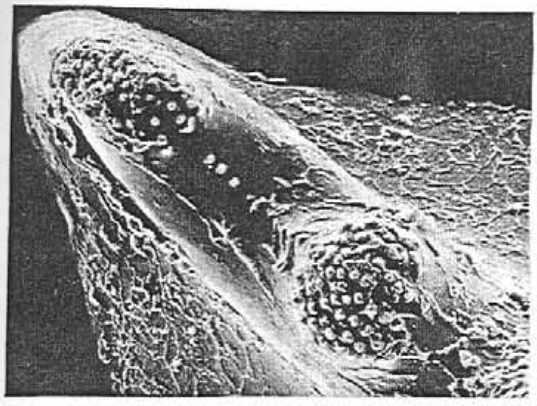
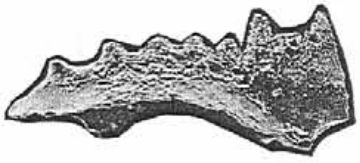
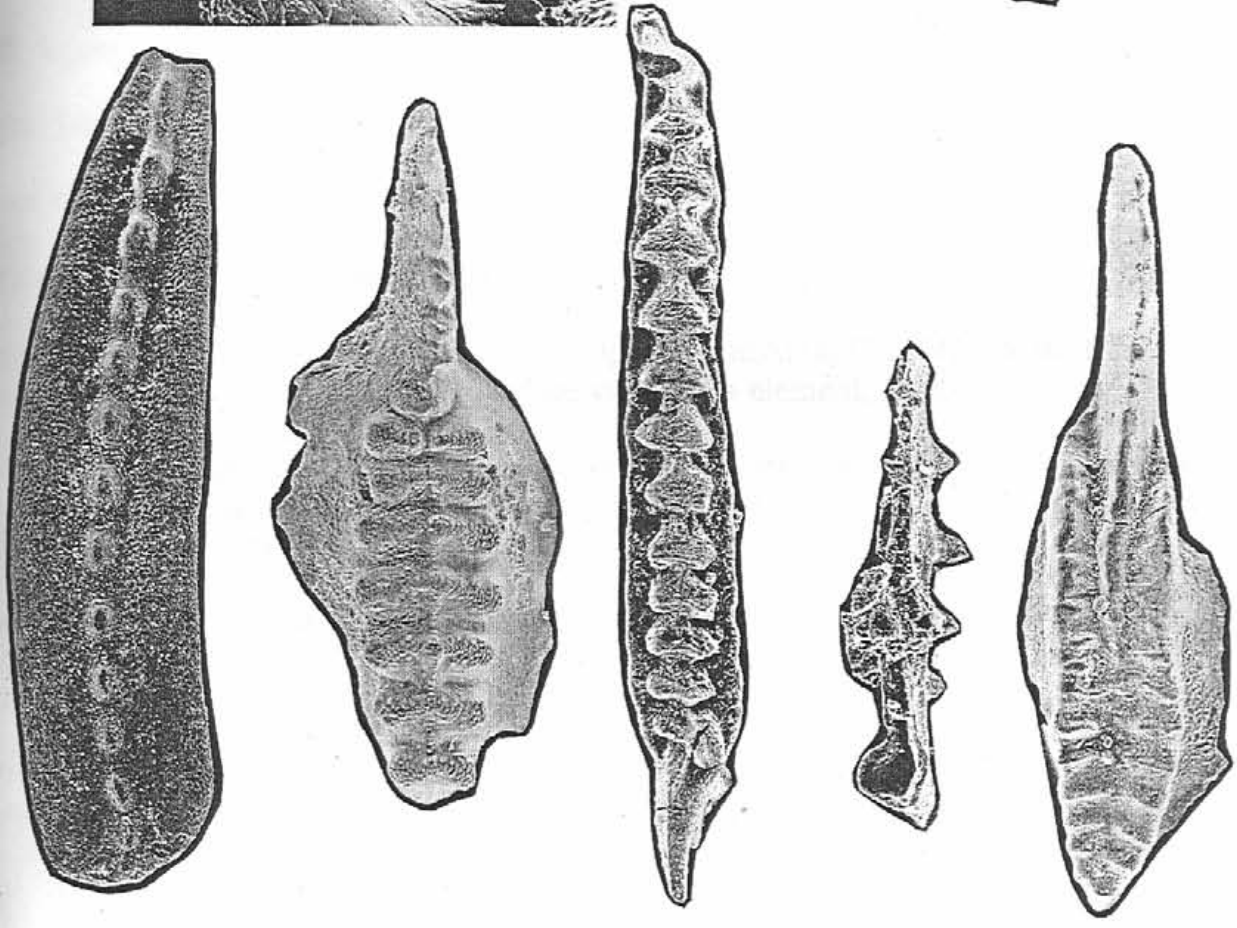
Permophiles



No. 21 November, 1992

A NEWSLETTER OF SCPS





SUBCOMMISSION ON PERMIAN STRATIGRAPHY

INTERNATIONAL COMMISSION ON STRATIGRAPHY

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

COVER PAGE

Upper Row: *Sweetognathus inornatus* Ritter, base of Zone P7, Lower Artinskian, C-148048, Devon Island, Canadian Arctic Archipelago, upper part of type section of Belcher Channel Formation.

Left: Upper view of posterior Pa element, X550.

Right: Lateral view of Pa element, X100.

Lower Row; Left to Right: *Neogondolella bisselli* (Clark and Behnken), base of Zone P7, Lower Artinskian, C-148030, Devon Island, upper part of type section of Belcher Channel Formation, upper surface view of Pa element, X100.

Neostreptognathodus clarki Kozur, Zone P8, Upper Artinskian, C-125421, S.W. Ellesmere Island, unnamed A formation, upper surface view of Pa element, X100.

Gondolelloides canadensis Henderson and Orchard, Lower Asselian, C-023911, northern Ellesmere Island, Canadian Arctic Archipelago, Hare Fiord Formation, upper surface view of Pa element Holotype GSC 64590, X50.

Gondolelloides canadensis Henderson and Orchard, Lower Asselian, C-023911, northern Ellesmere Island, Hare Fiord Formation, lower surface view of juvenile Pa element Paratype GSC 64591, X100.

Streptognathodus n.sp. *A*, Lower Asselian, Zone P3, C-125314, S.W. Ellesmere Island, Canyon Fiord Formation, upper surface view of Pa element, X100.

Photographs provided by Charles M. Henderson.

CONTENTS

1. CHAIRMAN'S REPORT ON THE BUSINESS OF THE PERMIAN SUBCOMMISSION

A. The prime task for the Subcommission in the last few years has been to set up the Global Stratotype Sections of the Permian (GSSP) of the basal boundary of the system and to find the most suitable boundary levels of major subdivisions.

B. The progress achieved recently by the Working Group on the Carboniferous/Permian boundary (WGCP) will be reported in detail by Dr. Wardlaw later on (see Item 3 IV, this Newsletter). However, here I'd like to remind you that there is a problem, as noted by Dr. Grant, "so belaboured and seems shopworn". The WGCP is the only group working on a systemic boundary not established until the middle eighties. Thanks to the cooperative efforts of members of WGCP, substantial results have been reached since it was set up in 1987. Before the 28th IGC, a collection of ten detailed submissions was compiled on potential boundary levels and stratotype sections in different parts of the world ranging from North America, the former USSR, Japan and China. A straw vote in selecting three horizons was taken at a meeting of the working group during the last International Congress. At the meeting, we were pleased to see that members are willing to make compromise for defining an international standard boundary. Last year, the Permian Conference in Urals provided an excellent opportunity to visit the Aidaralash sections. This is the stratotype of C/P boundary defined by the Permian Commission of USSR in 1989. After then, the International WGCP invited the Russian WGCP to submit a formal proposal to make that section a candidate for the boundary stratotype.

