International Union of Geological Sciences

International Commission on Stratigraphy

International Subcommission on Stratigraphic Classification

ISSC

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NEWSLETTER N. 10

(Circular n. 111)

November 2006

CONTENTS

1. EDITORIAL

This editorial written for ISSC Newsletter n.10 coincides with the beginning of stage 3 of my mandate, that expires in less than two years from now.
From the first editorial (February 2003) I quote:
"This is my first editorial written for ISSC and you will notice a change in style but not in goals. I strongly feel that our Subcommission differs substantially from all the other Subcommissions of ICS because we are not looking for new GSSPs or for new data sets.
We are responsible for the definition of the rules, and of their application."
"We do not need real specialists in Graptolites, or in Planktonic Foraminifers, or in Magnetostratigraphy, etc;, we do need strong scientists, good stratigraphers with experience in field mapping and close relationship with national Geological Surveys from all over the world, from all the continents, we need representatives of National stratigraphic commissions to interact with the local communities. However, we have to respect the new statute of ICS, approved last year by IUGS."
"After fifty years of activity ISSC appears in a steady state, which is inappropriate: we need new blood if we want to take an active part in the renaissance of stratigraphy, if we want to be the protagonists of our future.
The advances undergone by stratigraphy in the last fifty years are enormous. Isotopic stratigraphy was not even born in the early fifties, but it is now a leading science for understanding the evolution of our planet."
"We need to be theoretical and practical at the same time, to be aware both of the problems encountered by the field geologists and of the most advanced, leading scientific research.
We have always to keep observations and interpretations well separated. This is to me the strong message of Hedberg's approach that survived three generations of geologists."

The first stage lasted till August 2004, when the first workshop of ISSC was organized during the 32nd IGC in Florence. Entitled "Post-Hedberg Developments in stratigraphic classification", the workshop was convened by the present and past presidents of the subcommission. It was very well attended and is considered a milestone in developing a new "bottom up" approach, with real world examples to explain the application of the basic concepts of the newly developed subdisciplines of Stratigraphy.

The second, transitional, planning phase or stage lasted a couple of years with the appointment of task group leaders and working group leaders, the distribution of the outlines for various review articles, followed by the circulation of the whole text among the subcommission members (see ISSC Newsletter 5-9).

The third stage starts now. Indeed, the first article of the series NEW DEVELOPMEN IN STRATIGRAPHIC CLASSIFICATION sponsored by ISSC has been submitted for publication to the international scientific journal "Newsletters on Stratigraphy". Authored by Strasser, Hilgen and Haeckel, it is entitled CYCLOSTRATIGRAPHY – CONCEPTS, DEFINITIONS AND APPLICATIONS. It is preceded by a presentation by the ISSC Chair, here reproduced at pages 18-21 that explains the purpose of the initiative, as well as her role of scientific coordinator..

The third very important, productive stage will last till August 2008.At the 33nd IGC in Oslo we proposed a two days long workshop on "New Developments in Stratigraphic Classification" where

the protagonists of our initiative will present and discuss their results. Conveners of the proposed workshop are Cita, Embry, Strasser and Finney.
All ISSC members, veterans and new, are invited to participate actively to this important initiative, that requires more efforts, additional planning, writing, reviewing and finalizing.

MARIA BIANCA CITA

1. REPORT ON PENROSE CONFERENCE

Final Report
Penrose Conference
Chronostratigraphy: Beyond the GSSP

Schloss Seggau, Leibnitz, Austria
3-9 June 2006

Introduction
Chronostratigraphy, the temporal organization and classification of (predominantly) sedimentary strata provides the framework for deciphering earth history. Conceptually developed in the latter half of the 19th century, it has undergone successive metamorphoses, but at unprecedentedly accelerated rates in the last two decades. Given the size and scope of new databases and their ever-growing complexity and importance, and the multi-disciplinary nature of modern studies, we urgently need to re-examine the bases upon which our classifications of rock, events and time are assembled. Accordingly we organized a Penrose Conference to examine the fundamental nature of stratigraphic classification, and to make recommendations for modernizing and expanding its application by bringing together specialists who have been leaders in developing stratigraphy in recent years.

Topics
The conference was divided into a series of 6 topics, prefaced by a key-note address by Gian Battista Vai (University of Bologna) who traced the history of the early bipartite, and latterly, tripartite chronostratigraphic subdivision as seen from the perspective of a century of international geological congresses.

