Permophiles

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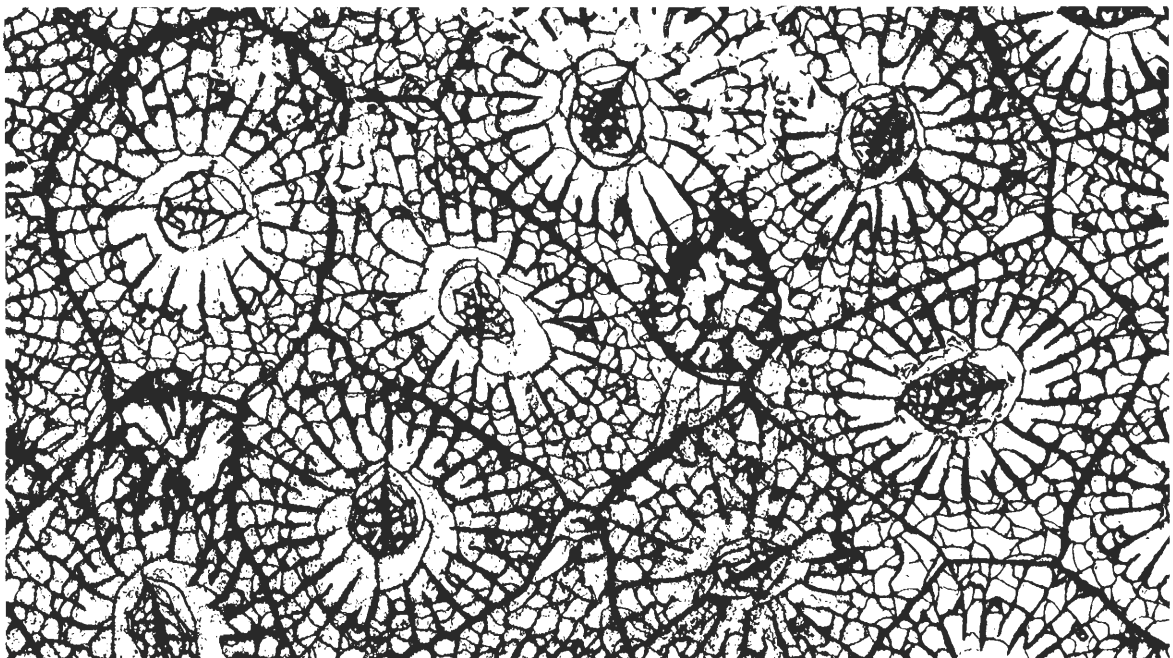
A NEWSLETTER OF SCPS



SUBCOMMISSION ON PERMIAN STRATIGRAPHY

INTERNATIONAL COMMISSION ON STRATIGRAPHY

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

CONTENTS

Cover:

Kleopatrina sp., Lower Permian, Sverdrup Basin, Ellesmere Island, Canada (collected by E.W. Bamber).

1. NEW OFFICERS:

Titular members voted in favour of the following slate of officers to serve the Subcommission on Permian Stratigraphy from 1989 to 1992.

Chairman:	Dr. Jin Yu-gan Nanjing Institute of Geology and Palaeontology Academia Sinica Chi-Ming-Ssu Nanjing, People's Republic of China
Vice-chairmen:	Dr. B.I. Chuvashov Institute of Geology and Geochemistry of the Urals Scientific Centre of the Academy of Sciences of the USSR SR-620219 Sverdlovsk USSR
	Dr. J.M. Dickins Bureau of Mineral Resources, Geology and Geophysics, Box 378 Canberra City Australia
Secretary:	Dr. J. Utting Institute of Sedimentary and Petroleum Geology Geological Survey of Canada 3303 33 Street N.W. Calgary, Alberta T2L 2A7 Canada

The new executive on behalf of all members wish to thank Prof. Sheng Jin-zhang for his guidance and leadership during his four year term of service as chairman to the subcommission.

Jin Yu-gan

2. SECRETARY'S NOTE

This issue contains contributions from members of working groups (Carboniferous-Permian boundary, and the Permian-Triassic boundary) and the working committee concerned with Upper Permian correlation and standard scale. In addition is a note concerning the correlation of the Permian sequence of the peri-Gondwana province of India, and one dealing with the Permian stratotype.

Reports are given of the Permian Subcommission meeting, and two working group meetings (Carboniferous-Permian and Permian-Triassic boundaries) held at the 28th International Geological Congress, Washington D.C., USA.

Details were given in the last "Permophiles" newsletter of a field excursion to the Urals region of the USSR planned for late August 1990. In addition I should like to remind members of a symposium to be held on the Guadalupian at Sul Ross State University, Alpine, Texas in 1991.

I should like to urge Titular and Corresponding Members to submit contributions to the secretary for the next Newsletter. These need not be long; for example a short note concerning research in progress and, if available, a list of recent publications, would be of interest.

I suspect some of the addresses given in the directory at the end of this Newsletter need revising. Please let me know of any changes.

J. Utting

3. REPORT OF INDIAN WORKING COMMITTEE ON UPPER PERMIAN CORRELATION AND STANDARD SCALE

The Director General, Geological Survey of India constituted a Working Committee to arrive at a national consensus on the Upper Permian Correlation and Standard Scale. They consisted of the following members:

1.	Mr. H.M. Kapoor, GSI	Committee Convener
2.	Mr. B.S. Jangpangi, GSI	Member
3.	Mr. V.K. Raina, GSI	Member
4.	Mr. S.C. Shah, GSI	Member
5.	Mr. B.D. Dungrakoti, GSI	Member
6.	Dr. D.K. Bhatt, GSI	Member
7.	Dr. R.S. Tewari, Birbal Sahni Institute of Palaeontology	Member
8.	Dr. Trilochan Singh, Wadia Institute of Himalayan Geology	Member

The Committee critically examined the various Correlation Charts published and other draft charts prepared by Dickins and Archebold; Dickins, Archebold and Thomas; Japanese Working Group; Nakazawa; and Kotlyar. They also examined the Guryul Ravine section of Kashmir valley and the collections of the Indo-Japanese team from Guryul Ravine present in the GSI Repository. They have now prepared a correlation chart for Central (Peri-Gondwana) Tethyan province for presentation to the IUGS Sub-Commission on Permian Stratigraphy.

1. The marine Upper Permian sequence is developed only in the Tethyan belt of the Himalaya. This belt including the Salt Range and South Tibet are included within the Central or peri-Gondwana Tethyan Province. The section of Abadeh (Iran) and North Tibet and South China are also included for correlation with West and East Tethyan provinces. The Karakoram region of the North Ladakh (east of Indus suture) in general, has closer affinity with the West Tethyan province, although there are some reports of the Peri-Gondwana facies from the South-Eastern part of the Ladakh. Within the Kashmir region of the chart, the para-autochthone belt of Pira-Mandi, South Ladakh and West Zaskar has been included; similarly Spiti covers Lahaul, East Zaskar and Kinnaur.

   In the correlation chart, the Guryul Ravine section has been considered not only as a reference section for Kashmir but also for the entire Tethyan belt.

2. **The limits and position of the Member D of the Zewan Formation and Unit E_1 of the Khunamuh Formation of the Guryul Ravine, Kashmir**

   The Indo-Japanese team, based on their studies between 1969 and 1978, concluded that:

   (a) deposition from the Zewan Formation to the Khunamuh Formation has been continuous and uninterrupted;
   (b) during the deposition of the member D, in the Upper part of the

Zewan shallowing of the sea had occurred but no sign of emergence above the sea level was noticed;

(c) the presence of Cyclolobus walkeri in Member C of the Zewan Formation indicates that the member is of early Dzhulfian stage;

(d) the presence of Otoceras woodwardi in Unit E_2 of the Khunamuh Formation indicates Griesbachian stage;

(e) Member D and Unit E_1 have been correlated with the Dorashamian stage based on its stratigraphic position, though no Dorashamian elements have been recorded.

Absence of Dorashamian fossils has led to varied interpretations of the status Member D and Unit E_1. The presence of hiatus/hiatuses of different magnitude, as well as in different positions have been speculated between Member D and Unit E_1, and between Unit E_1 (Claraia bioni zone) and E_2 (Otoceras woodwardi zone). E_1 has also been considered as belonging to Dzhulfian, Dorashamian and Griesbachian by various workers. Stratigraphers who considered Unit E_1 as Griesbachian, believe the Permian brachiopods present in the unit have been reworked from the underlying Zewan Formation.

The reworking of the Permian brachiopods of the Unit E_1 was also visualised by Dr. J.M. Dickins who along with Mr. S.C. Shah examined the collections of the Guryul Ravine made by the Indo-Japanese team. They noticed the attached matrix of Costiferina sp. described from Unit E_1 to have similar matrix as that of Costiferina sp. reported from Member B of the Zewan Formation. The working committee after examining the specimens believe that the fossil Costiferina sp. under reference belongs to Zewan (Member B) and has been wrongly labelled from Khunamuh. This view has been accepted by H.M. Kapoor (a member of the Indo-Japanese team). The Committee after examining fossils in Repository and in the field concluded that there is no reworking of Zewan brachiopods in Unit E_1 of the Khunamuh Formation.

Mr. S.C. Shah, however, is of the opinion that hiatus between Zewan Formation and the Khunamuh Formation exists as indicated by the absence of the Dorashamian elements and considers Unit E_1 to be the part of the Triassic sequence. Contrary to this, Mr. H.M. Kapoor based on his studies and the available geological data of different basins of Peri-Gondwana province, considers the sedimentation to have continued uninterrupted from the Zewan Formation to Khunamuh Formation in the Kashmir basin and the Member D and Unit E_1 consequently represent Late Dzhulfian-Dorashamian time. According to him a regressive cycle started in the Tethyan belt in post-Dzhulfian, which resulted in the complete withdrawal of the sea from Spiti and Kumaun basins followed by others later. However, in the major part of the Kashmir basin there was not a complete withdrawal of the Permian sea and this was in fact followed by a transgressive phase during the Khunamuh sedimentation without any hiatus, as has been suggested earlier by Nakazawa et al., 1975. This partial withdrawal of the Permian Sea from the adjacent areas according to Mr.