C. Among the stratotypes for internal boundaries of the Permian, emphasis was put on the Upper Permian because the Upper Permian of the traditional standard sections in the Urals is composed mainly of continental deposits. A consensus made by the Working Group on the Upper Permian (WGUP) shows that there are numerous different scales being used in different parts of the world and that there is little agreement so far concerning a standard scale. It indicates that at present we should concentrate on establishing reliable correlations with primary marine sequences particularly at the potential subdivision levels within the Upper Permian. To avoid the confusion of such informal series as the upper, middle and lower Permian, of which the contents are not precisely defined and because of differences in the conventional usage of the two-fold and three-fold subdivisions in different areas, it is encouraged to focus on formal subdivisions with a potential for global correlation.

In 1990, an international working group on the major subdivision of the Tethyan Permian was proposed; this was to be organized with a Chinese-Russian cooperative team as a core body. The main objective of the group is to integrate the major subdivisions of the Permian used in Tethyan areas into one international Tethyan scheme based on the cooperative investigation of accumulated fossil material and data. The project suggested by the subcommission during the IPC in the Urals last year to define the base of Dzhulfian or Wuchiapingian can be included in this program. The program is going well in spite of the fact that two Russian colleagues couldn't visit us as planned this year because of shortage of funds.

Last year, the Guadalupian Working Group proposed to take the Guadalupian as the international standard for the middle series of the tripartite subdivision. The lower boundary of the series is defined by the first appearance of the conodont *Neogondolella serrata* within the morphological transition between *N. idahoensis* and *N. serrata*. At the subcommission's meeting in Perm, it was decided to invite that candidates be proposed for a stratotype section of this series in addition to the section at the western escarpment of the Guadalupian Mountains.

Consideration of the proposal of Guadalupian Series (see Item 10, this Newsletter) will lead to a solution concerning the stratigraphical level which provides the best mid-Permian boundary, without prejudice as to whether the bipartite or the tripartite subdivisions might be used and what these subdivisions might be called. In the Tethyan areas, this level is likely to correspond with the *Cancellina* Zone. It is hopeful that this level will be flexibly used in the areas outside the palaeotropic belt in which the precise position of the mid-Permian boundary is difficult to assess.

D. The task of establishing the GSSP of subdivisions of the Permian is impossible to solve

based only on the marine sections. The precise correlation between marine and continental sections will allow one to evaluate the significance of biota change-over and select the globally correlatable boundaries within the Permian. An international committee on the continental Permian is very active in cooperation. A proposal on organizing an international working group on the P/T boundary in continental series is interesting many permophiles.

E. Our main task for the near future is to implement the plan made recently by the subcommission. We will help the convenors to set up the working groups and to create opportunities for exchanging view points, visiting potential stratotype sections and making decisions.

A field symposium on Permian stratigraphy is planning to be held in China in 1994. It is expected to see a formal proposal on the GSSP for the Carboniferous/Permian boundary submitted by the Russian Working Group. The Chinese Working Group will show the participants the C/P boundary sections in South China which are under extensive study. Other working groups are also invited to report their new substantial results, particularly that on major subdivisions of the Tethyan Permian. Field trips to visit Permian sections in South China, North China, and possibly those in Southern Xizang and Tianshan will be organized, depending on how many colleagues would like to join in the excursion.

In 1995 the XIIIth ICCP will be held in Cracow, Poland. This will provide us with a good opportunity to get together. The International Permanent Committee of the Congress reconfirmed that we should combine the Carboniferous and Permian meetings since a majority of geologists and palaeontologists work on both systems and it is difficult for us to attend so many conferences on similar topics. More Permian workers will be available as representatives of different countries on the Permanent Committee in order to issue a more regional representation and a higher profile for Permian geology.

Finally, I hope that we can achieve an agreement on the GSSP of the Carboniferous/Permian boundary, and possibly establish the most suitable stratigraphical level for the basal boundary of major subdivisions during the 30th IGC. As a start, it will be a major achievement if we could agree on just one major international boundary!

F. Although not every one can attend our infrequent meetings the newsletter "Permophiles" exists to foster communication. All permophiles, members of SCPS and non-members alike, are invited to send letters, giving their personal view on matters concerning SCPS or Permian stratigraphy in general, to Dr. Utting or to me, for inclusion in the Permophiles.

We also need to know the names of those who should be added to our mailing list. Now we have 17 Titular members and 108 corresponding members. We need to get as many people as possible involved in our activities.

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2. SECRETARY'S NOTE

In the last few months there have been some changes in the titular membership of the Permian Subcommission. B.R. Wardlaw of the United States Geological Survey will replace R. Grant, who resigned, but will continue as a corresponding member. We should like to thank Dr. Grant of the Smithsonian Institution for his many years service as a titular member. We should like to welcome as a new titular member C.B. Foster of the Australian Geological Survey Organisation. The 17 titular members are as follows:

Prof. G. Cassinis
Dr. B.I. Chuvashov
Dr. J.M. Dickins
Dr. C.B. Foster
Dr. Brian F. Glenister
Professor Sheng Jin-zhang
Dr. Makoto Kato
Dr. Galina Kotlyar
Dr. H. Kozur
Dr. E. Ya. Leven
Dr. M.L. Menning
Dr. W.W. Nassichuk
Dr. Charles A. Ross
Dr. John Utting
Prof. Wu Wang-shi

Dr. B.R. Wardlaw
Dr. Jin Yu-gan

I should like to thank all those who contributed to the issue of "Permophiles". The next issue will be in June 1993; please submit contributions by May 15.

Contributors may send in reports by FAX to the number given below. "Permophiles" is prepared using WordPerfect 5.1 for those wishing to send in 5¼ inch or 3½ inch IBM computer discs (please also send printed hard copy).

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Institute of Sedimentary and Petroleum Geology
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3. MINUTES OF THE PERMIAN SUBCOMMISSION, AUGUST 28, 1992 17:30-18:25 29TH INTERNATIONAL GEOLOGICAL CONGRESS KYOTO, JAPAN

Jin Yugan, Chairman
Bruce Wardlaw, Meeting Secretary

I. Attendance

Yin Hongfu, China
Carmine Virgili, Spain
Makoto Kato, Japan
Sumio Sakagami, Japan
Vikorn Nakornsri, Thailand
Juichi Yanagida, Japan
Masamichi Ota, Japan
Tasuhiro Ota, Japan
Zunyi Yang, China
Spencer G. Lucas, U.S.A.
Koji Nakamura, Japan
G. Cassinis, Italy
H.M. Kapoor, India
D. Baghbani, Iran
Mac Dickins, Australia
Bill Sando, U.S.A.
Aymon Baud, Switzerland
Tetsuo Sugiyama, Japan

II. Agenda

The following agenda was proposed and met with no objection

Report of the Chairman
Report of the Working Groups
Discussion

III. Report of Chairman

A. Recent meetings. The Permian Subcommission met twice in 1991. Once with the International Symposium of the Perm in the Urals and once with the Carboniferous Congress (now the Carboniferous-Permian Congress) in Argentina. Initially no meeting was planned for the 29th IGC, but with the presence of the Chairman and to inform our Japanese colleagues this ad hoc meeting was arranged.

B. Prime task. The prime task of the Permian Subcommission is to establish the global stratotype section and determine the base of the Permian and subsequently to establish the series and stage boundaries and make-up of the Permian.