The first topic of the conference reviewed the status quo of Cenozoic chronostratigraphy. William A. Berggren (Rutgers University) discussed some of the difficulties involved in constructing a satisfactory chronostratigraphy around some Cenozoic chronostratigraphic boundaries because of historical usage. He examined the heterogeneity in the procedures followed by various working groups in establishing GSSPs, and questioned the use of the stage as the basic unit of the chronostratigraphic hierarchy. John Flynn (American Museum of Natural History) demonstrated how magnetostratigraphy and isotope stratigraphy have been instrumental in correlating terrestrial and marine stratigraphies, using examples from the South American Cenozoic record, the Neogene of Mexico and the P/E boundary interval in Asia and North America. Mike Woodburne (Museum of Northern Arizona, Flagstaff) discussed the concept of North American Land Mammal Ages and the need for renewed biostratigraphic studies in order to improve both boundary definitions and the potential development of continental stages**.** As reviewed by Dennis Kent (Rutgers University), magnetochronology now forms the backbone of the Late Jurassic through Cenozoic time

scale, providing a resolution of <50 Ky. Whereas the early and middle Jurassic sequences of geomagnetic polarity reversals is as yet poorly known, Triassic sections have yielded a reliable magnetostratigraphy. Paleozoic magnetostratigraphy is promising. Carl Swisher (Rutgers University; as presented by D. Kent) pointed to the vast discrepancy between the analytical precision (<1%) of 40Ar/39Ar ages with the uncertainty (>1%) due to calibration and interlaboratory variations. His new age calibration on Paleogene tie-points brings the Paleogene time scale in synchrony with the new Neogene time scale (ATS04).
The second topic addressed (un)resolved problems in chronostratigraphy. Nick Christie-Blick (Columbia University) explained the rationale and procedures for placing in Australia the GSSP of the newly defined Ediacaran System of the Neoproterozoic Erathem. Stan Finney (Long Beach State College) reviewed the status of the Paleozoic systems with emphasis on the Ordovician. He pointed to the major role of graptolite stratigraphy in guiding GSSP definitions. Jim Ogg (Purdue University) remarked on the slow progress in the definition of Mesozoic GSSPs. There is no GSSP for the base of the Cretaceous as yet, and the Berriasian Stage may have to be abandoned. Rick Fluegeman (Ball State University) reviewed the state of Cenozoic GSSPs. He pointed out the importance of erecting a Sparnacian Stage between the Thanetian and Ypresian s.s. stages. Brad Pillans (ANU, Canberra) reviewed the problem with equating the Pleistocene with the Quaternary and supported the recent suggestion to decouple the two and retain the Tertiary and Quaternary as suberathem/subera of the Cenozoic. Stan Finney (on behalf of Maria Cita, University of Milano) presented an overview of the history of Mediterranean Neogene stages. Werner Piller (Graz University) discussed the history of regional stages for the Paratethys and their correlation to Mediterranean stages. He indicated that the only appropriate resolution to these correlation problems is the application of an integrated stratigraphic approach within which sequence stratigraphy provides the basic framework for correlation supported by bio- and magnetostratigraphic tie points. He questioned the usefulness of regional stages in the light of a GSSP-based chronostratigraphy.

The third topic dealt with recent methodologies in chronostratigraphy. As discussed by Nick Christie-Blick, there is strong potential for miscorrelation of genetically (un)related surfaces, with significant implications for time-stratigraphy. Sequence stratigraphy is most useful at basin scale, and cannot serve for any global stratigraphic framework. It is not a convention or scheme for stratigraphic classification. Linda Hinnov (Johns Hopkins University) reviewed the principles of cyclostratigraphy and its relationship to the astronomical time-scale. She distinguished the canonical (Cenozoic-Mesozoic; insolation-based) ATS and floating (pre-Mesozoic; orbital-like pattern-based) ATS, and reviewed the Latemar controversy. Joszef Palfy (Hungarian Natural History Museum, Budapest) showed how the methods of Unitary Association (UA) and Constrained Optimization (CONOP) assist in the definition of GSSPs and the evaluation of the reliability of correlations. Thierry Moorkens (Antwerp, Belgium) discussed the role of sequence- and cyclostratigraphy in studies of the Rupelian and Ypresian unit stratotypes and recommended (re)introduction of the Sparnacian Stage at the base of the Eocene. Based on Toarcian sections, Stephen Hesselbo (Oxford University) demonstrated that very high resolution carbon isotope stratigraphy has great potential for global (marine and terrestrial) correlations, with a stability and a resolution that far exceeds ammonite-based stratigraphy. Andy Gale (British Museum, London) reiterated this point based on Upper Cretaceous successions of England and showed that carbon isotopic records yield a Milankovich cyclicity.

