptolithina. In Ordovik Sibirskoy platformy. Paleontologitcheskiy atlas. Nauka, Novosibirsk, 103-111.

Petrunina Z.E., Sennikov N.V., Ermikov V.D., Zeyfert L.L., Krivtchikov A.V., Puzirev A.A. 1984. Stratigrafiya nizhnego ordovika Gornogo Altaya. In Stratigrafiya i fauna nizhnego ordovika Gornogo Altaya. Nauka, Moskva, 3-33.

Sennikov N.V. 1984. Nekotoriye retiolitidy (graptolity) Gornogo Altaya. In Paleontologiya i biostratigrafiya paleozoya Sibiri. Nauka, Novosibirsk, 48-55.

Sennikov N.V., Ermikov V.D., Petrunina Z.E., Puzirev A.A., Severgina L.G. 1982. O vozraste bazalnikh gorizontov ordoviksko-srednede-vonskogo kompleksa severo-zapadnogo Altaya. Geologiya i Geofizika 8, 56-61.

Sennikov N.V., Petrunina Z.E., Gladkikh L.A., Ermikov V.D., Zinov'eva T.V., Mamlin A.N., Shokal'sky S.P. 1984. Noviye pogranitchniye ordoviksko-siluriyskiye razrezi na Gornom Altaye. Geologiya i Geofizika 7, 23-27.

PEOPLE'S REPUBLIC OF CHINA

Guo Hongjun (Kuo Hungchun) of the Dept. of Geology, Changchun College of Geology, Changchun, Jilin Province writes that during the past months he has been involved in work on the Ordovician trilobites of the Xingan (Khingan) region, north-east China, and is continuing an investigation of the trilobites and conodonts, especially near the presumed Cambrian-Ordovician boundary stratotype section in Jilin Province.

Wang Xiaofeng of the Yichang Institute of Geology & Mineral Resources, Chinese Academy of Geological Sciences, P.O. Box 502, Yichang City, Hubei, reports as follows:

1. Current research: A successive research achievements on the biostratigraphy of the eastern Yangzi (Yangtze) area, China were completed by my colleagues and myself, which consist of five monographs as follows: 1. Sinian (Precambrian), 2. Lower Paleozoic era, 3. Upper Paleozoic era, 4. Triassic and Jarrasic and 5. Createceous and Tertiary. The monographs 1 and 3 were published last year. The monograph 2 (Lower Paleozoic) is in the press. This book described in detail all representative sections for the Cambrian, Ordovician and Silurian of the present area, and further discussed their subdivision and correlation in the lithostratigraphic, biostratigraphic and choronostratigraphic sense. Meanwhile, the correlations of various kinds of fossil zone and assemblage from Cambrian to Silurian between the eastern Yangzi Gorges area and elsewhere in the world were also reviewed. Altogether 800 taxa or so of various fossils, including small shelly fossil, archaeocyathid, coral, trilobite, ostracod, graptolite, cephalopod, conodont and microplant were described in this monograph. The authors are Wang Xiaofeng, Ni Shizhao, Zeng Qinglun, Xu Guanghong, Zhou Tianmei and Li Zhihong of Yichang Institute of Geology and Mineral Resources, and Ziang Liwen and Lai Caigen of Institute of Geology, Beijing.

A joint research by Prof. Dr. Erdtmann and myself is in progress, dealing with the international correlation of the Tremadoc graptolite zones and the 'morphogenetic plasticity' of the earliest nematophorous graptolites upon the materials from the Dayangcha, Hunjiang area, China, western Newfoundland and other regions of the world. The first manuscript about the earliest Ordovician graptolite sequence from Hunjiang, Jilin, China was present to the third international graptolite conference, held in Copenhagen last year.

2. Recent publications:

Wang Xiaofeng et al., 1983. The Ordovician-Silurian Boundary in the eastern Yangtze Gorges, China. Bull. Soc. geol. mineral, Bretagne, 1983, (c), 15, 2, 95-107.

Xu Jie (Hsu Chieh), Huang Zhigao and Wang Xiaofeng, 1983. On some important problems of Ordovician graptolite fauna in China, in Selected Works on Graptolites, 275-324, Geol. pub. House, Beijing.

Wang Xiaofeng, 1984. Occurrence of Dicellograptus in Silurian strata, Scientific papers on Geology for International Exchange-prepared for the 27th Inter. Geol. Congress, 1, 69-73, Geol. pub. House, Beijing.

Wang Xiaofeng & Yao Zhaogui, 1984. Early Devonian Graptolite faunas from Yulin, Guangxi, Geol. Review, n. 5, 416-424.

Wang Xiaofeng & Bernd-D.Erdtmann, 1985. The Earliest Ordovician Graptolite Sequence from Hunjiang, Jilin Province, China, which was presented to Third Inter. Graptolite Conference and published soon.