C. The Carboniferous-Permian boundary working group. This group was established late (1987) in the history of the ICS and has made significant strides toward its goal. It produced a multichapter report after the last congress and has a serious candidate for a boundary stratotype proposed by the Russian working group. In 1989, the working group decided to concentrate on three boundaries that correspond to the base of the *"bosbytauensis"*, *"vulgaris-fusiformis"*, and *"moelleri-fecunda"* zones in the Urals. A straw vote was taken and the *"moelleri-fecunda"* zone was overwhelmingly favoured. In Perm, the Aydaralash section was proposed as a candidate for the boundary stratotype and was generally favored. Reliable global correlations can only be established in marine facies; the Upper Permian of the Urals is continental facies; so we must look elsewhere to establish our Upper Permian divisions. We must be sure whatever section is finally approved for the boundary, or for any series of stage boundary, that it provides reliable correlation to continental facies.

D. Future meetings. We hope to meet in 1994 in Nanjing in conjunction with a proposed field symposium on the Permian of China.

We will meet with the Carboniferous-Permian Congress in 1995 in Cracow, Poland. We will meet in 1996 in Beijing with the next International Geological Congress. We plan no official meeting for 1993.

E. Permophiles. The newsletter "Permophiles" has become an extremely important means for communication of our subcommission and we hope all of you will utilize it to voice your opinions.

F. Membership. The Permian Subcommission currently consists of 17 titular members and 108 corresponding members, everyone interested in the Permian system is invited to become a corresponding member.

IV. Report of Working Groups

A. Carboniferous-Permian Working Group (Bruce Wardlaw, secretary). In addition to what has been already reported by our Chairman, the working group has received a serious proposal for a boundary stratotype between beds 19 and 20 in the Aydaralash section, southern Urals. We have requested that the Russians work on improving the exposure of the section and sample the shales. Shales collected by Brian Glenister turned out to be abundantly fossiliferous and we feel the previously unsampled shales should be sampled before formal proposal of the boundary stratotype. We hope to get this accomplished before the field symposium in China in 1994.

B. Post-Artinskian Stage Working Group (Bruce Wardlaw, chairman). I have graphically correlated all my sections from West Texas to show the composite ranges of conodonts. This was displayed in my poster session on Wednesday and will be submitted to "Permophiles". I look forward to open discussion on the proposed zonation and its correlation. Clearly, the interval occupied by the "Leonard Formation" represents the Kungurian of the Urals and it is an adequate reference for marine faunas and floras for this interval.

C. Guadalupian Series Working Group (Bruce Wardlaw, co-sponsor). The proposal for the Guadalupian to serve as the series of the Middle Permian is now documented in a 50 page manuscript accepted in the first issue of the Proceedings of the Perm Symposium and will hopefully be published within the year.

D. Division of the Permian Working Group (Mac Dickins, chairman). Some confusion exists whether to proceed with a two-part subdivision as was once felt mandated, or develop a three-part subdivision, which seems more popular now. Mac then proceeded to explain the confusion. It is hoped to proceed to develop a chart with areas of consensus and differences on all the series and stage boundaries as now understood. It is also hoped that at the IGCP 272 meeting in Vladivostok, following the IGC, that meetings with Kotlyar will help clarify the current Tethyan subdivisions. Nevertheless, an effort should be made to include Tethyan and Boreal zonations and their correlation.

V. Discussion

A. Wardlaw - The Tethyan subdivisions are unusable at present because they are based solely on provincial fususlind zonations. Until more complete faunal control is developed they are inappropriate for international correlation.

B. Baud - The nomenclature of conodonts and fusulinids needs to be standardized to some common form.

C. Dickins - Bivalves provide more control than ammonoids in the mid-Permian of the two part Permian subdivision.

D. Kato - The Japanese have formed several national groups that are active on several problems of the Permian. One is working on the Carboniferous-Permian boundary but so far only on the carbonate facies. Most faunal groups have been well documented except the conodonts. The Japanese are adaptable to any boundary working group. Other groups that are active include an Upper Permian group and a boreal correlation group. Kato will submit to "Permophiles" a list of the active groups and their chairman or contact person.

E. Baud - The Subcommission on Triassic Stratigraphy will meet at 7:00 p.m. on Monday, August 31, in room F, following the IGCP 272 meeting. The Permian-Triassic boundary working group is not very active at present. There is still much controversy on problems of correlation

of ammonite zones and conodont nomenclature and correlation.

F. Wardlaw - Does the body assembled favourably view the establishment of the Carboniferous-Permian boundary between beds 19 and 20 in the Aydaralash section based either on the changes of conodonts, fusulinids, or ammonoids (which are nearly synchronous)? We will take no comment as a unanimous endorsement.

VI. Adjournment (18:25)

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4. THE PRESENT CONDITION OF THE OUTCROP OF THE TYPICAL OOLITIC HORIZON OF TESERO IN THE SOUTHEASTERN ITALIAN ALPS, AT THE PERMIAN/TRIASSIC BOUNDARY

The oolitic levels that make up the Horizon of Tesero were identified for the first time by Venzo (1954). After which, the area of their diffusion has been enlarged and their depositional characteristics have been specified by Bosellini (1964).

At the beginning of the '80s my colleagues from the University of Ferrara and I specified the stratigraphical position of the oolitic levels and the presumed continuity of marine sedimentation of the Permian-Triassic boundary inside of this Horizon.

The results of our research, today shared by many stratigraphers, were described during the meeting on "Permian and Permian-Triassic boundary in the South-Alpine segment of the Western Tethys" (Brescia, Italy, July 1986).

During that meeting the most important excursion was that near the village of Tesero (Val di Fiemme, Trento) to a typical outcrop of the Oolitic Horizon where every layer of the sequence was numbered. Every number corresponded to the level from which were taken the samples described in our previous publications of 1986 (Broglio-Loriga et al., 1981; Pasini, 1982; Neri & Pasini, 1985; Pasini, 1985), in the Field Guide-book (Neri, Pasini & Posenato, 1986) and in my report given at that excursion. So the area of Tesero seems to be one of the rarest places in the world where today the continuity of marine sedimentation between Permian and Triassic can be observed. Therefore, the preservation of the typical sequence is very important.

After 1986, until three years ago, new sampling made by other scientists interested in the subject respected the numbered section. Recently I returned to Tesero, but there were no longer traces of the original numbering on the outcrop and the outcrop itself has been cut back by about 1 m, right in the place where the numbering of the P/T boundary had been. I hope this is not work of geologists!!

In the next summer (1993) I will therefore return to Tesero and I will rewrite the numbers, trying to repeat the original numbering: I know however that this is not strictly possible given the type of sediment. We will then endeavour, along with the local Authorities, to protect the renumbered sequence from other unauthorized actions. Moreover in 1993, about forty years after the identification of the Oolitic Horizon of Tesero, I will publish a complete bibliography concerning this topic.

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5. REPORT CONCERNING PERMIAN RESEARCH IN AUSTRALIA

The BMR (Bureau of Mineral Resources, Geology & Geophysics) has undergone a name change to the AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION. The street addresses and telex codes remain the same, some fax numbers have changed; that of Clinton Foster is now 61 62499972. However with this name change has come a 12 month review of the function of the AGSO. Should it be combined with another Australian Federal Government organisation (CSIRO), or made an independent body, or remain attached to the Department of Primary Industries &

Energy? These are the questions exercising the minds of the review panel. It is interesting to note the strong support received for the BMR/AGSO, including that from principal Permian workers, and metals and petroleum exploration companies. All supporters are proven achievers in the fields of earth science and exploration.