Kapoor possibly restricted the migration of the Dorashamian fossil elements into the Kashmir basin from East and West Tethyan basins. The Dorashamian characteristic fossils viz. cephalopods, fusulinids and Comelicania developed in a relatively deeper facies than Kashmir. In Member D and Unit E_1 in fact, a very few fossils have been reported, these include brachiopods which are also known from Lower Zewans; but there is a remarkable deviation in size, they show a relative tendency of reduction in size in Member D and complete dwarfness in Unit E_1. Mr. Kapoor is of the view that the brachiopods of Early Zewan, which could adapt to changing environment, continued into the Upper Zewan representing Late Dzhulfian and Dorashamian stages. He considers that a similar situation also holds good for Lower Kathwai (Salt Range) and basal Pangjang (Nepal). The transgressive phase, according to him, actually started (Salt Range, Kashmir and Nepal), in the Peri-Gondwana Province prior to the deposition of the lower Otoceras beds.

The Working Committee has, however, come to the conclusion that on the available evidence, there is no justification to change the present status of the D Member and Unit E_1 of the Kashmir basin, though we may put a question mark against Unit E_1.

II. Comments on correlation Charts circulated by other SPS Members/Groups

1. Comelicania bed for Lower Kathwai of the Salt Range is a misnomer in the absence of Comelicania (ref. Dickins & Archebold). It has however later been modified to Crurithyris beds (ref. Dickins, Archebold and Thomas).

2. The plant beds (Mamal Formation) of Kashmir are mostly confined to Artinskian except a single horizon (Mamal bed) which possibly extends up to basal Kungurian. The underlying Panjal Volcanics are also limited up to the Artinskian (ref. Dickins and Archebold; Dickins, Archebold and Thomas, Kotlyar).

3. The "Mamal bed" of Mamal Formation is correlatable with the plant bed of the Amb Formation of the Salt Range; the Amb Formation therefore, is possibly basal Kungurian-Artinskian, (ref. Japanese Group, Nakazawa, Kotlyar).

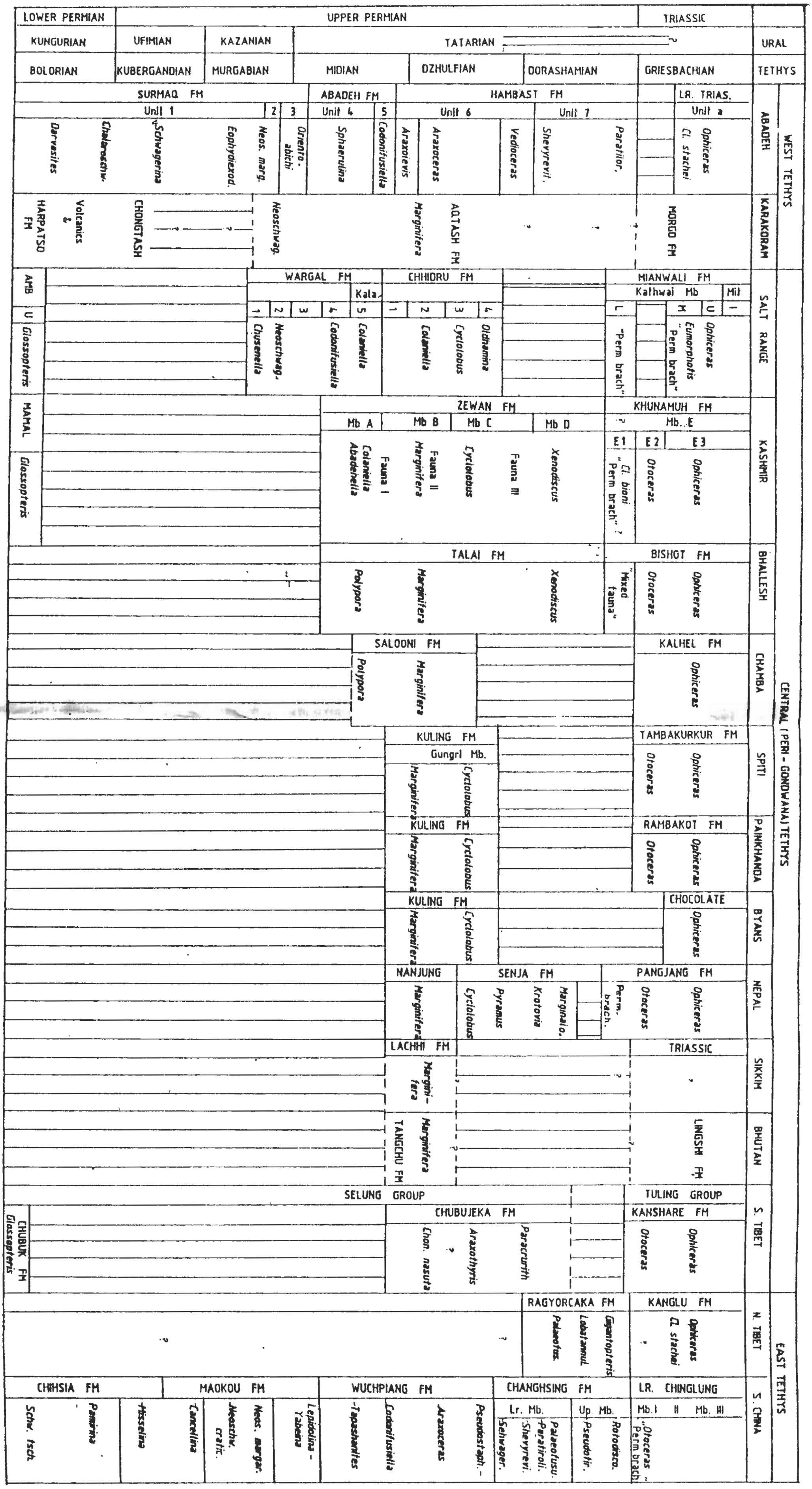
4. Mianwali Formation (excluding Lower Kathwai Member) in Salt Range starts slightly above the Otoceras zone (this zone being absent in the Salt Range). Its Lower limit has to be shown slightly above (Ref. Dickins, Archebold and Thomas).

5. The base of the Zewan Formation has been shown within Kazanian stage, while it starts in Midian. (ref. Dickins, Archebold & Thomas).

III. Division of Permian System

A two fold division is, in general, followed in India. The Kungurian (except the basal part), Ufimian and also Kazanian stages (except in Salt Range) are not developed in the Peri-Gondwana Tethyan Himalaya.

H.M. Kapoor Convener



Indian Committee for Up. Permian Correlation, 1988 - 89.

4. CORRELATION OF THE PERMIAN OF THE PERI-GONDWANA PROVINCE

Correlation of the Permian sequence of peri-Gondwana province has been relatively more confusing than those of other provinces, mainly due to the absence of fusulinid fauna. Lower Permian fauna with Eurydesma and Stepenoviella faunas is distinct from the western and eastern provinces; and indicate shelf deposition on the margins of a southern continent. The Middle Permian is in general a hiatus, whereas the Upper Permian presents a different cycle of transgression which took place sometimes in Abadahian (Median). The fauna in general is rich in brachiopods, bryozoans and a few molluscs and almost an absence of fusulinids. An analysis recently made by me, gives an impression that the peri-Gondwana marine basin of the Late Permian was actually a distinct basin, which had some narrow connections with Tethys in the Salt Range and in the Karakoram region, through which some cephalopods could pass during Dzhulfian times. Post Dzhulfian deposition in general is regressive in nature and except in a few localities the sea regressed quickly. Kashmir is one of the areas where sedimentation continued; in a restricted sedimentary basin, while in Nepal and the Salt Range it was intermittent. During Dorashamian this basin remained cut off completely from the Tethys, as such we have complete absence of Dorashamian ammonoids in Kashmir; although sedimentation continued. Tethyan deposits, possibly start with the Triassic transgression. The Otoceras whose ancestors are absent in Himalaya, possibly showed their appearance after the sea (Tethys) regressed in the west and entered in the peri-Gondwana province, thus changing it to be part of the Tethys.

This is presently a hypothetical model on which I am working in order to find the solutions to the problems that I am facing in correlating the Permian strata. Permian correlation of this province, particularly of Kashmir, has been interpreted various ways by workers. Hiatus has been suggested at a number of positions by different workers in the Guryul Ravine section (Kashmir), while, data from sedimentology do not support this break.

I would also like to inform you that I am retiring from the active service in August 1989, but will be engaged with Permian and Triassic research. My address from August will be H.M. Kapoor, River Bank Colony, Behind 'F' Block, Lucknow- 226018 (India).

H.M. Kapoor Convener

5. SUBCOMMISSION ON PERMIAN STRATIGRAPHY:

Minutes of meeting held during 28th International Geological Congress, Washington, 12 July, 1989

Members present: J.M. Dickins (Australia), Jin Yu-gan (China), B.F. Glenister (USA), J. Utting (Canada), J. Ross (USA), W.C. Sweet (USA), B. Runnegar (USA), E.T. Tozer (Canada), R.E. Grant (USA), H. Kozur (Hungary), B. Cairncross (South Africa), R. Langford (Australia), B. Wardlaw (USA), M. Kato (Japan), B.I. Chuvashov (USSR), C. Spinosa (USA), Zhou Zu-ren (China), H. Kerp (USA), E. Plein (West Germany), J. Visser (South Africa), Wu Wang-shi (China), C.M. Henderson (Canada), G. Cassinis (Italy)

The meeting was chaired by J.M. Dickins. After calling on members to introduce themselves Yin Yu-gan (chairman of Permian Subcommission) was requested to present a report of past activities and future plans. This included a summary of work in progress by the Carboniferous-Permian working group (chairman Prof. Wu Wang-shi), and by the Permian-Triassic working group (chairman E.T. Tozer). Mention was made of new work being carried out on the Permian-Triassic boundary section of Selong, Xizang, southern Tibet, and its consideration as a potential stratotype (Permophiles, No. 13, October 1988).