Wang Xiaofeng, 1985. Lower Silurian Graptolite Zonation in the eastern Yangzi (Yangtze) Gorges, China, Ibid.

Wang Xiaofeng, et. al., 1986. Rediscussion on the definition and correlation of the Ordovician-Silurian boundary. Bull. Chinese Acad. Geol.Sci., in press.

Wang Xiaofeng & Xue Zijian, 1986. Early Silurian graptolites from Xichuan, Henan, Ibid, in press.

UNITED STATES

Richard J. Diecchio (Dept. of Geology, George Mason University, 4400 University Drive, Fairfax, Virginia 22030) has published the following papers:

Diecchio, R.J., 1985. Post-Martinsburg Ordovician stratigraphy of Virginia and West Virginia: Virginia Division of Mineral Resources, Publication 57, 77 p.

Diecchio, R.J., 1985. The Taconian clastic sequence of northern Virginia and West Virginia: Society of Economic Paleontologists and Mineralogists, Eastern Section, Field Trip Guidebook, 62 p.

Stan C. Finney (School of Geology, Oklahoma State University, Stillwater, OK. but see directory) is publishing the following:

Finney, S.C. 1986. Graptolite Biofacies and Correlation of Subsidence, Eustatic, and Tectonic Events in the Middle to Upper Ordovician of North America: Palaios, v.1, No.4 (August 1986).

This paper evaluates and revises that part of the North American graptolite zonation equivalent to the British zones of gracilis, multidens, clingani, and linearis. The revisions have been required by the discovery of sections in the Arbuckle and Ouachita Mountains of Oklahoma and Arkansas and in the Lexington Limestone of Kentucky that have yielded excellent graptolite faunas across a critical interval in the graptolite zonation. These revisions are also supported by conodont biostratigraphy.

David M. Rohr (Dept. of Geology, Sul Ross State University Alpine, Texas 79832) lists the following recent publication:

Rohr, D.M. & R.B. Blodgett, 1985. Upper Ordovician Gastropoda from west-central Alaska. Jour. Paleontology 59, 667-673.

Frederick K. Lobdell (Grand Forks,ND) is working on doctoral dissertation 'Paleontology and paleoecology of Gunn Member, Stony Mountain Formation (Upper Ordovician), Manitoba and North Dakota'.

BIBLIOGRAPHY

Aceñolaza F.G. and Baldis B. 1986. Informe anual correspondiente al periodo 1984-1985. Proyecto 192 desarrollo del cambrico y ordovicico de Latinoamerica, pp.1-13.

(Includes report of the various meetings in Latin America during 1985, details of present research projects and plans for further work. A bibliography is appended containing some 37 entries).

Dr. Matilde S. Beresi (San Juan 491, TB1, 5to.23, 5500-Mendoza, Argentina) recently sent copies of summaries of Ordovician papers read at the recent meetings in the Department of Natural Sciences, Universidad Nacional de San Juan, San Juan, Argentina, of (1) the First Meeting on the Geology of the Precordillera, west Argentina, 9-11 October 1985, and (2) the meeting of Paleontological Communications of the Asociacion Paleontologica Argentina, 7-8 June 1985. Titles of abstracts of the 'First Meeting' are as follows:

Benedetto J.L., Ortega G., Brussa E and Toro B., Estratigrafia y fauna de la secuencia neo-ordovicica y llandoveriana del Rio Escondido (flanco Occidental del Cervo del Fuerte), San Juan, p.14.

Beresi M.S., Biofacies con Nuia (microorganisino algal) en la Precordillera de San Juan, p.14-15.

Beresi M.S., Capas con Archaeoscyphia (Porifera) en los sedimentos carbonaticos ordovicicos de la Precordillera de San Juan, p.15.

Beresi M.S. and Nullo F., Dos unevas especies de Orthambonites (Brachiopoda) en la Formacion San Juan, Precordillera de San Juan, p.15-16.

Beresi M.S., Presencia de algas calcareas en los sedimentos carbonaticos arenigianos de Talacasto, Precordillera de San Juan, p.16.

Cuerda A.J. and Furque G., Graptolitos del Techo de la Formation San Juan, Cerio la Chilca, Precordillera de San Juan, p.18.

Gamboa L.A., Caracterizacion paleoecologica de los terminos basales de Formacion San Juan, en el Cervo Viejo de San Roque, p.19.

Hunicken M.A. and Sarmiento G.N., Oepikodus evae (Conodonta, arenigiano inferior) en la Formacion San Juan, Aº Salado, Villicum, San Juan, Argentina, p.20.

Kerileñevich S.C., Graptolites de la Formacion Alcaparrosa, en el flanco Occidental de la Sierra de Tontal (Precordillera de San Juan), p.21.