A paper recognizing 5 new palynological zones in the Late Carboniferous-Early Permian by the Galilee Basin (Queensland), eastern Australia, has recently been published by M.J. Jones & E.M. Truswell, (*BMR Journal of Australian Geology & Geophysics,* 13: 143-185). It is well illustrated, and provides detailed spore-pollen taxonomic data. As is customary, and necessary for global assessment, assemblages are dated using northern hemisphere nomenclature, but further work is required to strengthen the correlations. In this connection, plant microfossils from the earliest Permian, fauna-bearing sequences are being studied, by Clinton Foster, from the Carnarvon Basin (Western Australia) and the Cranky Corner Basin (eastern Australia). Faunas are being studied, by Neil Archbold (Deakin University), and Mac Dickins (AGSO). The "*Granulatisporites*" *confluens* Zone has been recognised in each basin, and there has been increasing Gondwanan recognition of the zone, with the recent record from Antarctica by Larsson et al, (1990, *Antarctic Science* 2: 331-344). When accessing the saccate pollen from the glacial and immediate pre-glacial sequences it seems that there are generic/?species links with Euramerican assemblages, suggesting that the flora was established in Gondwana prior to the well known glacial episodes. These ideas are being investigated by examining comparative Euramerican assemblages.

The importance of comparative studies was again emphasised during the Permian Conference held in Perm during 1991. The opportunity to examine Russian Permian and Early Triassic spore-pollen assemblages at the microscope was very informative and should be a continuing process. We greatly appreciated the efforts of Drs. Fefilova and Koloda to make this possible in Perm. Further comparative study was undertaken with Drs. A.V. Gomankov and O. Yaroshenko at the Geological Institute in Moscow; I remain very grateful for their support and assistance. The question of either miospore homeomorphy, or records of species migration, with all the implications for inter-regional correlation, needs to be answered using all available techniques including TEM methods. Of course, such work can only proceed through exchange of materials.

The Phanerozoic Timescale Project of the AGSO is employing both palaeontological and ion-probe zircon dating (SHRIMP) methods to solve international and inter-regional correlations. For the Late Palaeozoic of eastern Australia SHRIMP dating of tuffaceous sediments is being carried out by Prof. John Roberts of the University of New South Wales, and AGSO. Associated faunas and plant microfossil data are being reassessed to accompany these new numeric dates. Ties with international stratotypes, such as the Late Permian of China (Claoue-Long et al., 1991, *Earth and Planetary Science Letters*, 105: 182-190), are essential and will continue wherever suitable, biostratigraphically constrained, samples are available. I would be interested to hear about any potential Permian locations/samples of which members may be aware.

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6. THE DIVISION OF THE PERMIAN SYSTEM AT A SERIES LEVEL

During the Guadalupian Symposium held in Alpine, Texas in March, 1991, it was decided to propose the stratotype section of the Guadalupian Series as a world standard for the Middle Permian. This proposal was introduced in "Permophiles" (no. 18) and also at the International Congress of the Permian System of the World by Brian Glenister. In the proposal of Glenister, a tripartite division, rather than a bipartite, for the Permian was preferred. However, one has difficulty seeing the advantages or the necessity for a tripartite division. Among a number of reasons against the tripartite division, the following points are most important:

(a) it needs sufficient documentation to support the abandoning of the traditional bipartite division,

(b) the chronostratigraphic range of each series can hardly be considered as equal,

(c) the tripartite division does not reflect the main events of geological and biological evolutionary history.

It is apparent that the Guadalupian Series represents an important epoch in Permian geological history. This epoch is characterized by the most extensive transgression and the warmest climatic conditions in the Permian. Its initiation and conclusion are both marked by the great and rapid changes of marine faunas. The Cyclolobids and the early forms of Ceratitids begin at the base of the Guadalupian Series and its equivalent in the Tethys and reach their acme near the end of the Permian and into the Triassic. The fusulinids experienced a remarkable development in this epoch, only a single advance genus (*Misellina*) existed before this epoch and many advanced forms appear at the beginning of this epoch. At the beginning, early forms of *Armenia* and *Pseudodoliolina* appear, and a little later early forms of *Cancellina* appear, representing three new families (Verbeekinidae, Pseudodolinidae, and Neoschwagerinidae, respectively) begin with this epoch. Other new families that begin within this epoch include Polydiexodinidae and Yangchienidae. Based on the zonation of these advanced fusulinids, three stages, the Kubergandinian, Murgabian, and Midian were established in Tethyan areas. A combination of these three stages essentially corresponds to the Guadalupian Series. Most of the fusulinids and the goniotitids disappeared by the end of the Guadalupian.

We agree with our American colleagues in treating the Guadalupian as a series of the Permian System because the events marking its beginning and end are globally recognizable. However, the geological event that occurred between the Sakmarian and the Artinskian is not reflected in their scheme. In most sections of Permian marine deposits, the Asselian and Sakmarian (possibly Asselian-lower Artinskian) are usually separated by an unconformity from the overlying strata. The upper part of the Lower Permian is commonly partially or wholly absent in these sections and the Sakmarian beds are covered directly by the Upper Permian. This is obvious in the Tethys, particularly in the PeriGondwana areas such as Iran, south Afghanistan, south Pamirs, Himalayas, Karakorun, and Xizang. In these areas, the Asselian-Sakmarian mostly consists of a clastic transgressive sequence with floras and faunas of cold climate unconformably overlain by carbonate sequences with faunas of warm climate. The base of these carbonate sequences is diachronous ranging in age from the Yachtashian to the Murgabian. The post-Sakmarian unconformity is especially distinct in South China where traditionally it was regarded as the base of the Permian. The corresponding unconformity occurs between the Wolfcampian and Leonardian deposits in North America. By the end of the Sakmarian stage or at the beginning of the Artinskian (Yachtashian) stage, the most distinct evolutionary change in fusulinids occurs. Forms that dominated the Asselian and Sakmarian fusulinid faunas disappeared or nearly so. These forms include *Sphaeroschwagerina*, *Pseudoschwagerina*, *Zellia*, *Rugosofusulina*, and numerous species of *Pseudofusulina*. Meanwhile, *Pamirina*, the pioneer genus of a more advanced lineage of fusulinids appeared associated with *Mesoschubertella*, *Toriyamaia*, and *Charaloschwagerina*. The species composition of *Pseudofusulina* and *Darvasites* was entirely renewed.

In order to reflect the biological and physical evolution properly, the Permian should be divided into four series rather than three. A similar conclusion has been reached based on the stratigraphic materials of the Biarm Province and put forward by Ganelin and Kotlyar during the International Congress of the Permian System of the World. It is the most suitable way to combine two series of the Upper Permian and the Lower Permian into superseries or subsystems for keeping the traditional bipartite classification of the Permian (Table 1).

The tetrapartite subdivision is better than the tripartite in that it best reflects the main events of the Permian. This scheme is capable of accommodating various classifications of the Permian being used in different areas without major alteration. This way the traditional bipartite subdivision would be maintained; the lower boundary of the Permian previously used in China is reflected; and it agrees with the proposal of the American colleagues for the Guadalupian Series.