Written comments (Item 8, this Newsletter) by W. Sweet concerning the use of **Otoceras** for defining the Permian-Triassic boundary and the implications of the evidence from conodonts were circulated to members of the Permian-Triassic boundary working group. Members of the Subcommission on Permian Stratigraphy and the Permian-Triassic boundary working group, and the Subcommission on Triassic Stratigraphy, also received a written communication (Item 9, this Newsletter) from E.T. Tozer entitled "Permian-Triassic (P-T) correlation and boundary problems". It was decided that discussion of these two important documents should take place in a joint meeting with members of the Subcommission on Triassic Stratigraphy to be convened immediately after the Permian Subcommission meeting. Results of the Upper Permian correlation and standard scale working committee were summarised.

Future plans include a field symposium in the USSR entitled "The boundaries of the Lower Permian stages of the Urals". B.I Chuvashov provided further details concerning the symposium which will be held late August, 1990, on the western slope of the South Urals. The symposium will be co-sponsored by the Institute of Geology and Geochemistry of the Urals section of the Academy of Sciences USSR and the Interdepartmental Stratigraphic Committee of the USSR. Five sections from Upper Carboniferous to Upper Permian will be seen, including the stratotypes for the Orenburgian, Asselian and Sakmarian stages. Different sedimentary facies will be seen including flysch and carbonate sediments. Guidebooks will be available and it will be possible to collect samples, although sets of samples already made up may be available to individuals.

It is planned to hold symposia on specialised topics, yet to be finalised, at the X11 International Congress of Carboniferous-Permian Stratigraphy and Geology, Buenos Aires, Argentina, September 22-27, 1991. Also it is hoped that some members will be able to present the results of their work at the 29th International Geological Congress, 1992, to be held in Japan.

B. Wardlaw mentioned that in March 1991 there will be a Guadalupian Symposium in Alpine, Texas, which will include a field excursion to the Glass Mountains. Proceedings will be published in a Smithsonian Contributions to Paleobiology. Those interested should contact B. Wardlaw.

H. Kozur mentioned that a symposium is being planned in Czechoslovakia on the Rotliegende and that anyone interested in obtaining further details should contact him.

G. Cassinis said that meetings were being organised in southern France and northeast Spain on continental Permian and Triassic rocks in 1992 or 1993; this is part of IGCP 272. The chairman asked if the Permian Subcommission should sponsor this meeting, and this proposal was accepted.

M. Dickins commented that a lot of progress had been made in the Permian Subcommission in the last 9 years. The Permian-Triassic boundary in particular had generated much interest. The importance of biostratigraphy in determining system and stage boundaries was stressed, especially where correlations are being made on a global scale. Members of the working groups come from a variety of different cultural and scientific backgrounds and sometimes individuals may have to be flexible in order to come to a consensus.

With regards to the working committee for the Upper Permian correlation and standard scale, the conclusion is that there are numerous different scales being used in different parts of the world, and there is little agreement so far about having a standard scale, although a five fold division appears to be favoured (Ufimian, Kazanian, Midian, Dzhulfian and Changhsingian). Correlation charts are now available for India, the Soviet Union, China, Japan, Australia and New Zealand, and Europe. Most workers appear to favour dividing the Permian into lower and upper units, although a few wish to have a middle unit as well. So far no contributions have been received by workers in N. America.

W. Sweet briefly outlined his views on moving the position of the base of the Triassic (Item 8, this Newsletter) and the problem was further discussed by H. Kozur who pointed out that the Permian-Triassic boundary should be placed between two zones, but there was no suitable ammonite zone below **Otoceras** where that genus occurs. B. Glenister asked if there was a continuous evolutionary trend demonstrated by conodonts at the boundary; H. Kozur replied that there was. The chairman suggested that further more detailed discussion should be held later in the evening when the group had joined with members of the Subcommission on Triassic stratigraphy.

B. Glenister mentioned work in progress using graphic correlation between the

Delaware Basin and the **Eoaraxoceras** beds of Coahuila, Mexico and Abadah, Iran. using graphic correlation. He also made a plea for workers to stop using Ochoan and Tatarian as stage terms as they have no defined time significance. He added that perhaps we should concentrate on establishing reliable correlations with primary marine sequences before we concern ourselves with the significance of the Tatarian, Kazanian and Ufimian. Members agreed that perhaps Ochoan should be omitted from range charts. However, H. Kozur pointed out that in his view Tatarian is latest Permian of the boreal realm and does have time significance; also terrestrial facies should not be omitted from our study. M. Dickins also pointed out the importance of correlating marine and continental facies. B. Chuvashov stated that the Tatarian can be zoned using vertebrate fossils, but the relationship between the terrestrial and marine facies of the Upper Permian was admittedly unclear. Zhou Zu-ren pointed out difficulties of correlating between N. America and South China.

Wu Wang-shi announced that the meeting of the working group on the Carboniferous/Permian boundary would take place the next evening (July 13).

J. Utting

6. CARBONIFEROUS - PERMIAN WORKING GROUP

Circular No. 5 August 30, 1989

During the 28th IGC, the International Carboniferous and Permian Boundary Working Group held a meeting in Dr. G.A. Cooper's study room in the Smithsonian Institute, Washington, D.C. on the evening of July 13. 16 voting and corresponding members participated, namely Drs. L. Babcock (USA), B.I. Chuvashov (USSR), J.M. Dickins (Australia), B.F. Glenister (USA), C. Henderson (Canada), Jin Yu-gan (China), M. Kato (Japan), H. Kozur (Hungary), C. Maples (USA), J. Ross ((USA), C. Spinosa (USA), J. Utting (Canada), B.R. Wardlaw (USA), R. West, (USA), Wu Wang-shi (China) and Zhou Zu-ren (China).

Wu Wang-shi opened the meeting with a brief review of the progress of the C-P Boundary Working Group since 1987. Drs. C. Henderson, J. Utting, B. Chuvashov, B. Wardlaw and Wu Wang-shi then introduced the Carboniferous- Permian boundary of their respective countries. All participants in the meeting were interested in these presentations and the documents of the Working Group compiled by Dr. B. Wardlaw. Ten reports, abstracts, and papers from members have been compiled and will be sent by him to those members who were unable to attend the Washington meeting.

Of significance was the straw vote taken at the meeting to see which level can serve as the best International Carboniferous-Permian Boundary position. For this purpose, three well identified levels were proposed by Wu Wang-shi, B.I. Chuvashov and B.R. Wardlaw; these are based on current opinions concerning the International Carboniferous-Permian boundary position. They were: the base of the Daixina bosbytanesis--D. robusta zone and its equivalents; the base of the Schwagerina fusiformis--S. vulgaris zone and its equivalents; and the base of the Schwagerina moelleri--Pseudofusulina fecunda zone and its equivalents. As a result of the voting, most members were inclined to take the base of the Schwagerina moelleri--Pseudofusulina fecunda zone and its equivalents as the International Carboniferous-Permian boundary position. In practice, the boundary definition will be verified through research in different parts of the world. Of course, it still remains a problem as to how to correlate the fusulinid and conodont zones. Although the boundary position has been provisionally set up, it has not been commented on by other members, also it is still very important and useful for us to recommend a candidate for the stratotype section.

How to better organize the activities in the C-P Boundary Working Group was another interesting subject discussed. All members can join two activities. One is the meeting of the Subcommission on Permian and the C-P Boundary Working Group organized by Dr. Chuvashov to be held in the Urals of the Soviet Union next August. The other is Excursion 4 to visit "the Carboniferous and Permian Akiyoski limestone Group" organized by the Japanese scientists for the symposium of "the 4th International Benthic Foraminifera in Japan" from September 28th to October 2nd, 1990. Prof. Kato has informed members about this activity. Your participation is welcome. If any one has decided to join any of these activities, please directly inform Dr. Chuvashov or and Prof. Kato.

Wu Wang-shi

7. PERMIAN-TRIASSIC WORKING GROUP MEETING (July 12):

Members of the Subcommission on Permian and Triassic stratigraphy met jointly to discuss the Permian-Triassic boundary. A. Baud chaired the meeting which opened with a review of written communications received from W. Sweet and E.T. Tozer concerning their views on the Permian-Triassic boundary (Items 8 and 9, this Newsletter). A letter from N.J. Newell(USA), which suggested that the Permian-Triassic boundary should be placed at the base of the Dienarian was summarised; also he urged that selection of a boundary stratotype should not be influenced by national preferences.

W. Sweet summarised his views outlined in a written communication sent to all members of the working group (Item 8, this Newsletter). H. Kozur then reiterated his view expressed during the meeting of the Subcommission on Permian Stratigraphy that the Permian-Triassic boundary must be placed between two biozones, the **Otoceras** Zone occurred in the boreal lower Triassic, but there was no corresponding ammonoid zone in the uppermost Permian. B. Glenister pointed out that in his view evolutionary continuity does not occur in any of the sections proposed as stratotype candidates, and that is unlikely that **Otoceras** had ancestors in the Dorashamian. E.T. Tozer pointed out the problems of using graphic correlation techniques and listed anomalies which result from this method. For example **Otoceras** does not occur in the Changhsing section of Meishan although graphic correlation techniques suggest that it should. He stressed that biostratigraphy should be based on the observable vertical distribution of fossils, rather than a fictitious projected range. He also pointed out that in Iran, otoceratids occur with **Paratirolites** in the Dorashamian. W. Sweet stressed that by using graphic correlation techniques certain results were obtained and he wanted to present these to members before any decision was made on the boundary problem. Further discussion took place on data concerning magnetic reversals. It was pointed out by M. Steiner that the base of the Triassic (**Otoceras** Zone) has normal polarity; the Meishan section of China, polarity is reversed at the top of the Changhsing Limestone but at and the base of the Chinglung Formation it is normal. A. Baud discussed stable isotopic (carbon isotope) changes across the boundary (data in press). M. Dickins pointed out that at the Guryul Ravine section fossils of Dorashamian or Changhsingian age were absent. Mention was made by E.T. Tozer of new data from Selong, Xizang in southern Tibet. H. Kozur asked if there was any data concerning the thermal maturity of this material. J. Utting replied that palynological samples he had studied suggested a very high Thermal Alteration Index.