The fourth topic was concerned with the future of chronostratigraphy. Stan Finney observed that there are competing definitions of chronostratigraphy and reviewed the use of

biostratigraphy in assisting the definition of GSSPs. He described the current status of the global stratigraphic correlation program, and demonstrated the home page of the ICS and its subcommissions. Bob Carter (James Cook University, Townsville) questioned whether the stratigraphic tools exist to satisfy future societal needs. He proposed to broaden lithostratigraphy to include synthems as the highest hierarchical unit, to abandon the dual concept of chronostratigraphy, to merge global chronostratigraphic units into Global Chronologic units down to the level of Ages, abandon the (local) stage, and retain local biostratigraphies including the oppelzones.

The fifth topic was devoted to examining potential improvements in current concepts and practices. Marie-Pierre Aubry (Rutgers University) traced the concept of GSSP to Harland's approach to chronostratigraphy. She pointed to significant conceptual ambiguities in the GSSP approach, illustrated by the complex architecture of the Cenozoic stratigraphic record with its extended gaps and the resulting potential for miscorrelation based on event stratigraphy. Among other items, she proposed that boundary definition be based on horizons rather than points, and that reference sections in terrestrial and marginal marine stratigraphies complement the marine-based GSSP definition. Lucy Edwards (USGS, Reston) attempted to reconcile the desirability of stable means of communication among stratigraphers with the need to revise stratigraphic codes and guides to reflect advances in the field of stratigraphy. Yuri Gladenkov (Geological Institute, Moscow) represented the view of the Russian school of stratigraphy. He noted that, whether regional or global, "natural" boundaries (i.e., based on major changes in earth history) should prevail in stratigraphic classification. He questioned the validity of the GSSP concept and suggested that unit-stratotypes be reconsidered. Finally he recommended that the revision of the *International Stratigraphic Guide* proceeds through the involvement of the international stratigraphic community. Brian McGowran (The University of Adelaide) noted that cultural diversity in stratigraphy was not removed by the *Guide*, that our perceptions of earth and life history have changed greatly (e.g., a resurgence of punctuationism driven by "revolutions" in plate tectonics, cyclo- and sequence stratigraphy, and impact theory), and that we have become much more unifying and integrating in recent decades. He cited assertions that stratigraphy has marginalized itself by way of the triad of litho/bio/chronostratigraphy, and he used examples from each of the three facets to show how stratigraphy must reassert its rightful place at the integrating and synthesizing centre of earth and life history.

The conference also provided the opportunity to discuss the proposal of the British Stratigraphic Commission to transform the dualistic hierarchy of current chronostratigraphy into a unitary system in the form of a debate between Jan Zalesiewicz (Leicester University) and Marie-Pierre Aubry.

A proposal to develop cyclostratigraphy tools for the Mesozoic by a task force within the CHRONOS project was elucidated by Linda Hinnov and Jim Ogg. The idea of a web-based community time scale was also discussed by John Van Couvering (Micropaleontology Project) and Jim Ogg. This proposal was strongly questioned because of inherent instability, risking the paper trail on which clarity of citation and communication must be based.

The conference ended with an open discussion that revolved around two main topics: the current status of stratigraphy and the content of the *Guide*. The audience expressed its concern at current levels of recognition and growth of stratigraphy in the earth sciences. Stratigraphy is central to geology in academia and industry, and must remain there as the earth sciences

contribute to the welfare of societies. The training of experts in basic stratigraphic disciplines is an important step in meeting this challenge. Another matter of concern is the revision of the *Guide*, in which members of the stratigraphic community wish to participate. The consensus was that the *Guide* should not be simplified at this time, and it should be more explicit in some categories, in particular with regard to the description of the GSSP. The majority was for preserving the dual hierarchy of chronostratigraphic and geochronologic subdivision.