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(translated from Russian by Jin Yu-gan, edited by B.R. Wardlaw)

SUBDIVISIONS OF THE PERMIAN

Table 1

Permian Subsystem	Series	Urals	Tethys	N. America
Upper P_2	Upper P_2^2	Tatarian	Dorashamian Dzhulfian	Ochoan
	Lower P_2^1	Kazanian Ufimian	Midian Murgabian Kubergandinian	Guadalupian
Lower P_1	Upper P_1^2	Kungurian Artinskian	Bolorian Yachtashian	Leonardian
	Lower P_1^1	Sakmarian Asselian	Sakmarian Asselian	Wolfampian

7. AMMONOIDS AND FUSULINACEANS NEAR THE CARBONIFEROUS-PERMIAN BOUNDARY IN THE CANADIAN ARCTIC ARCHIPELAGO

Important discussions on the Carboniferous-Permian boundary have been reported in the literature in recent years and we support a growing consensus that the boundary stratotype should be selected at or near the base of the Asselian Stage in the Urals. Indeed, we are of the opinion that the Aidaralash Creek section in the Aktiubinsk area of Bashkiria might be an excellent candidate for the stratotype since it contains numerous ammonoid, fusulinacean and conodont horizons.

Bogoslovskaya and Popow (1986), Davydov et al. (1990) and Bogoslovskaya et al. (1991) all agree that the Carboniferous-Permian boundary should be drawn between the *Shumardites-Vidrioceras* and the *Svetlanoceras-Juresanites* genozones; that is, near the base of bed 20 in the Aidaralash Creek section in Bashkiria. Davydov et al. (1990) indicated that the boundary between these ammonoid zones coincides with the base of *Schwagerina* (=*Pseudoschwagerina*) *vulgaris-Schwagerina* (=*Pseudoschwagerina*) *fusiformis* Zone (Table 1).

Chuvashov (1990), however, suggested that the evolutionary changes shown by fusulinaceans, ammonoids and conodonts between beds 19 and 20 are too subtle to define a systemic boundary and preferred to draw the boundary somewhat higher; that is, at the base of the *Sphaeroschwagerina moelleri-Schwagerina fecunda* Zone (Table 1).

Fusulinacean faunas in the boundary interval in the Canadian Arctic Archipelago, though abundant, are dramatically different from those in the Urals. Whereas *Schwagerina* and *Daixina* are abundant and diverse within the boundary interval in the Urals, they are exceedingly rare in the Sverdrup Basin where *Pseudofusulinella* is the dominant fusulinacean. Indeed, neither the "*Schwagerina*" *fusiformis*-"*Schwagerina*" *vulgaris* Zone nor the *Sphaeroschwagerina moelleri-Schwagerina fecunda* Zone is readily apparent in the Sverdrup Basin. Accordingly, we have begun a study on the Carboniferous-Permian boundary interval within the Sverdrup Basin in the Canadian Arctic to determine the degree to which fusulinacean zones that are clearly recognizable at Aidaralash Creek and elsewhere in the Urals can be correlated with the Sverdrup Basin.

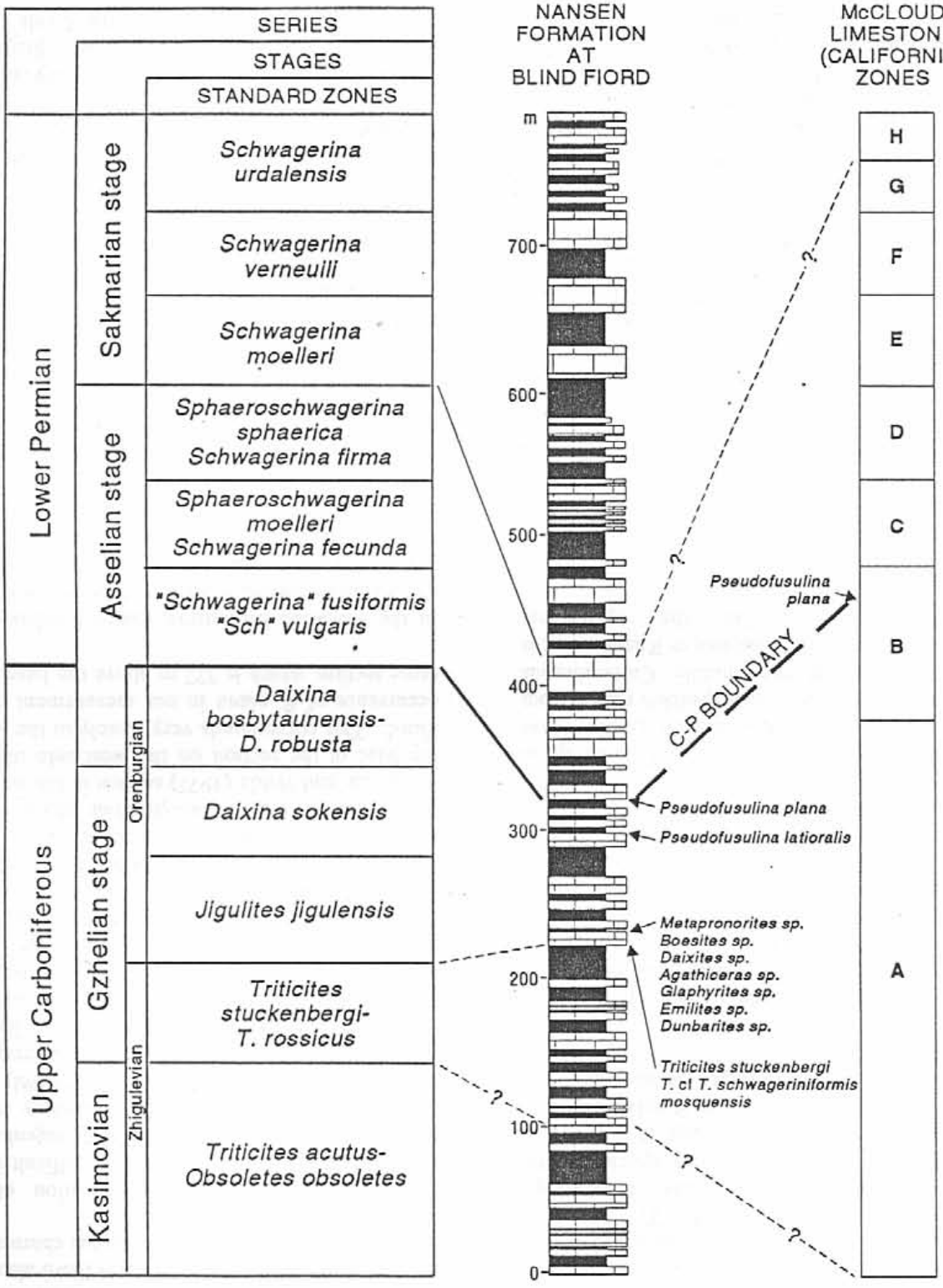
Preliminary data reported here are from the Nansen Formation at Blind Fiord in southwestern Ellesmere Island where we consider the Carboniferous-Permian boundary to be considerably higher in the formation than was suggested by Nassichuk and Wilde (1977), Nassichuk and Henderson (1986) and Henderson (1990).

Thorsteinsson (1974) was the first to study fusulinaceans in the Nansen Formation at Blind Fiord. He (*ibid.*) suggested, because of the presence of species of "*Fusulinella*" and *Triticites*, that the lower "several hundred feet" of the formation was of Late Carboniferous (Zhigulevian) age and that species of *Schwagerina* and "*Fusulinella*" higher in the section suggested an Asselian or Sakmarian age.