8. CONSEQUENCES OF AN OTOCERAS-BASED P/T BOUNDARY PRELIMINARY EVIDENCE FROM CONODONTS

In a recent report (Sweet, 1988b) ranges of 29 conodont species in 13 stratigraphic sections are used graphically to effect a high-resolution chronostratigraphic framework for the lower Triassic. Within this framework, and at the 95% confidence level, it is possible to recognize in all component sections the temporal equivalents of units 5m thick in a standard reference section at Guryul Ravine, Kashmir. Data on which the framework is based are from sections in Primor'ye, Japan, Kashmir, Pakistan, northern Italy, and the states of Utah and Idaho in the western United States.

No data from China or Iran were incorporated in Sweet's (1988b) Lower Triassic framework. However, Yin et al. (1988) show that available information on the ranges of several conodont, cephalopod bivalve, and foraminiferal species in sections at Shangsi (Guangyuan Co., Sichuan), and Meishan (Changxing Co., Zhejian) may make it possible to add these important South Chinese sections to the network established by Sweet. Further, data provided in reports by Stepanov, Golshani & Stocklin (1969), Kozur et al. (1978), and the Iranian- Japanese Research Group (1981) permit addition of sections in Transcaucasia as well as in central and northwest Iran. Inclusion of these data expands the Lower Triassic network geographically and also adds to it stratotypes of the Changxingian and Dorashamian stages, which are thought to be largely or entirely coeval and of latest Permian age. An advantage of the graphically assembled network is that it enables us to assess relationships between stadial stratotypes in the Permian-Triassic boundary interval within a single, high- resolution chronostratigraphic framework. Further, it is also possible to relate these stadial stratotypes to the several levels that have been proposed as potential P/T boundary stratotypes.

Results of the unpublished graphic correlation exercise that relates South Chinese, Iranian, and Transcaucasian sections to the standard reference section at Guryul Ravine, Kashmir are sufficiently stable to indicate the correlations shown in Fig. 1. In that figure, the dotted horizontal line marks the projected base of the Otoceras beds (=Bed 52) in the lower Khunamuh Fm. at Guryul Ravine. This is the level favoured by a majority of the Permian-Triassic Boundary Working Group (PTBWG) as a stratotype of the basal Triassic boundary. Note, however, that this level projects to a level midway through the stratotype of the Changxingian Stage (at Meishan) and is well below the base of the Dorasham beds (at Dorasham II), which are typical of the Dorashamian Stage. Indeed, if the base of Bed 52 at Guryul Ravine is selected as stratotype for the base of the Triassic System, the Dorashamian Stage and the upper half of the Changxingian Stage will be Triassic, not Permian.

Chinese stratigraphers have for some years used a clay bed at the top of the Changxingian and its presumed equivalents to mark the Permian-Triassic boundary. Note in Fig. 1, however, that the Chinese "Boundary Clayrock" is at a level well above the dotted horizontal line, which marks the projected level of the base of Bed 52 at Guryul Ravine, Kashmir and is the level favoured by the PTBWG as the base of the Triassic System. This relationship has been documented graphically by Yin et al. (1988) and in the unpublished study by Sweet from which Figs. 1 and 2 are taken. Clearly, the basal Triassic boundary favoured by Chinese stratigraphers is not the same as one anchored at the level of first occurrence of Otoceras at Guryul Ravine and preferred by a majority of the PTBWG. This mismatch must be cleared up before a stratotype for the base of the Triassic is recommended formally to the Commission on Stratigraphy.

Ranges of significant conodonts and cephalopods in the graphically assembled network of Late Permian and Early Triassic rocks are summarized in Fig. 2, which also indicates the extent in that network of several stadial stratotypes. Kozur (1978), Kozur et al. (1978), Yin (1985), Yin et al. (1988), and a number of others have suggested that it might be sounder biostratigraphically to fix the base of the Triassic System at the level of first occurrence of Isarcicella parvus (also termed Anchignathodus parvus or Hindeodus parvus), and thus at a level somewhat above the one at which Otoceras first appears in the section at Guryul Ravine, Kashmir. Such a level would coincide approximately with the top of the Boundary Clayrock in at least the Shangsi section (Guangyuan Co., Sichuan) and with the base of the Isarcica Zone in Sweet's (1988b) Lower Triassic scheme. The base of Isarcica Zone also projects to a level that is approximately coincident with the base of the Seis (or Werfen) beds in at least one section in the Southern Alps (Sweet, 1988b); thus it may also correspond very closely to the base of the nonmarine Triassic in the Germanic Basin.

While it is not the purpose of this note to advocate any particular level as the one best suited to define the base of the Triassic, it should be noted that the conodonts whose ranges define the zones named in Fig. 2 (and in Sweet's 1988b report on the Lower Triassic) are far more cosmopolitan in their distribution than any of the other fossil species customarily cited as appropriate boundary markers. Should the first occurrence of the conodont Isarcicella isarcica or I. parvus be selected as the biological criterion for the basal boundary of the Triassic System, careful attention would have to be paid to defining the species precisely in modern taxonomic terms; in documenting its phylogenetic relationships; and to determining its range precisely in the section selected as stratotype. Sweet (in Ziegler, ed., 1977) treats Anchignathodus parvus as a junior subjective synonym of Isarcicella isarcica, and Isarcicella as a monospecific genus characterized by a monoelemental apparatus. Later (Sweet, 1988a) it was suggested that Isarcicella was a short-lived derivative of Diplognathodus, a long-ranging late Paleozoic genus. However these interpretations should be reviewed on the basis of new collections made at several localities from carefully and closely sampled strata in the Permo- Triassic boundary interval.

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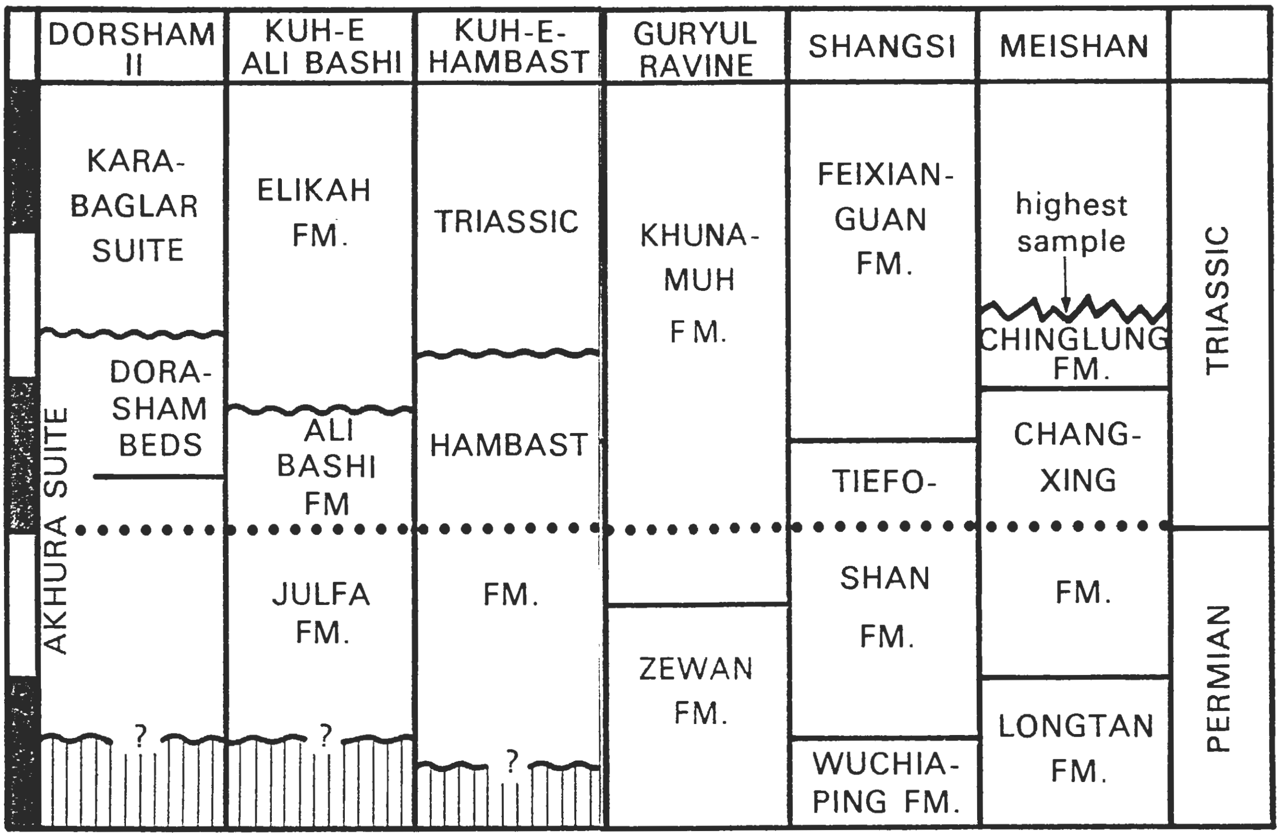

Fig. 1.--Correlation of sections in South China (Meishan, Shangsi), Transcaucasia (Dorasham II), and Iran (Kuh-e-Ali Bashi, Kuh-e-Hambast) with standard reference section (SRS) in Kashmir (Guryul Ravine). Divisions in ladder scale along left margin are Standard Time Units (STU). Each is represented by 5 m of rock at Guryul Ravine, 23 m at Shangsi and Kuh-e-Ali Bashi, 21.5 m at Meishan, 18.7 m at Dorasham II, and 12.4 m at Kuh-e-Hambast. Boundaries and other events separated by less than one STU cannot at the 95% confidence level be said to differ in age. Dotted horizontal line is level of first occurrence in SRS of Otoceras woodwardi. "Boundary clayrock" in Shangsi and Meishan sections is at top of Tiefoshan and Changxing Fm., respectively.