As to the science itself of stratigraphy, Nick Christie-Blick captured the spirit of the meeting thus: our great advances in precision and accuracy in correlation and age determination embolden us to ask those questions of the stratigraphic record that we have hitherto been too insecure to ask.

Main recommendations

1- The need to bring further together the stratigraphic community in the interests of integration, synergy and synthesis. Multi-disciplinary advances notwithstanding, the community is still too divided by methodologies and expertise and according to different precepts in subdividing the Proterozoic and Phanerozoic Eonothems.

2- We need to unify concepts and protocols across different geocultural traditions.

3- Stratigraphy plays a strong central role in discovering and elucidating earth and life history. We have to promote that role vigorously, beginning with a revival of historicist thinking in education by way of historical biology and historical geology.

Secondary recommendations

4- Regulating all stratigraphic tools and procedures is unnecessary (e.g., in sequence stratigraphy)

5- There was on balance a preference for retaining the dual nomenclature of stratigraphy (from Eon/Eonothem to Age/Stage)

6- Neither mammal ages nor biochronology are recognized explicitly in current stratigraphic codes or guides. This deserves further consideration.

Organisational

The conference was held at Schloss Seggau in Leibniz, Austria from June 3-9, 2006 and was attended by 31 scientists from Africa, Australia, Europe, and North America and 6 European part-time observers.

Field trip

A mid-conference field trip was organized on June 6, 2006 co-guided by Martin Gross (Joanneum Museum, Graz), Werner E. Piller and Ali Soliman (both University of Graz). It provided an overview on the Neogene basin fill of the Styrian Basin and related stratigraphic problems. Stop 1, within the area of Schloss Seggau, provided an overview on the field trip and gave insight into the Paleozoic basement of the Styrian Basin. Stop 2 (brickyard Wagna) exposed the Lower/Middle Miocene boundary, corresponding to a major tectonic phase and a related stratigraphic gap. Stops 3 and 4 dealt with a Middle Miocene (Badenian) carbonate facies and lateral and vertical transitions into siliciclastics. Quarry Retznei (stop 3) provided a good insight into facies relationships and fossil content. The subsurface quarry at Aflenz, with

its roots back to the Roman Empire, shed light on the local importance of these carbonates as building stones. Fossil rich, upper Miocene sediments were examined in the clay pit of Mataschen (stop 5), which are characteristic of the late non-marine episode (Lake Pannon) of the Styrian Basin. Finally, pelites of maar lake deposits of Plio-/Pleistocene age marked the last period of basin evolution.

Concert in Schloss Seggau, June 7, 2006

As part of a social evening program a concert on "Secular music at the Inner Austrian court in Graz (1564-1619)" was presented by the group "Catkanei", an ensemble specialized in ancient music on original instruments; they were joined by the vocalists of the ensemble "A più voci", also well known for their performances of ancient music. The program included works by F. Rovigo, M. Ferrabosco, E. Widmann, L. de Sayve, P. A. Bianco, J. D. del Giovane da Nola, G. Mainerio, and O. di Lasso. Replicas of ancient instruments were exhibited and their use demonstrated for the audience by the artists.

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2. ANSWERS TO QUESTIONNARIES DISTRIBUTED IN ISSC NEWSLETTER 9

ISSC Newsletter n. 9 – June 2006:
3 questionnaires:

1- Chemostratigraphy –concepts and applications

International Subcommission on Stratigraphic Classification
Outline by HELMUT WEISSERT

2- Biostratigraphy –concepts and applications

International Subcommission on Stratigraphic Classification
Preliminary Outline by JACQUES THIERRY

3- OSLO 2008 IGC

SPECIAL SYMPOSIUM ORGANIZED BY ISSC
NEW DEVELOPMENTS IN STRATIGRAPHIC CLASSIFICATION

COMMENTS RECEIVED BY:
WINTER July 4, 2006
EMBRY July 4, 2006 and July 29, 2006
DERMITZAKIS July 12, 2006
ODIN July 12, 2006
PRATT July 13, 2006
CITA July 18, 2006
PETRIZZO July 20, 2006
TAKAYANAGI July 20, 2006
FINNEY July 22, 2006
RICCARDI July 22, 2006
WATERHOUSE July 26, 2006
COOPER July 26, 2006
EDWARDS July 28, 2006
CSASZAR July 30, 2006 and July 31, 2006
JOHNSON July 31, 2006
BRAKEL July 31, 2006
ZALASIEWICZ July 31, 2006
MENNING July 31, 2006
CHANG August 1, 2006
THIERRY August 12, 2006
GRIGELIS August 21, 2006