Nassichuk and Wilde (1977), however, found no representatives of *Schwagerina* and *Fusulinella* in their *Pseudofusulinella thompsoni-Pseudofusulinella* ex. gr. *P. usvae* Zone in the lower 60 m (185 ft.) of the formation. Nassichuk and Wilde (*ibid.*) correlated this assemblage zone with Zone A in the McCloud Limestone in northern California. Skinner and Wilde (1965) suggested that Zone A was either of late Pennsylvanian (Virgilian=Orenburgian) or earliest Permian (Wolfcampian) age but Nassichuk and Wilde (1977) followed the views of Wilde (1971) and Kalymkova (1975) who concluded that Zone A was Permian. All fusulinacean and ammonoid data now available from the Blind Fiord section strongly suggest that all of Nassichuk and Wilde's (1977) *Pseudofusulinella thompsoni-P.* ex. gr. *P. usvae* Assemblage Zone and much of the *Pseudofusulina plana* Zone; that is, the interval below the first appearance of true *P. plana*, are of Late Carboniferous age (Table 1).

In 1985, Charles M. Henderson discovered an important ammonoid fauna from within Nassichuk and Wilde's *Pseudofusulina plana* Zone, 235 m above the base of the Nansen Formation on the west side of Blind Fiord. Nassichuk and Henderson (1986) listed the long-ranging genera *Neopronorites* sp. (now *Metapronorites* sp.), *Daixites* sp., *Boesites* sp., *Agathiceras* sp., *Glaphyrites* sp. and *Emilites* sp. and assigned them to the Asselian. Subsequently, the exclusively Upper Carboniferous (Zhigulevian-

Table 1


SERIES
STAGES
STANDARD ZONES
Lower Permian
Upper Carboniferous
Sakmarian stage
Asselian stage
Gzhelian stage
Kasimovian
Orenburgian
Zhigulevian
Schwagerina urdalensis
Schwagerina verneuili
Schwagerina moelleri
Sphaeroschwagerina sphaerica
Schwagerina firma
Sphaeroschwagerina moelleri
Schwagerina fecunda
"Schwagerina" fusiformis
"Sch" vulgaris
Daixina bosbytaunensis-
D. robusta
Daixina sokensis
Jigulites jigulensis
Triticites stuckenbergi-
T. rossicus
Triticites acutus-
Obsoletes obsoletes
NANSEN FORMATION AT BLIND FIORD
m
700
600
500
400
300
200
100
0
McCLOUD LIMESTONE (CALIFORNIA) ZONES
H
G
F
E
D
C
B
A
Pseudofusulina plana
C-P BOUNDARY
Pseudofusulina plana
Pseudofusulina latioralis
Metapronorites sp.
Boesites sp.
Daixites sp.
Agathiceras sp.
Glaphyrites sp.
Emilites sp.
Dunbarites sp.
Triticites stuckenbergi
T. cf T. schwageriniformis
mosquensis
?

Orenburgian) *Dunbarites* sp. was recovered from the same locality, confirming a late Carboniferous age and not a Permian age for at least the lower 235 m of the Nansen Formation on the west side of Blind Fiord (Table 1).

Fusulinaceans from GSC loc. C-20416, 10 m below the ammonoid bed contain abundant *Triticites stuckenbergi* Rauser and *T.* sp. cf. *T. schwageriniformis mosquensis* Rosovskaya (Table 1). The former is an "index" species for the middle part of the Gzhelian Stage (C_3C_2) in the vicinity of the stratotype in the Russian Platform and the latter ranges from upper Kasimovian (C_3B) to middle Gzhelian (C_3C).

Within the ammonoid bed (Table 1), the most common fusulinaceans are *Pseudofusulinella usvae* Dutkevich and *P.* sp. cf. *P. pulchra* (Rauser and Beljaev). The former was described originally from the Kasimovian (C_3A-C_3B) in Russia but later it was found associated with species of *Ozawainella, Fusulina, Quasifusulina, Schubertella, Protriticites, Eotriticites* (=*Montiparus*) and *Triticites* in the Nordenskvoldbreen Formation within the Gipsdalen Group, West Spitzbergen and with *Triticites* sp. in the middle of the Wordiakammen Group, West Spitzbergen. *Pseudofusulinella pulchra* ranges from the upper part of the middle Carboniferous Moscovian Stage to the Asselian in Russia but it is particularly common in the uppermost Carboniferous (Gzhelian).

Fifteen species of *Pseudofusulinella, Pseudofusulina* (=*Rugosofusulina* of Rauser-Chernoussova and others), *Schubertella* and *Pseudoendothyra* occur in the 92 m interval above the ammonoid bed at Blind Fiord, but representatives of *Schwagerina, Pseudoschwagerina, Sphaeroschwagerina*, and *Triticites* are absent. Most of the species of *Pseudofusulinella* in this interval also occur in Zone A of the McCloud Limestone in California (Table 1). *Pseudofusulinella pulchra mesopachys* (Rauser and Beljaev) seems to be confined to the Upper Carboniferous *Triticites* Zone in Russia.

Further, *Pseudofusulinella* sp. cf. *P. usvae* and *Pseudofusulinella* sp. cf. *P. pulchra*, which are common in this interval, also occur in the underlying ammonoid bed. *Pseudofusulina latioralis* (Rauser) occurs 302 m above the base of the Blind Fiord section. According to Scherbakova (1986), *P. latioralis* occurs in the the uppermost Carboniferous *Daixina bosbytauensis-D. robusta* Zone at Kosiv River in the Urals; elsewhere in the Urals it has also been reported from lower Asselian strata. In short, all of the fusulinaceans in the 92 m interval above the ammonoid bed, that is, all those up to 327 m above the base of the Nansen Formation on the west side of Blind Fiord also have a distinctive uppermost Carboniferous character.

As we indicated earlier, identification of the Carboniferous-Permian boundary is difficult in the Blind Fiord section because *Pseudoschwagerina* and related species that define the boundary in the Urals are absent. Accordingly, we tentatively place the boundary at or near the first occurrence of *Pseudofusulina plana* (=*Rugosofusulina* of Rauser-Chernoussova and others) 92 m above the ammonoid bed. It should be pointed out that Nassichuk and Wilde (1977) showed the lowest occurrence of *Pseudofusulina plana* to be at 159 m above the base of the Nansen Formation on the west side of Blind Fiord; we now believe this species to be *Triticites* sp. Accordingly, the lowest occurrence of true *Pseudofusulina plana* in the Nassichuk and Wilde (1977) section is 318 m above the base of the section on the west side of Blind Fiord. This corresponds very closely to the lowest occurrence of *P. plana* in our measurment of the same section, which is 327 m above the base.

In the McCloud Limestone, *Pseudofusulina plana* and *Paraschwagerina fairbanksi* Skinner and Wilde first occur near the top of Zone B, whereas *Pseudoschwagerina californica* Skinner and Wilde occurs at the base of Zone C. *Paraschwagerina* appears to be absent from pre-Permian strata in North America and China. In Darvas and the southern Urals, however, it has been reported from uppermost Carboniferous as well as Asselian strata (Leven and Scherbovich, 1978; Davydov, 1986). It is important to note that the shape and internal structure of *Pseudoschwagerina californica* are closely similar to *Pseudoschwagerina uddeni* (Beede and Kniker) and *P. uddeni russiensis* Rauser; all three of these species can be considered to belong to the *Pseudoschwagerina uddeni* group. According to Rauser-Chernoussova (1949) *Pseudoschwagerina uddeni russiensis* first occurs in the lower part of the "*Schwagerina*" Zone in the southern Urals.