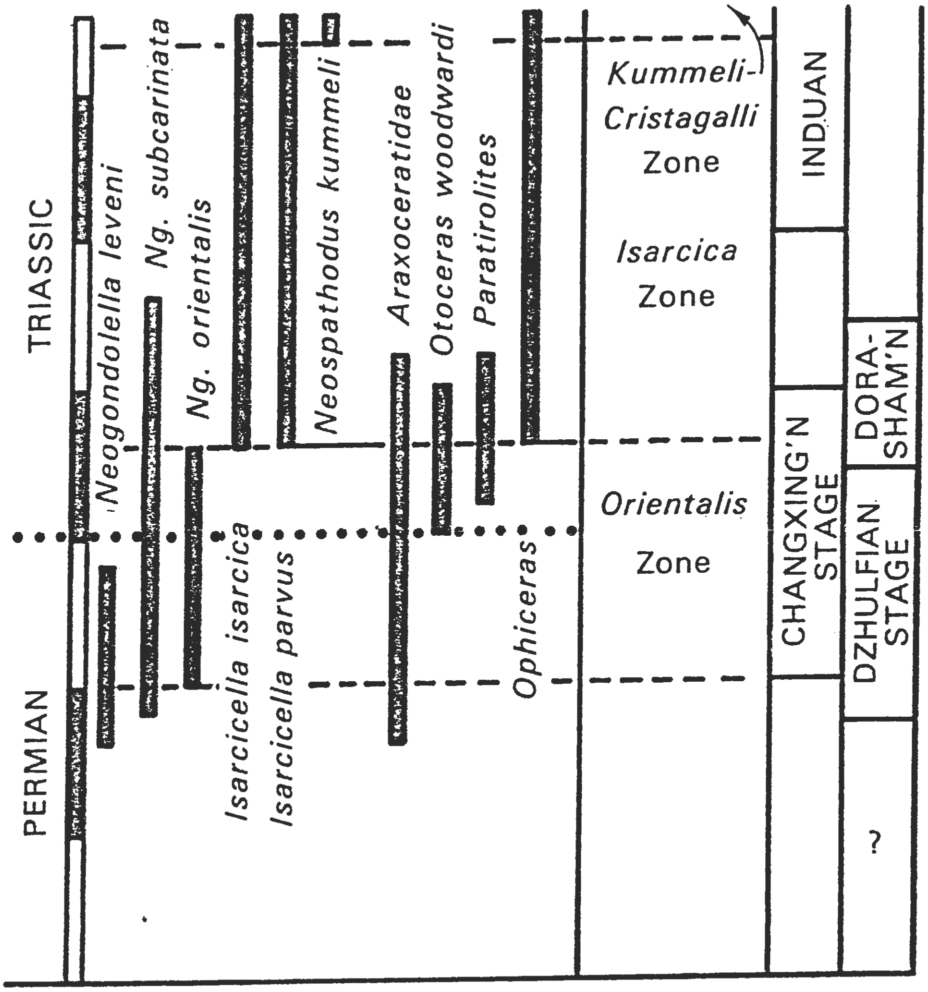

Fig. 2.--Ranges of selected conodonts and ammonoids in Composite Standard Section (CS) assembled by graphic correlation of sections in Fig. 1. Divisions in ladder scale along left margin are Standard Time Units; finer chronostratigraphic divisions cannot at present be recognized at the 95% confidence level and events or boundaries separated by less than 1 STU cannot at present be said to differ in age.

9. PERMIAN-TRIASSIC (P-T) CORRELATION AND BOUNDARY PROBLEMS

(With 5 figures)

From the 1920's until about 1970 nobody seemed to worry much about the definition of the P-T boundary. The question had been debated around the turn of the Century but the issue was more or less settled before the Great War of 1914-18, with the adoption of the procedure advocated by Waagen and Diener (1895), whereby the Otoceras beds of the Himalayas formed the stratotypic base of the Triassic System. The issue seemed dead, perhaps in part because Frech, the principal advocate for putting the Otoceras beds in the Permian, died during the War. Nearly everybody seemed content to define the base of the Triassic by the Otoceras beds, e.g. Spath, 1934; Smith, 1932; Muller and Ferguson, 1939; Teichert, 1939; Newell and Kummel, 1942; Kiparisova and Popov, 1956; Kummel, 1957; Zhao, 1959; Tozer, 1961).

Reading the old accounts leaves me with the feeling that the old-timers knew nearly as much as we do today. There have been great advances in knowledge but they haven't changed the picture that much. Many new localities for Otoceras have turned up in the last 60 years. Conodonts have contributed enormously to the correlation of the boundary beds. The conodont correlations based on similarity of forms with a short time range agree almost perfectly with the correlations previously proposed from the ammonoid and bivalve faunas.

Regarding the stratigraphy of the boundary beds the most important post-Diener discoveries have been in China. The discoveries there, and the reinterpretation of the sections in Trans-Caucasus first elucidated by A.A. Stoyanow, have led to the recognition and naming of the Dorashamian and Changhsingian Stages to accommodate latest Permian rocks in Trans-Caucasus and China, respectively (Figure 1). Zhao (1965) seems to have been the first to propose this interpretation, which I publicised in 1969 (Tozer, 1969).

All seemed to be going peacefully towards a recommendation that the base of the Otoceras beds be recognized by the International Commission on Stratigraphy (ICS) as the stratum for defining the base of the Triassic. As Chairman of the Permian-Triassic Boundary Working Group (PTBWG) I circulated a questionnaire in 1984 to its 21 members, asking for their choice of stratotype level. Eighteen replied, 16 chose the base of the Otoceras beds.

By 1985 I thought we certainly had a large majority favouring the Otoceras level. With a bit of discussion and persuasion I thought we might even be able to make a unanimous proposal.

In 1979 clouds on the horizon heralding disagreement about the interpretation of this level appeared in a paper by W.C. Sweet (1979). Sweet arrived at a correlation with the Paratirolites beds of Trans Caucasus (Dorashamian) overlapping in time the Otoceras beds of the Himalayas. This was somewhat startling because by 1979 virtually everybody regarded the Paratirolites beds as Paleozoic. Sweet's correlation Table is reproduced here (Figure 2). In a talk given at the Geological Society of America meeting in November 1988 Sweet reasserted this correlation but with more emphasis. (Sweet, 1988a).

Is it not a truism that in biochronology sequences of faunas are established from observations at stratigraphic sections; correlations are then made by recognizing identical faunas at different localities? Correlation by this means, e.g. of the Otoceras beds between the Himalayas, Siberia, Spitsbergen, Arctic Canada and Alaska, is pretty obvious, and has served to convince almost everybody that the beds at these places are the same age, within the limits of the biochronological method. At some levels in the stratigraphic record correlation becomes impossible owing to complications introduced by faunal provincialism etc. but there is no good evidence (contrary to the views of Yin et al., 1988) that this applied in Otoceras time.

Sweet's system for biochronology is entirely different. His sequence of faunal events is expressed in relation to "Standard time units" (STUS), "each representative of the same increment of time" (Sweet, 1979, p. 243). Less felicitous is his later description of these units as "representing the same interval of time" Sweet, 1988b, p. 253). I assume that his earlier definition expresses his intended meaning. STUS make up the Composite Standard (CS). The CS is developed from the Standard Reference Section (SRS) by adding data projected from other sections by his method of graphic correlation. Sweet's SRS is at Guryul Ravine, Kashmir, chosen because it is "long (and) apparently continuous" (Sweet, 1988b, p. 259). Ranges from taxa are expressed by Sweet in relation to the CS. These ranges combine data form the SRS with data projected graphically from other sections. In this way he deduces time ranges some of which cannot be demonstrated or denied at any locality. His time ranges are thus interpretations and this must not be forgotten when they are applied to correlations.

I propose to show that Sweet's construction of a composite scale to cover the P-T boundary interval is invalidated by his failure to take into account the normal vagaries of sedimentation. In particular he dismisses the possibility that unconformities (paraconformities, diastems) may be present. This has led him to unjustified correlations and to attribute unsubstantiated relative ranges to significant taxa.

Sweet's most startling conclusion is "If the horizon of first appearance of Otoceras woodwardi at Guryul Ravine, Kashmir, is taken as the level of the Permian-Triassic boundary, the Dorashamian Stage, previously regarded as youngest Permian, is not only entirely Triassic, but is also mostly younger than the supposedly coeval Changxingian Stage, the top of which is somewhat above the *projected* (my italics) level of the O. woodwardi datum in Kashmir" (Sweet, 1988a). He thus correlates the Dorashamian with part of the Griesbachian (cf. Figure 1). In my opinion this correlation is not supported by any significant similarities in faunas, whether, ammonoids, bivalves or conodonts. Against Sweet's correlation is the presence of a varied, undoubtedly indigenous Paleozoic fauna (fusulinids, corals, brachiopods, goniatites) in the Dorashamian.

How did Sweet arrive at his correlation? To analyse his case I have duplicated his results, using a few key taxa, and making the same assumption, namely continuity of sedimentation. Figure 3 gives raw data for the two critical sections: Guryul Ravine, Kashmir (GRK) and Kuh-e-Ali Bashi (KAB), Iranian Trans Caucasus. Figure 4 is a graphic correlation using Sweet's method. The time range of Paratirolites is interpreted to overlap that of Otoceras. This overlap is established by projecting the range at KAB, via the Line of Correlation (LOC), to the SRS (GRK). This adds KAB data to the GRK SRS. With this and other additions the SRS becomes transformed into the CS.

This graphic correlation is dependent on the assumption that sedimentation was continuous at KAB and GRK for the P-T boundary time interval. Also, unless I have misunderstood the procedure, CS units, which are interpreted as units of time of equal duration, have a linear relationship to stratigraphic thickness. In other words a regular, unchanging rate of sedimentation is assumed for both the SRS and the sections from which data are projected to the SRS.

Figure 5 is my own graphic correlation introducing an alternative interpretation of the rock sequence, in which Lower Griesbachian is unrepresented at KAB, Dorashamian at GRK. Of course Dorashamian time happened at GRK, Lower Griesbachian happened at KAB, but in both cases there is no rock record. This is my interpretation. I am not alone. It is explicitly that of Dickins (1987) and the Dagys's (1988). We could be wrong, but the absence of an undoubted Dorashamian fauna at GRK and of a Lower Griesbachian fauna at KAB is a fact that must be considered. It is probably difficult, perhaps impossible, to prove continuity in sedimentation. Perhaps it never occurs. In my interpretations evidence for discontinuity is provided by absence of faunas coupled with abrupt changes in lithology. I have studied the KAB and GRK sections and am impressed by the presence of distinct bedding planes at the Ali Bashi-Elikah contact, and the Zewan and Khunamuh contact (Figure 3). Both look suspiciously unconformable. On Ellesmere and Axel Heiberg Islands there is no doubt about the unconformity beneath the Otoceras beds. Field as well as laboratory observations are undoubtedly necessary for understanding the nature of the P-T boundary.