From: Hendrik de la Rey WINTER <winterh@xconnect.co.za>
Subject: Response to ISSC Newsletter No.9
Date: July 4, 2006

CHEMOSTRATIGRAPHY
Is this detail really what we want? Review your objectives, says IUGS. Is it subsidiary to lithostratigraphy or an adjunct to improve to a better classification?
BIOSTRATIGRAPHY
Forget about the superclassical fundamental branch stuff, and concentrate on why and how this approach helps to sustain sequence stratigraphy as being the measuring tool of local basin analysis, because any interruption in deposition can and has dated the sequence of events needed by petroleum geologists to determine its petroleum potential.

OSLO ICG, 2008
Looking back on what I heard about Firenze 2004, I have my doubts about the effectiveness of meetings this large, when there is no-one sufficiently reliable to give an accurate summary of the numerous simultaneous sessions held. In South Africa the AAPG has planned a conference the same year, expecting to have 10 simultaneous sessions and more than 1000 papers read! You pays your money and you takes your choice.
Then one has the spectre of copyright such as on the Penrose Conference.

From: Ashton Embry <AEmbry@NRCan.gc.ca>
Subject: RE: ISSC Newsletter 9
Date: July 4, 2006
Regarding the ISSC symposium for IGC 2008, the topic you have chosen seems very appropriate. I definitely plan to attend and present in the symposium and would be pleased to act in any other capacity that you see fit. You might look at having more discussion time during the symposium. I thought the 2004 IGC symposium was excellent and a few people did mention to me that they had wished there had been more time for discussion. I realize it is difficult to fit so much into one day.
I'll get back to you with comments on the biostratigraphy and chemostratigraphy outlines although they will be brief given my peripheral involvement in these disciplines. The same applies to magnetostratigraphy.

From: Michael Dermitzakis <mdermi@geol.uoa.gr>
Subject: Re: ISSC Newsletter 9
Date: July 12, 2006
BIOSTRATIGRAPHY
Comments: case studies focused in regional andd global biozonal schemes
Suggested additions: biostratigraphy and chemiostragraphy; biozones and isotope excursion events
CHEMOSTRATIGRAPHY
Comments: I consider that the term Chemostratigraphy is based on the word Chemo-(in Greek means juice). Therefore it should bettr replaced by Chemiostratigraphy as Chemio- is based on the word Chemia which is the Greek word for Chemistry.
Suggested additions: 1- isotope stratigraphy and stratotypes; 2- Contribution of isotope stratigraphy to PETM and its ecological significance.
OSLO ICG, 2008
DO YOU PLAN TO ATTEND THE CONGRESS? Yes
ARE YOU INTERESTED IN GENERAL? Yes
DO YOU VOLOUNTEER AS CO-CONVENER? No
ARE YOU ESPRESSING A PERSONAL POSITION? No
OR AN INSTITUTION? Yes

From: Gilles Serge ODIN <gilodin@ccr.jussieu.fr>
Subject: réponse circulaire 9
Date: July 12, 2006
CHEMOSTRATIGRAPHY OUTLINE
COMMENTS
- on «First step should be an integration of reference isotope stratigraphies into stratigraphic charts».
I am not sure that stratigraphic chart proposed by ICS must give "reference stratigraphies" . ICS Stratigraphical chart must remain simple and focused on the CONVENTIONAL information. Conventions are part of the role of ICS. Information on KNOWLEDGE is NOT part of the role of ICS. If the so called "reference stratigraphies" (geochemical, sequence or age numbers…) , are integrated in the chart it will reinforce tendancy toward unique thinking.
SUGGESTED ADDITIONS…nothing
BIOSTRATIGRAPHY OUTLINE
COMMENTS
- I appreciate the proposal to illustrate the four ERAS which suggests that Quaternary is an Era a fully historical and justified rank.
- I agree on all lines of the Outline but have a comment on the last one
« the unavoidable part of biostratigraphy for the designation of GSSPs»
As far as Palaeo-, Meso-, and Cenozoic are concerned it is correct that biostratigraphy is unavoidable for GSSPs. The question, of the Quaternary and its subdivisions, neither GSSP nor biostratigraphy are unavoidable (may be useful but NOT necessary).
SUGGESTED ADDITIONS nothing
OSLO 2008 IGC