To conclude, although we cannot precisely correlate the base of the "*Schwagerina*" *fusiformis*-"*Schwagerina*" *vulgaris* Zone in the Urals to the

Nansen Formation, our preliminary data suggest that the first appearance of *Pseudofusulina plana*, some 327 m above the base of the formation on the west side of Blind Fiord (92 m above the ammonoid bed) correlates closely to the base of that zone. Further, we suggest that the first appearance of *Pseudofusulina plana* corresponds approximately to the base of the *Pseudoschwagerina uddeni-P. texana* Zone in the United States and to the first appearances of *Pseudoschwagerina uddeni, P. beedei* and *P. texana* in South China.

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8. UPDATE ON PERMIAN CONODONT STUDIES IN WESTERN AND ARCTIC CANADA

Research at the University of Calgary on Permian conodonts has progressed in several directions. In general, my research is directed towards establishing conodont biozonal schemes in the sparsely fossiliferous Permian strata of the Western Canada Sedimentary Basin and refining the biozonal scheme established in my Ph.D. thesis on the Sverdrup Basin (Henderson, 1989; University of Calgary).

In the Sverdrup Basin, I presently recognize fifteen Permian conodont zones (three in the Asselian although one or two of these may end up in the Carboniferous; two in the Sakmarian; five in the Artinskian; and five in the ?Kungurian to Wordian interval). This zonation has been determined from strata deposited on the inner to outer shelf (Canyon Fiord and Nansen formations; Belcher Channel and Nansen; unnamed A and B; and Sabine Bay, Assistance, Trold Fiord formations). Work is in progress to examine the slope to basinal facies of the Hare Fiord Formation (Upper Carboniferous to Sakmarian). A preliminary examination suggests that, despite differences of generic relative abundance, the zonation previously established will correlate with the basinal facies.

In Permian strata of Western Canada, only twelve zones have been recognized to date. Those zones not recognized in both regions may be missing from Western Canada beneath several intra-Permian unconformities, or they have not yet been recognized, owing to the reconnaissance nature of Permian conodont studies in Western Canada. This is highlighted by the fact that one of my M.Sc. students (Pauline Chung) has recovered a good zonation of Serpukhovian to Moscovian conodonts from rocks (Kindle Formation in northeastern British Columbia and part of the Belloy Formation in the subsurface of west-central Alberta) previously correlated with the Permian on a lithostratigraphic basis. Anita Harris (pers. comm., 1992) recently told me about similar occurrences in Alaska. I would like to know of other comparable case studies.

Work has also focused on the recognition of the Carboniferous-Permian and Permian-Triassic boundaries in Canada. I have concentrated my efforts on the Carboniferous-Permian boundary as a voting member of the International Commission on Stratigraphy's Carboniferous-Permian boundary working group. It was formally proposed at the 1991 meeting in Perm, Russia that the boundary stratotype for the Carboniferous-Permian boundary be provisionally defined at the base of the *Sphaeroschwagerina vulgaris-S. fusiformis* Zone between beds 19 and 20 of the Aidaralash section, with a parastratotype at the Usolka River section. In effect, this proposal directed paleontologists to determine the suitability of this boundary definition and the ease of recognition in their respective regions. Neither the genus nor species of fusulinacean named above are present in Western or Arctic Canada, making this boundary definition difficult to recognize. However, according to Davydov et al. ("Permophiles" #19) the conodont *Streptognathodus barskovi* appears in the lower portion of the above *Sphaeroschwagerina* Zone at the top of bed 20. The appearance of *S. barskovi* in a thick section of Nansen Formation on southwestern Ellesmere Island, Canadian Arctic is associated with a significant change in the small foraminiferal assemblages (Sylvie Pinard, pers. comm., 1992) and close to the appearance of *Pseudofusulina plana* (only about 15 m below *P. plana*). *Pseudofusulina plana* correlates with Zone B of the McCloud Limestone in northern California at the very base of the *Pseudoschwagerina-Paraschwagerina* Zone (see Nassichuk and Rui Lin, this newsletter). It is thus suggested that the appearances of *Pseudofusulina plana* and *Streptognathodus barskovi* in the Canadian Arctic can be approximately correlated with the first inflated schwagerinids (*Pseudoschwagerina* and *Paraschwagerina*) in North America and that *Streptognathodus barskovi* in the Urals corresponds closely to the first Russian-Kazakhstanian

occurrences of inflated schwagerinids (*Sphaeroschwagerina*). Furthermore, the boundary established in the Canadian Arctic occurs slightly above a major sequence boundary pointing to its chronostratigraphic significance, if a comparable sequence boundary can be recognized in the Ural Mountain sections. The near association of fusulinacean, foraminiferal, and conodont biotic events, slightly above a sequence boundary in the Canadian Arctic, suggest that these biotic changes represent a natural and significant boundary interval. If they truly correlate, or at least correlate closely with the *Sphaeroschwagerina vulgaris-S. fusiformis* zone, then the position proposed at Perm is very suitable, but clearly difficult to recognize with certainty in Canada because the fusulinacean genera and species exhibit a high degree of endemism. A recently described new conodont genus, *Gondolelloides* Henderson and Orchard, appears in the Lower Asselian in the Canadian Arctic and near the base of the transgressive carbonates of the lowest Permian Belcourt Formation in Western Canada. This conodont genus may prove valuable for recognizing the Carboniferous-Permian boundary where other elements are lacking.

I have not concentrated to the same extent on the Permian-Triassic boundary, but the most significant aspect of this work is that I have recognized "uppermost Permian" conodonts in the basal "Triassic" transgressive shale in the Canadian Arctic. Are they indigenous or reworked? If the latter, from which unit are they reworked? I would appreciate correspondence from anyone that may have recognized comparable occurrences. I plan to address this question further during the 1994 field season on northern Ellesmere Island.

Finally, my research at the University of Calgary involves the Carboniferous as well as the Permian. In particular, Carboniferous sections are thick and extensive throughout Western Canada and conodont studies have only been completed on a reconnaissance basis. I have several potential projects for students on Carboniferous or Permian biostratigraphy-sequencestratigraphy/sedimentology in either Western or Arctic Canada. There is considerable work to be done in these regions, with surprises around every corner that make these opportunities very exciting. I would be very interested to receive information on, or correspondence from potential M.Sc. or Ph.D. students interested in working at the University of Calgary as early as September, 1993.

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9. REPORT ON THE CARBONIFEROUS AND PERMIAN CONODONT BIOSTRATIGRAPHY OF NOVAYA ZEMLYA, RUSSIA

A complete and comprehensive report on Carboniferous and Permian biostratigraphy of Novaya Zemlya, Russia, is in final stages of preparation and will be published by the Geological Survey of Canada, through the Canada/Russia Arctic Exchange Agreement. This paper was written by Nikolai Sobolev and Ol'ga Vinodgradova of the VNIIOkeangeologiya, St. Petersburg. Ol'ga Vinodgradova recently visited the Geological Survey of Canada in Calgary to discuss the manuscript with W.W. Nassichuk and C.M. Henderson.

The paper is in the style of a bulletin and includes methods and techniques, stratigraphy, biostratigraphy, conodont systematics, including several new species, and sections on local and circum-Arctic correlation and the Carboniferous Permian boundary.

The following are excerpts from the Abstract: A total of eleven Middle-Upper Carboniferous and twelve Lower Permian conodont assemblage zones and subzones have been established on 21 sections and three Pechora Sea wells. Samples were collected from a large area with numerous different facies zones ranging from shallow to deep water. Chronostratigraphic correlations indicate that these zones range from Early Bashkirian (*Declinognathodus noduliferous* Assemblage Zone) to Late Artinskian (*Neostreptognathodus pequopensis* Assemblage Zone). The conodont assemblages can be correlated with the Russian Platform and the Urals, and with the Canadian Arctic Islands and Svalbard. The conodont assemblages are complete across the area of the Carboniferous-Permian boundary and should assist in international discussion of where the boundary should be located.