Sweet's correlations and determination of taxa ranges are dependent upon his interpretation that sedimentation was continuous in the P-T boundary beds at the GRK SRS. If sedimentation was not continuous his correlations are vitiated.

Sweet, in a memo to the members of the PTBWG circulated in 1989, proposes a P-T boundary stratotype at Shanghsi, Sichuan Province, China. Yin et al., (1988, p. 334) give a summary of this section. In faunal terms Sweet's basal Triassic would be defined at the Isarcica conodont Zone. It seems that the level of the Isarcica Zone is generally, perhaps invariably above that of Otoceras (See Figure 1). Sweet's proposal would place the Otoceras beds in limbo or the Permian.

The absence of certain correlatives of the Otoceras beds in China, Trans-Caucasus and the Mediterranean region probably indicates that beds of this age are unrepresented in these areas. The Otoceras beds seem to be a deposit for an interval of time that has not left its record everywhere where there is marine

Lower Triassic. This does not detract from the reality of the beds, the existence of their time, of their suitability for characterizing the earliest Triassic. The Isarcica fauna is more widespread but seems to be younger. As such it is of great significance and useful for correlation, contributing to the picture whereby very earliest Triassic time (Lower Griesbachian) has left a much less widespread record than the Upper Griesbachian.

I continue to maintain that the stratotype level for the basal Triassic should be the Otoceras beds. The certainly indigenous fauna of the Otoceras beds lacks Paleozoic elements. The Otoceras beds appropriately characterize the start of the Mesozoic Era. The Paratirolites beds (Dorashamian), contain a host of characteristic Paleozoic fossils and are justly interpreted as being older than the Otoceras beds, despite the fact that they are not actually known to underlie them.

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E.T.Tozer

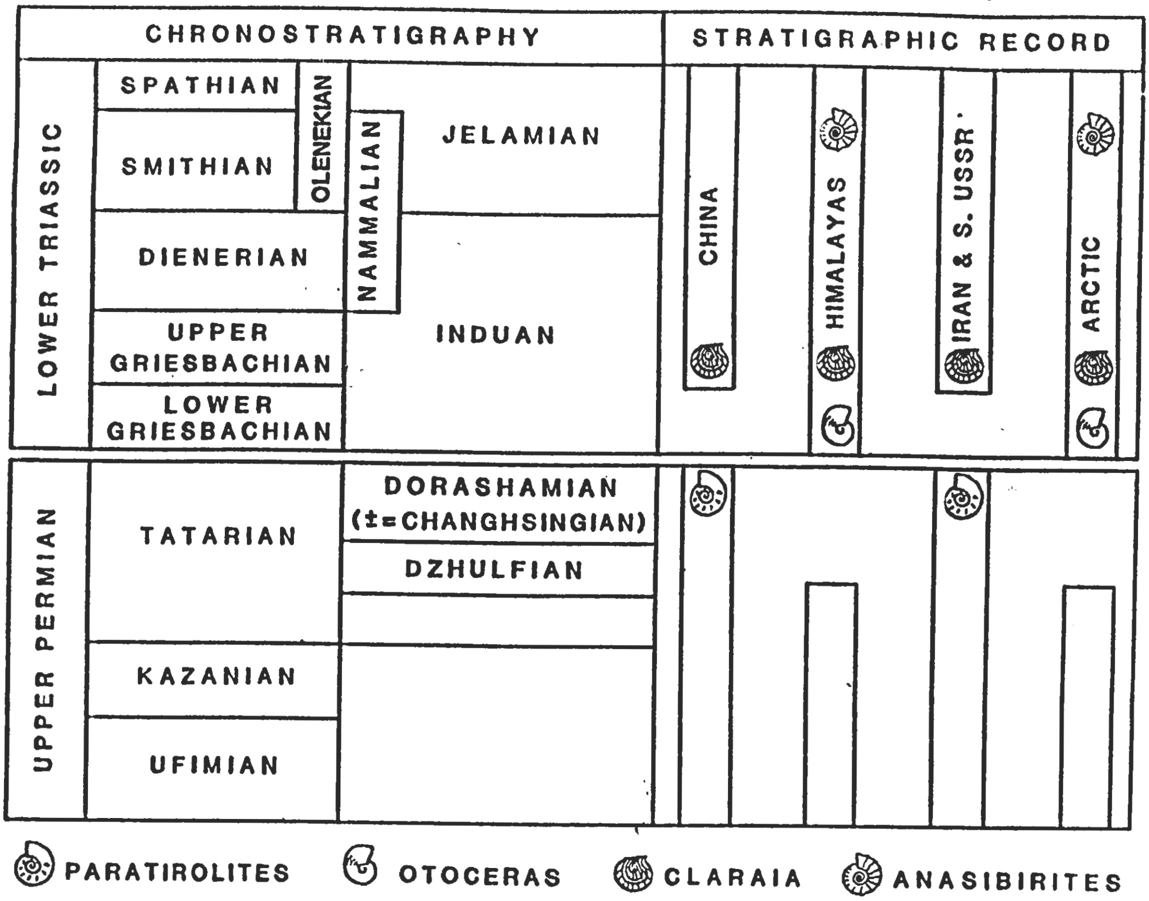

Figure 1.

Correlation Chart, latest Permian and earliest Triassic (Tozer, 1988b). In this interpretation an unconformity everywhere separates the Permian and Triassic rocks. In the Canadian Arctic Islands this unconformity is readily recognized.

Most conodont occurrences seem to contribute to these correlations.

Sweet (1988a, p. 268A) regards Neogondolella orientalis as characteristic of the latest Permian; Isarcicella isarcica characterizes a level at about that of Claraia (above).

N. orientalis is with Paratirolites in Iran (Kozur et al., 1978) and in the Changhsingian of China (Sweet, personal communication). It is apparently absent at Guryul Ravine, Kashmir. Bhatt, Joshi and Arora (1981) report this species from the Otoceras bed of Spiti (Himalayas).

Isarcicella isarcica is at the level of Claraia in China (Yin et al., 1988, p. 334), Iran (e.g. Sweet, 1979, p. 241) and just above Otoceras at Guryul Ravine (Sweet, 1979, p. 240).

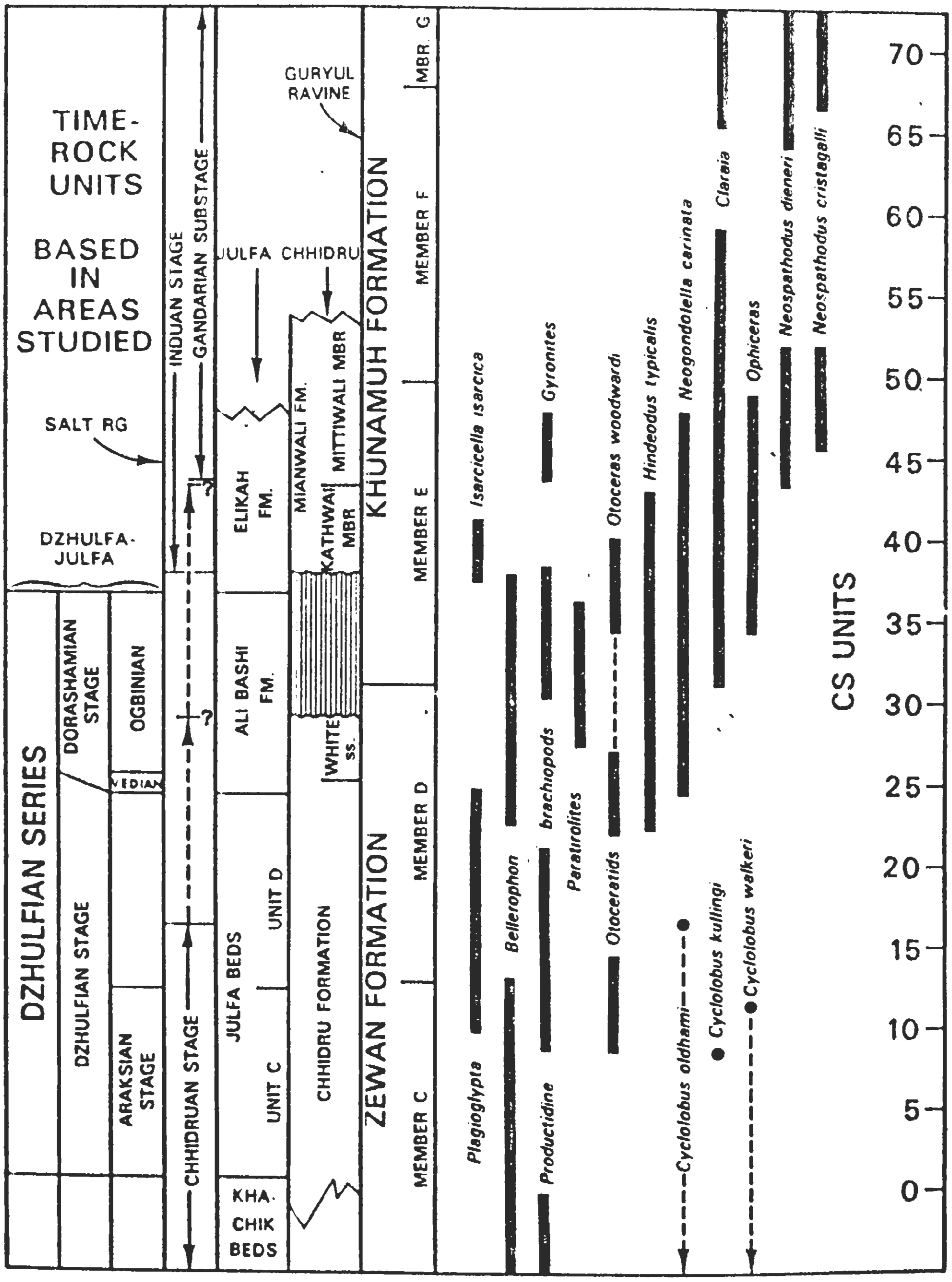

Figure 2. Correlation and range chart from Sweet (1979, fig. 2, p. 244). Note that an unconformity is introduced between the Chhidru and Mianwali Formations but not elsewhere. CS units are "Composite Standard Units" each of which is said in the caption to "represent an equal increment in time". The scale for the CS units is derived from the stratigraphic thickness scale in metres of the Guryul Ravine Section (GRK). Ranges given for the taxa are "composite-standard ranges" (caption) derived from an interpretive coordination of range data from all sections considered. These ranges are not established from objective sequential obser vations. Some relationships, e.g. the overlap of <u>Paratirolites</u> and <u>Otoceras woodwardi</u>, are nowhere demonstrable.