SPECIAL SYMPOSIUM ORGANIZED BY ISSC
DO YOU PLAN TO ATTEND THE CONGRESS? No
ARE YOU INTERESTED IN GENERAL? Yes
DO YOU VOLOUNTEER AS CO-CONVENER? No
ARE YOU ESPRESSING A PERSONAL POSITION? Yes and No

Yes because I did not question my colleagues for this particular inquiry, No because I often discussed the point with colleagues of the French speaking community ; of the Quaternary community ; of the community of geochronologists.

OR AN INSTITUTION? No

From: **Brian R. Pratt** <brian.pratt@usask.ca>
Subject: Chemostrat & Biostrat
Date: July 13, 2006

The outline by Helmut Weissert seems comprehensive. They might include Sm/Nd and epsilon-Nd chemostratigraphy. I am sure that he and Michael Joachimski will discuss at length some of the caveats about the use of C-isotopes as global indicators versus local or regional variations in productivity. O-isotopes have limited use in the Paleozoic at present because of questions about fractionation, freshwater influences and diagenesis.

The outline by Jacques Thierry seems good too. I think here is the place for them to downplay the various, rarely used types of biozones that reside in the Code and Guide. I tried to get my fellow NACSN committee members Lucy Edwards and Alf Lenz to follow this suggestion when we revised the biostratigraphic part of the Code but they wouldn't go for it. But, frankly, Acme Zone, Abundance Zone, Lineage Zone, Concurrent Range Zone and so on are, and were, almost NEVER used--I checked this by going through 10 years' worth of all the major paleontology journals before giving a presentation at an NACSN meeting. I still have the data if anyone wants it. Even the drawings in both the Guide and Code showing spindles, phylogenies and stratigraphic ranges portray conceptually different things. Some are forced and rather contrived attempts at finding biozonal indicators, and nowadays would not make much sense given how much more we understand of paleoenvironmental settings. These types of biozones can be mentioned in the historical part of course, but the chapter should focus on what has proven to be the most useful and meaningful methods. I don't have much to say about statistical biostratigraphy--some people have explored that sort of thing (e.g. Peter Sadler) but in reality it seems to me that, for the most part, the practical biostratigrapher works on what is there rather than what might be there or what should be there but has not been found yet etc. Statistical treatment would not work without regard to the facies. Some very fine case studies are out there, especially the use of graptolites (e.g. Roger Cooper on the Ordovician).

Regarding the Oslo congress: provisionally, I plan to attend. Early August is not an optimal time for me because it conflicts with the short field season we have in this country, but we shall see.

From: **Maria Bianca Cita** <maria.cita@unimi.it>
Subject: ISSC Newsletter 9
Date: July 18, 2006

<u>BIOSTRATIGRAPHY OUTLINE</u>

COMMENTS: an excellent outline. Suggest to treat briefly but adequately special aspects of biostratigraphy as mammal ages, pollen zones discussing their global versus regional or local (basin-wide) significance.

ADDITIONS: a glossary at the end explaining the significance of the acronyms commonly used by biostratigraphers plus simple concepts. I strongly recommend that you appoint a working group of 3-5 qualified scientists, widely international and possibly including ISSC members (the majority of members since the beginning were paleontologists) to provide case-studies.

<u>CHEMOSTRATIGRAPHY OUTLINE</u>

COMMENTS: an excellent outline. All the scientists contacted concur that the only branch of chemostratigraphy that has a global significance relevant to chronostratigraphy is isotopic stratigraphy. But I suggests to dedicate just one page to say a few words on other branches of geochemistry (major, minor, trace elements, total versus organic carbon, clay minerals) and organic geochemistry commonly used in basinal studies and in environmental-oriented studies. You suggest tot appoint a working group on isotope stratigraphy within ISSC. I encourage you to realize this plan possibly including ISSC members, see list published on Newsletter 7, pages 2- 4 of scientists presumably interested to take an active part in the new guide. This task group should include the scientists you are selecting to provide the case studies.