Conodont Colour Alteration Indices are presented and they identify potential hydrocarbon producing zones.

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10. REPORT FROM NORTH AMERICAN FRIENDS OF THE PERMIAN

INTRODUCTION As has become customary in recent years, North American Friends of the Permian conferred in conjunction with the Annual Meeting of The Geological Society of America, 19 Friends participating in an informal 2½ hour discussion in Cincinnati Ohio, October 27 1992. Written communications were received from 2 additional members.

I. The convenor opened the meeting by reviewing what he termed the year's "unspectacular progress" toward international agreement on boundaries of the Permian System and its component stages. This situation is especially disappointing in light of the optimism generated in 1991 by the extremely successful Guadalupian Symposium and Perm Conference. However, several significant compilations were either published or assembled in 1992. Especially notable was the publication by Cambridge University Press of "Permo-Triassic Events in the Eastern Tethys", edited by Walter C. Sweet and colleagues. Additionally, the first selection of papers from the Perm Conference is due for publication late this year or early in 1993 in International Geology Review, and Proceedings of the Guadalupian Symposium will appear later in the year as a Smithsonian Contribution. An international group of 14 authors is using the IGR to formally propose the Guadalupian as world standard for the Middle Permian Series.

Despite meagre progress in the year past, Permian specialists seem poised for rapid future international agreements on boundaries of the Permian System and its component stages. Russian colleagues have achieved near-consensus for designation of the base of the *Sphaeroschwagerina vulgaris - S. fusiformis* Zone at Aidaralash as the C/P boundary, essentially the level defined by V.E. Ruzhencev (1936). Lower Permian stages are susceptible to satisfactory definition in the classic areas of the Southern Urals, perhaps with modification of major groupings as suggested by Ernst Ja. Leven elsewhere in the present edition (see Item 6). Prospects for progress in this area were enhanced recently by the award of American National Science Foundation funds to Claude Spinosa and colleagues for two summers of field work in collaboration with Russian specialists, especially Valery V. Chernykh, Vladimir I. Davydov, and Tatyana B. Leonova. Collaboration is already firmly established with Americans facilitating English publication of several significant Russian Permian research contributions.

Cooperating authors have developed a strong case for recognition of the Guadalupian as international standard for the Middle Permian Series (Glenister et al., IGR, 1993). A problem remains in existence of an interval that is demonstrably post-Artinskian (Baigendzhinian Substage) but pre-Guadalupian (Roadian Stage). The stratotype for this additional stage will be best selected in objective stratigraphic succession either above the Baigendzhinian or below the Roadian. Restricted facies of the Russian Kungurian mitigate against use of this reference, and the Cathedral Mountain interval of West Texas (Cathedralian, Ross & Ross, 1987) seems preferable.

Having formally proposed acceptance of the Guadalupian as the international Middle Permian Series, North American Friends are concerned that boundaries of the Upper Permian Series receive early attention, particularly because final acceptance of a base for the Series will automatically allow us to recognize the top of the Guadalupian. Definition and correlation of the base of the Triassic continue to represent major problems.

II. Participants next discussed individual research projects. Overall review of the status of Permian studies resulted in instruction that the Convenor communicate the following statements to the respective chairs of the Permian and Triassic subcommissions. The statements are made in the understanding that acquisition of data must continue indefinitely, but that sufficient information now exists for informed consummation of the "housekeeping" phase of Permian studies so as to facilitate communication and permit more rapid progress with the science.

1) Dr. Jin Yugan - SPS. North American Friends of the Permian request that you urge sponsors of competing Upper Permian candidate sections (particularly those of South China and Transcaucasia) to proceed rapidly with formal proposals. Sponsors can be encouraged in the knowledge that post-Lamar (type uppermost Guadalupian) faunas (particularly conodonts) are now known well enough that they can be correlated confidently to any reasonable choice for definition of the base of the international standard upper Permian stratotype. All members are invited to send in their comments concerning the recognition of the Guadalupian as an international standard for the Middle Permian Series, and the recognition of the Guadalupian/Lopingian (Dzhulfian) boundary.

2) Dr. Aymon Baud - STS. North American Friends of the Permian were disturbed to read in minutes of the Kyoto meeting (29th International Geological Congress, reported herein) of the apparent lack of progress in definition of the base of the Triassic. They look forward to some indication that we are moving toward resolution of this most difficult of the Permian boundary problems. Norman D. Newell has again submitted a thoughtful written statement on the subject.

III. The meeting concluded with review of research responsibilities for North American Friends. It was suggested that results of research may be available for evaluation as Guadalupian Symposium II, possibly in March 1994 or 1995.

1) Definition and stratotype designation of the pre-Guadalupian (Roadian) Cathedralian Stage, Glass Mountains, West Texas.

2) Fuller documentation of cyclolobid (*Demarezites* > *Waagenoceras*) and other ammonoid transitions across the Roadian/Wordian boundary.

3) Definition of bases for Wordian and Capitanian stages by reference to microfossils, particularly conodonts and fusulinaceans.

4) Fuller documentation of post-Guadalupian (post-Lamar) microfossil successions, particularly conodonts, to afford the basis for correlation to the international standard base of the Upper Permian Series.

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11. FIRST ANNOUNCEMENT. THE INTERNATIONAL SYMPOSIUM ON PERMIAN STRATIGRAPHY, ENVIRONMENT AND RESOURCES

August 29-31, 1994
Guiyang, China

In cooperation with the SCPS, the Chinese Permian friends are planning to hold an international symposium towards the end of August, 1994 on the stratigraphy, environment and resources of the Permian. The venue of the symposium will be Guiyang, the provincial capital of Guizhou, southwestern China. This province is characterized by fully developed carbonate sequences from Sinian to Triassic, fantastic karst landscape, interesting geology, and highly diverse life-style and culture of local minority nationalities. The Permian marine sequences of carbonate shelf and basin are fully developed around Guiyang and have been extensively studied and therefore, may prove to be of great significance to global correlation of the Permian.

The main themes of this symposium, as indicated by its title, include stratigraphy, environment and resources of the Permian throughout the world. To build a widely acceptable unified choronostratigraphic scheme for the System is a task that should be accomplished as soon as possible. It is expected that some formal proposals will be presented, and voted on, concerning the stratigraphic levels with potential for global correlation, the candidate section for GSSP, inter-system boundaries, and the major internal boundaries of the system. Also participants will be encouraged to present fresh results which may lead to a better understanding of various aspects of Permian stratigraphy.

The geographic, climatic and ecological evolution during the last period of the Paleozoic is still full of mystery to us and so, is here treated as one of the main themes. This symposium will present a unique

opportunity for participants to compare the environments and their relevant resources of such offshore island seas as South China Sea with the major craton shelf seas. Also, it will provide a forum for the exchange of ideas both at the meeting as well as in the field.

Two post-symposium excursions are planned. One will focus on the marine sequences in South China, mainly on the boundary sections, reefs, coal-bearing beds and mining, while the other will concentrate on the continental sequences in Northern Tianshan, Xinjiang including the highly fossiferous continental Permian-Triassic section in Tailongkou and in Turpan. Excursions to particular sections or localities before the symposium would be organized at the request of international working groups.

This symposium will be sponsored by the Chinese societies and institutions involved in the Permian geology, local governments and science foundations.

The First Circular is going to be distributed in March, 1993. For further information, please contact Dr. Wang Xiandong at the address mentioned below.

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