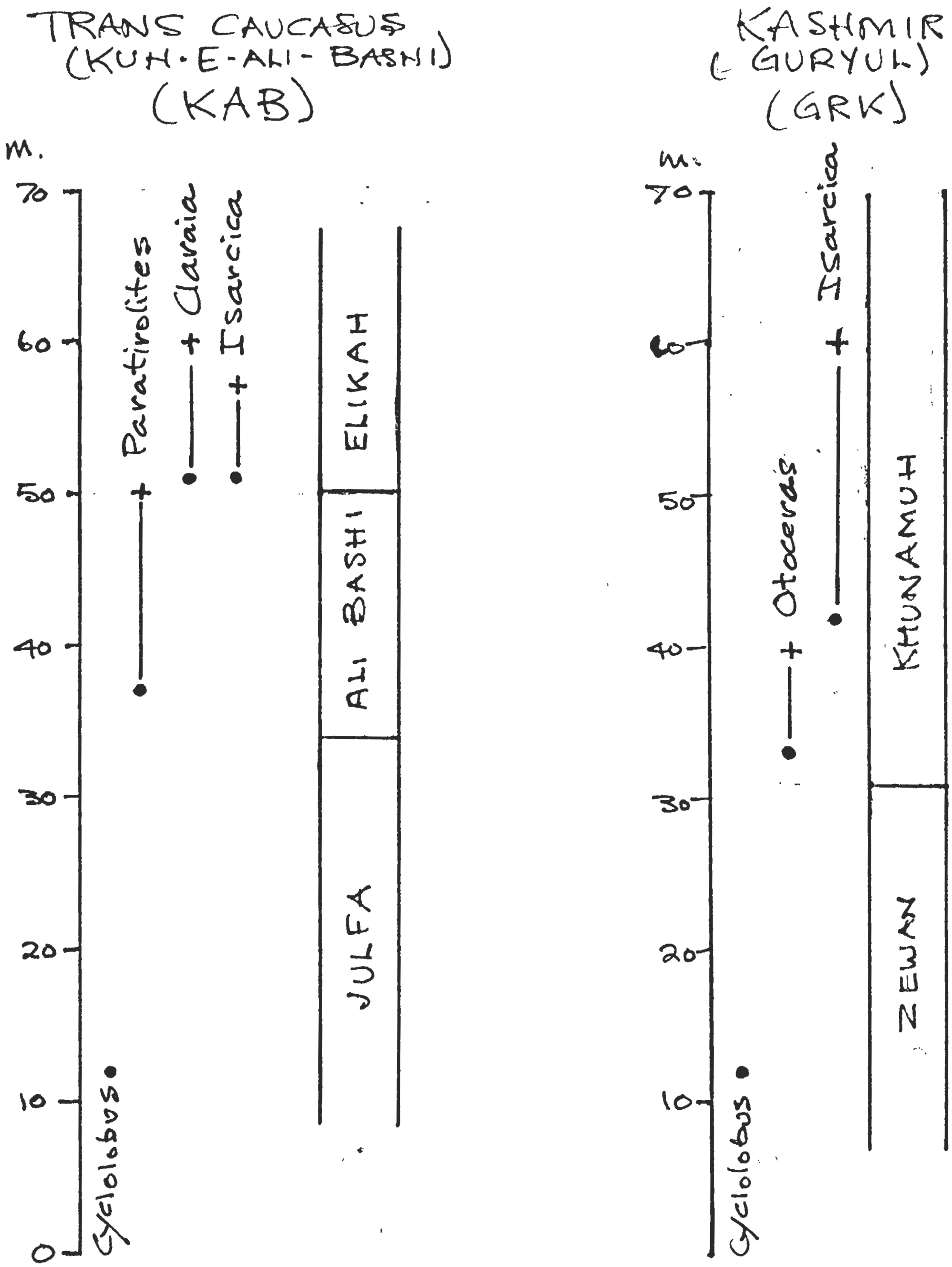

Figure 3. Sequence of formations indicating position and range of taxa significant for defining and recognizing the Permian-Triassic boundary. From compilation by Sweet (1979, p. 240, 241).

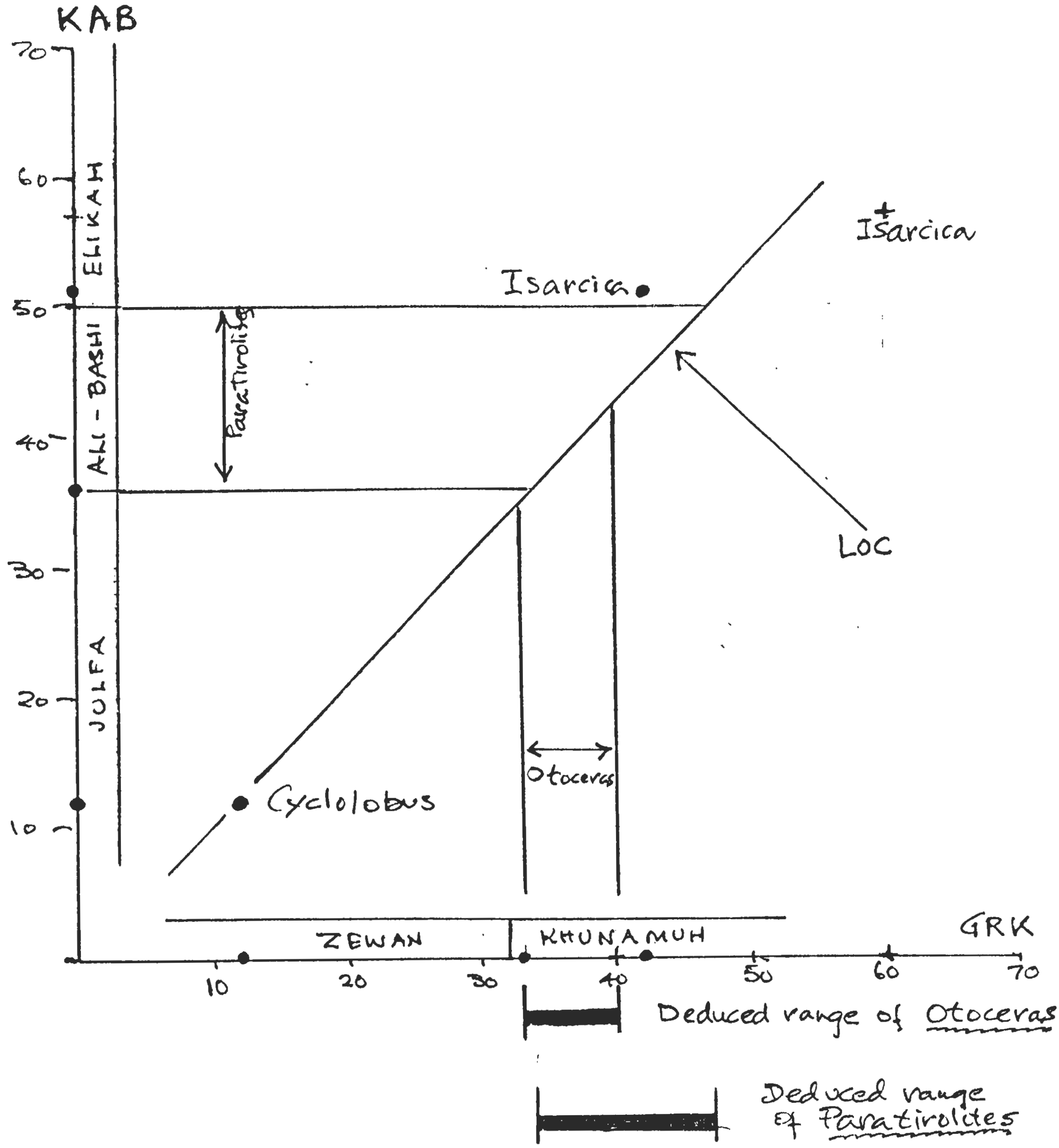

Figure 4. Graphic correlation, employing Sweet's procedure, of of sections (p. 7) at Kuh-e-Ali Bashi (KAB) - Y axis, and at Guryul Ravine (GRK) - X axis. Vertical and horizontal scales are in metres. Continuous sedimentation is assumed (see Figure 2) and explicitly stated at GRK (Sweet, 1988b, p. 259).

The range of Paratirolites (Dorashamian) in relation to that of Otoceras (Lower Griesbachian) has been deduced by projecting its range from Y to X via the Line of Correlation (LOC).

These ranges for Paratirolites and Otoceras are somewhat different compared with Figure 2 but agree with the ranges adopted by Sweet in 1988 (Sweet, 1988a and personal communication).

In Sweet's interpretation, the scales, although given in metres, are also "objective reference standards for a succession of chronozones of conceptually equal temporal value" (Sweet, 1988b, p. 265).