Peralta S.H., Graptolitos del Llandoveriano inferior en el paleozoico inferior clastico del pie oriental de la Sierra de Villicum, Precordillera oriental de San Juan, p.24.

Pereyra E., Tipificacion de acumulaciones trombolíticas en le Formacion San Roque en la zona de Jachal, p.25-26.

Sarmiento G.N., La biozona de Amorphognathus variabilis-Eoplacognathus pseudoplanus (Conodonta), Llanvirniano inferior, en el flanco oriental de la Sierra de Villicum, Provincia de San Juan, Argentina, p.26.

Extended abstracts presented at the Meeting of the Asociacion Paleontologica Argentina (Reun. Com. Paleont. APA San Juan) include the following:

Baldis, B., Bordonaro O. and Pereyra E., Comportamiento standard de los biociclos algales en el limite cambrico-ordovicico de San Juan, p.20-21.

Beresi M.S., Presentcia de ostracodita en los sedimentos carbonaticos de la Formacian San Juan, p.23.

Beresi M.S., Nuia sibiritica, microorganismo algal en la Formacion San Juan, p.24-25.

Bordonaro O.L., Colpocoryphe huacoi n.sp. (trilobite Phacopida) de la Formation San Juan, en la Quebiada de Huaco, San Juan, p.26-27.

Cabaleri N.G., Presencia de Lingula en la base de la Formacion las Aguaditas y su implicancia paleontologica, p.28-29.

Rao R.I., Conodontes arenigianos en el Cerro Bola, Sierra Chica de Zonda, Provincia de San Juan, p.46-47.

Vaccari N.E. and Waisfeld B.G., El hallazgo del genero Hollia (Trilobita) en los niveles superiores de la Formacion San Juan (ordovicico), p.49.

Di Prinzio B., Primevos datos sobre braquiopodos acrotretidos de la Formacion San Juan (ordovicico) en la zona de Huaco, provincia de San Juan, p.50.

Carrera M., Descripcion de algunos poriferos de la Formacion San Juan (ordovicico, Precordillera de San Juan), p.51-52.

Astini R., Benedetto J.L. and Canas F., La fauna de los niveles de Transicion entre las formaciones San Juan y Gualcamayo en la region norte de la Precordillera (Prov. San Juan y la Rioja), p.54-55.

Benedetto J.L., El hallazgo de la tipica fauna de Hirnantia en el ashgiliano tardio de la Sierra de Villicum, San Juan, p.56-57.

Sanchez, T.M., El genero Modiolopsis (Bivalvia, Modiomorphoida) en el ashgiliano de la Sierra de Villicum y la comunidad de Hirnantia-Modiolopsis, p.58-59.

Peralta S.H. and Uliarte E., Graptolitos ordovicicos en la Formacion Rinconada, Precordillera de San Juan, p.69-71.

Cabaleri N., Gonzalez S and Armella C., Acumulaciones arrecifales en el Ordovicico medio-superior de la Formacion Las Aguaditas, Precordillera de San Juan, p.74-76.

Stratigraphy and Palaeontology of Systemic Boundaries in China - Cambrian-Ordovician Boundary, (1)-(2). 18 contributions from 36 authors; 840 pages, 114 plates, English edition 1984. (Price U.S.$40 ($46 if required by air mail from Nanjing Institute of Geology and Palaeontology, Academia Sinica Chi-ming-Ssu, Nanjing, P.R. China).

Chen Junyuan, Qi Yiyuan, Lin Yaokun, Zhang Junming, Wang Zhihao, Yin Leiming and B.-D. Erdtmann, 1985. Study on Cambrian-Ordovician Boundary Strata and its Biota in Dayanggcha, Hunjiang, Jilin, China. China Prospect Publ. House, Beijing. 1-138 pp., 39 pls.

Other Papers:

Aldridge, R.J. 1986. Conodont palaeobiogeography and thermal maturation in the Caledonides. J. geol. Soc. Lond. 143, 177-184.

Anstey, R.L. 1986. Bryozoan provinces and patterns of generic evolution and extinction in the Late Ordovician of North America. Lethaia, 19 33-51.

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OTHER NEWS

1. Professor A.J. Boucot (Dept. of Geology, Oregon State University, Corvallis, Oregon 97331, USA) has been appointed Second Vice Chairman of the International Commission on Stratigraphy (ICS) and will be involved in organizing the ICS programme of meetings at the next IGC in Washington D.C. in 1989. Topics already suggested by the Chairman of ICS, Dr. John Cowie, include the following:

    1. Stratigraphy through into the 21st Century: a review.
       Organizer: J.W. Cowie.
    2. Chemostratigraphy - Molecular Stratigraphy: geochemical anomalies and phase changes in earth history.
       Organizer: G. Eglinton.
    3. Archaean and Proterozoic Earth History.
       Organizers: K. Plumb and A.N. Other
    4. Global Sedimentology and Stratigraphy.
       Organizer: R.N. Ginsburg.
    5. Event Stratigraphy: catastrophism, gradualism and evolution in the geosphere-biosphere. (In cooperation with IUGS Commission on Planetology)
       Organizer: D.J. McLaren
    6. New dynamic revitalized teaching of stratigraphy.
       Organizer: J. Remane and W.H. Matthews.
       (in cooperation with IUGS Commission on Geology Teaching).

2. The Secretary General of ICS, Professor J. Remane, has been active in establishing links with the IUGS Commission on Geology Teaching to stimulate interests in the teaching of stratigraphy. An inaugural meeting of a new ICS Committee on Quantitative Stratigraphy was held in Aberdeen, Scotland, in April 1986, and the following is a draft report from the ICS Circular Newsletter 1 of May 1986):

COMMITTEE ON QUANTITATIVE STRATIGRAPHY DRAFT

Outline of Guidelines

Description

Quantitative stratigraphy uses relatively simple or complex computer-based mathematical-statistical methods to calculate stratigraphic models that with a minimum of data provide a maximum of predictive potency and include formulations of confidence limits. Use of the methods to solve geological problems allows rigorous use of multiple working hypothesis which is an essential part of a more quantitatively based geological science.

The methods are applicable with unique, non-recurrent fossil ranges or fossil events in biostratigraphy or with recurrent physical events employed in lithostratigraphy, well-log analysis, magnetostratigraphy, isotopes stratigraphy, seismostratigraphy, etc. Quantitative biostratigraphy and quantitative physical stratigraphy have been successfully applied in economic geology. A third important application involves calculation of linear time scales and development and use of methods to find tectonic and burial histories of sedimentary basins.

Techniques commonly used include sequencing and multivariate methods in biostratigraphy, sequencing and matching methods in (geo)physical events stratigraphy and various interpolation techniques in the formulation of time scales.

Correlation of stratigraphically defined and ordered events or units generally expresses the hypothesis that a mutual relation exists between them as observed at different geographic locations. A major aspect of quantitative stratigraphy is the formulation of geologically meaningful confidence limits when correlating. The uncertainty in geological correlation, expressed in stratigraphic (like thickness) or chronologic (like time) units of measurement provides insight in the validity of geological models and in the accuracy and precision of the current, widely-used correlation techniques.

Activities

The Committee on Quantitative Stratigraphy promotes the acceptance and use of Quantitative Stratigraphy in Paleontological, Geological and Geophysical Sciences. A major philosophical objective is to adapt quantitatively defined stratigraphic methods and its units of correlation to future versions of the Stratigraphic Codes as used on several continents. The approaches to mathematical-statistical stratigraphy need to be incorporated in the standardized stratigraphical philosophy and practices. Eventually we shall have unambiguous definitions of simple quantitative stratigraphic terms derived from the use of the methods. A third key objective is to foster further development and application of techniques using different computer systems and different data sets. The ultimate aim is to make geological applications of quantitative stratigraphy routine and give it its rightful place in a more quantitatively

formulated geology. A number of avenues will be pursued to adhere to the goals of the Committee, including (not in order of priority):

1. Distribution of a Newsletter.
2. Exchange of stratigraphic data and programs on (micro)computers.
3. Sponsoring and organisation of short courses like those arranged by IGCP Project 148.
4. Sponsoring and organisation of International and National Meetings and Symposia.
5. Publication of a comprehensive bibliography of published studies.
6. Sponsoring of comprehensive manuals or textbooks dealing with (a) Quantitative Biozonations, Log Analysis, etc. (b) Use of Methods on various computers, (c) Glossary of terms, (d) Code of Quantitative Stratigraphy and other topics in Quantitative Stratigraphy.
7. Entrenchment of the new stratigraphy in the standard stratigraphic philosophy.
8. Acceptance of the new stratigraphy in the educational curriculum of geological sciences at universities.
9. Application of quantitative stratigraphy in economic geology, like exploration for oil and gas.

3. An Institute of Cambrian Studies

The organisers of the Second International Symposium on the Cambrian System (M.E. Taylor, A.R. Palmer, R.A. Robison and A.J. Rowell) held in Denver, Colorado in August 1981, have been able to invest remaining monies and to add some private donations to a fund to establish an Institute for Cambrian Studies. It was formally incorporated under the laws of the State of Colorado as a non-profit corporation in March 1982, with stated objectives and purposes as follows:

"To promote the scientific study of the Cambrian System in all its aspects in all parts of the world" And,

"to promote the exchange of scholarly information by conducting technical conferences and by publishing scientific books and articles of timely interest to the international scientific community".

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