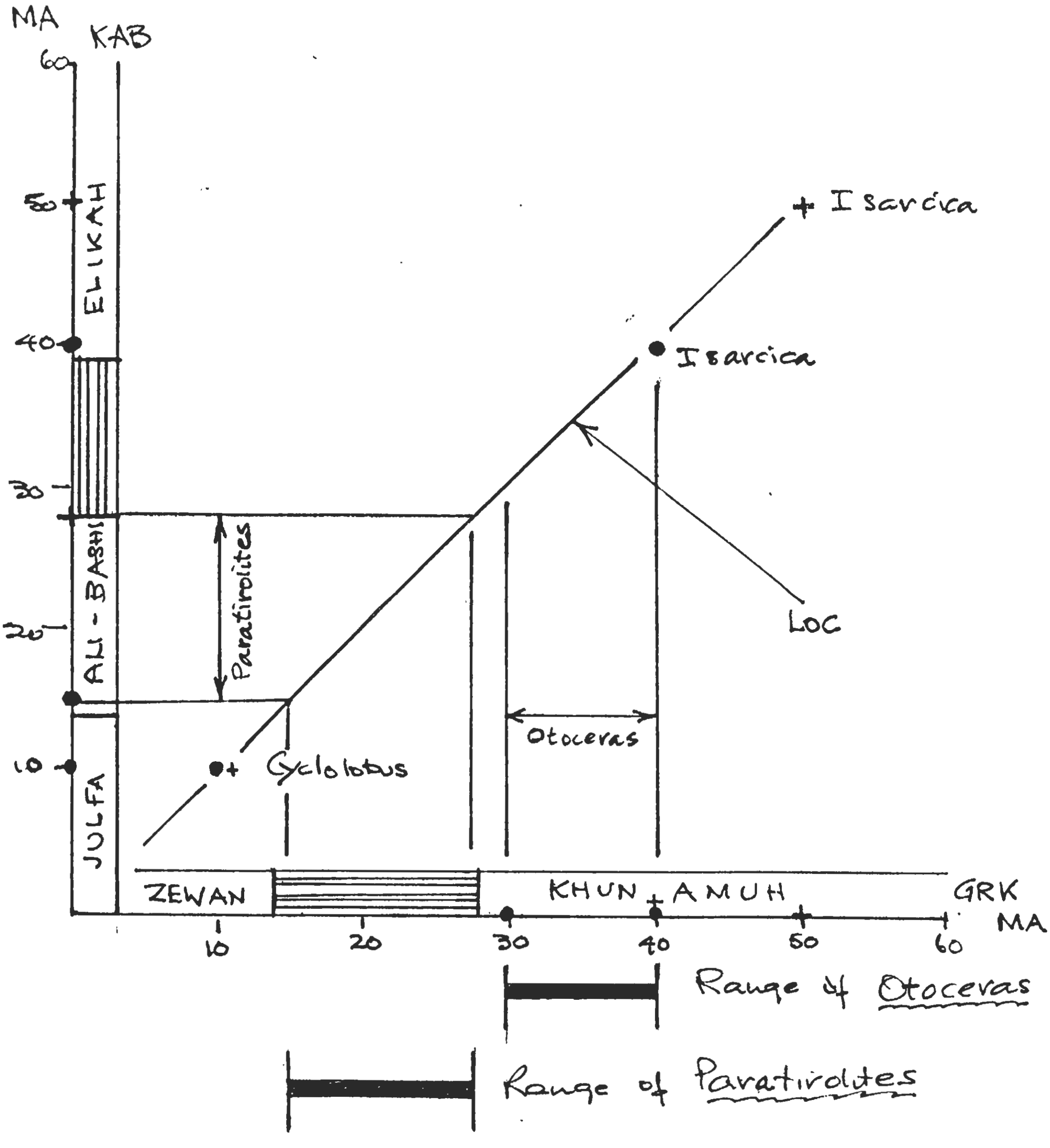

Figure 5. A form of graphic correlation which accomodates the possibility (unlike Figure 4) that sedimentation was interrupted for a million years or so between deposition of Permian and Triassic rocks in Trans Caucasus (KAB) and Kashmir (GRK).

In common with Figure 4 the scale is Time, here given in MA instead of CS units.

In this interpretation earliest Triassic (Lower Griesbachian) is not represented by rock at KAB; latest Permian (Dorashamian) is unrepresented at GRK. The range of Paratirolites, projected through the Line of Correlation (LOC) is wholly older than Otoceras. This is the interpretation in Tozer (1988a,b) (See Figure 1).

10. PERMIAN STRATOTYPE

29 August 1989

Dear Friends of the Permian Stratotype:

This is a note concerning additional stratigraphic data on the type section of the Road Canyon Formation (which extends the lower part of the formation), and a proposal to designate a stratotype for the Roadian Stage of the middle Permian on this section.

In the process of collecting the type section of the Road Canyon Fm. for fusulinids, and working out the stratigraphic units and depositional environments of this oft-visited section, we have increased the stratigraphic description of this section, and made some significant observations that bear on the earlier descriptions of this section made by Cooper & Grant (1964) and Cys (1981). We have also found that the story of depositional environments outlined by Lehrmann (1987) in his Master's thesis is excellent, and fully appropriate for the Road Canyon Fm. in the central and southern Glass Mts. and Del Norte Mts.

Our major discovery is that the oldest units of the Road Canyon Fm. were not described or collected in earlier work on the type section. The coarse grained units in the lower part of the Road Canyon Fm. are very lenticular, and previous sections were measured and collected starting from the base of the exposure on the <u>west</u> side of the main outcrop. This is at the base of a 13.5 m thick conglomeratic channel fill, which has eroded out up to 9 m of grainstones and lesser conglomerate that is exposed on the east side of the type section outcrop, around a 10.5 m thick megaclast that has sunk into the underlying sediments. The 13.5 m channel fill conglomerate pinches out to 0 within the outcrop area, and at the margin it can be seen to overlie the older conglomerate mass, which is capped by a thin quiet-water spiculitic, siliciclastic siltstone deposit that was also eroded away by the channel conglomerate. After deposition of the underlying grainstones and conglomerates, there was an interval of quiet water before deposition of the channel fill unit, which is the basal unit of the previously published section descriptions. Our collections and section descriptions include the east side of the outcrop area as well as the west side.

The lenticularity of the units in the lower part of the formation, and presence of at least two spiculitic siltstones suggests that there are more than two conglomerate zones in this part of the formation. Superpositional relationships of the units can be determined in the type section exposure, but they cannot be traced laterally with any certainty. Lehrmann's lower megabreccia unit in the type section is actually composed of two separate megabreccia units, of which the younger cuts away much of the older.

Differences in thickness of the Road Canyon Fm. type section reported by Cooper & Grant and by Cys result almost entirely from differences in measurement of the upper parts of the section, above unit 4 of Cooper & Grant (the thick planar bedded peloidal grainstone unit). Although the differences are great, they are not terribly important, except that the section needs to be measured more carefully, to get a confident thickness to report. Our measurements are closer to (but less than) those of Cooper & Grant.

A notable fact is that many of the beds casually referred to as "shale" or "siltstone" are actually composed of very fine grained, well sorted, quartzose sand.

There appears to be much discrepancy in determining the horizon of the top of the Road Canyon Fm. Cooper & Grant use an horizon higher than the one we regard as suitable, and surprisingly (to us), this appears to be above that chosen by Cys. It is easier to recognize the highest units described in the Cooper & Grant section than those described in the Cys section. Limestone beds become thinner and further apart going upsection after the highest conglomerate unit (unit 8 of Cooper & Grant), but thin limestones occur in orange-brown siltstones and sandstones well up in the Word Fm., and in strata almost to the top of the knob. In the absence of a very detailed stratigraphic description of the section, a group decision by the Friends of the Permian is needed to stabilize the formation boundary. We favour a horizon at the top of the highest conspicuous limestone, which is fossiliferous although the fossils are broken bioclasts. This is definitely below the horizon chosen by Cooper & Grant, but is a better horizon for a formation boundary because it is mappable.

These problems are solvable with a modest amount of further work.

We recommend that the type section of the Road Canyon also serve as the type section for the Roadian stage. The section is 99% exposed, and fossil collections can be unambiguously placed in proper superpositional relationships. As Lehrmann noted, this is by far the best exposed section of the Road Canyon available for study. The section has been sampled for conodonts, and we have fusulinid samples from many horizons. There are ammonoids in the highest conspicuous limestone unit, although we are not sure if the entire type section has been searched for ammonoids. Unfortunately, Cooper & Grant did not collect brachiopod samples from the type section itself, although brachiopods were collected from many sites within a kilometre or two to the west, as well as at the eastern end of the ridge containing the type section. The type section contains multiple conodont zones and multiple fusulinid zones, which provide a basis for definition of the Roadian stage and its boundaries. We have encountered a greater diversity of fusulinids within the type section than any other Road Canyon section, and a great abundance of fusulinid-bearing horizons.

Work that remains is: 1) provide a detailed section description 2) produce a section showing exact horizons of fossil occurrences for fusulinids, conodonts, ammonoids, and brachiopods, and any other fossil groups that may have been collected 3) designate zones and datums within the section. The fusulinid and conodont zones have both been tested and proven to be of practical use in several Road Canyon sections.

Our work with fusulinids is in agreement with the suggestion that the lower part of the Road Canyon formation is better placed in the Leonardian Series, while the upper part of the Road Canyon Formation is better placed in the Guadalupian Series.

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Zhen-Dong Yang

11. GUADALUPIAN SYMPOSIUM

This is just to remind you that we are planning a symposium in 1991 on the Guadalupian. The symposium will be held at Sul Ross State University in Alpine, Texas, during their spring break (mid-March, final dates have not been set by the university). Proceedings and a symposium volume will be published. The symposium volume will be published by the Smithsonian as a number of the Contributions to Paleobiology series, edited by Grant and Wardlaw. We would like papers for the volume before the symposium and are targeting September 30, 1990, for initial submittal of titles, abstracts, or completed manuscripts. If we do not receive at least a title and intent to participate by that time it will be difficult to be included.

We have decided to run this symposium ourselves with aid from the Smithsonian and USGS and under the sponsor of the Permian Subcommission. This way we can limit the size and use 6 vans to get us to all critical outcrops for some lively discussions. We will announce the meeting in several publications to insure participation.

Bruce R. Wardlaw

12. **IUGS Subcommission on Permian Stratigraphy (SCPS)**

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