SUGGESTED ADDITIONS: I suggest to make it clear that isotopic geochemistry is indeed a new method, that did not exist some 40 years ago. That it is an expensive method, which requires fully equipped laboratories run by highly specialized personnel. Provide costs of the third generation (fourth?) mass spectrometers, maintenance costs etc. Indicate approximately how many such laboratories exist today in the various continents in universities, scientific institutions, oil companies. A glossary at the end of the chapter with all the acronyms used and suggestions on the terminology.

From: **Maria Rose Petrizzo** <mrose.petrizzo@unimi.it>
Subject: ISSC Newsletter 9
Date: July 20, 2006

BIOSTRATIGRAPHY OUTLINE

COMMENT: The outline is good, however I think that Part 4 is a little confused as different methods are mixed together. I suggest restricting the paper on the biostratigraphic methods only, and adding a new chapter titled "Integrated Stratigraphy" in which the various stratigraphic methods are compared, integrated and correlated with the aim to create Time Scales.

CHEMOSTRATIGRAPHY OUTLINE

COMMENT: a very good and comprehensive outline.

From: Stanley C. Finney <scfinney@csulb.edu>
Subject: Re: REMINDER -ISSC Newsletter 9
Date: July 22, 2006

CHEMOSTRATIGRAPHY

Only one suggestion. Important work is being done today on Oxygen isotopes in conodonts, which is the only reliable means of assessing oxygen isotope trends in the Paleozoic. Perhaps this topic should be added.

BIOSTRATIGRAPHY

I am concerned because from the outline it appears that the paper will not be restricted to biostratigraphy but instead will include chronostratigraphy. The entire last section with headings such as "Biostratigraphy and geochronology", "Biostratigraphy and Chronostratigraphy", etc. There are many biostratigraphic zones that are diachronous. Based on the guide, biostratigraphic units are strictly descriptive units without time implications, and once time relationships of rocks bodies defined on biostratigraphy are considered, then one is dealing with chronostratigraphy.

SPECIAL SYMPOSIUM AT OSLO 2008 IGC

Do you plan to attend? YES
Are you interested in general? YES
Do you volunteer as co-convener? YES
Are you expressing a personal position? PROBABLY
or an institution? NO

From Yokichi Takayanagi - received by post

OSLO 2008 IGC
SPECIAL SYMPOSIUM ORGANIZED BY ISSC
NEW DEVELOPMENTS IN STRATIGRAPHIC CLASSIFICATION
DO YOU PLAN TO ATTEND THE CONGRESS? No
ARE YOU INTERESTED IN GENERAL? Yes
DO YOU VOLOUNTEER AS CO-CONVENER? No
ARE YOU ESPRESSING A PERSONAL POSITION? No
OR AN INSTITUTION? Yes No

From: Alberto Riccardi <riccardi@fcnym.unlp.edu.ar>
Subject: Re: ISSC Newsletter 9
Date: July 22, 2006

CHEMOSTRATIGRAPHY OUTLINE

COMMENTS: I agree in general
SUGGESTED ADDITIONS: I do not see the need to stress (Introduction) the significance of the Cenozoic and foraminifera.

BIOSTRATIGRAPHY OUTLINE

COMMENTS : I agree in general.
SUGGESTED ADDITIONS: I do not see the need to stress "the rise of micropaleontology, microfossils and biostratigraphy in the petroleum and academic research" (Point 1).

I do not agree with expressions (Point 4) such as
"the ever up-to-date relative dating..."
"the still obvious calibration ..."
"the necessary estimation of the duration..."
"the necessary calibration of ...

" the unavoidable part of ..."……..

OSLO 2008 IGC

SPECIAL SYMPOSIUM ORGANIZED BY ISSC
DO YOU PLAN TO ATTEND THE CONGRESS? Yes
ARE YOU INTERESTED IN GENERAL? Yes
DO YOU VOLOUNTEER AS CO-CONVENER? No
ARE YOU ESPRESSING A PERSONAL POSITION? Yes
OR AN INSTITUTION? Yes

From: Bruce Waterhouse <perma@xnet.co.nz>
Subject: Re: REMINDER -ISSC Newsletter 9
Date: July 26, 2006

CHEMOSTRATIGRAPHY

A good start. There should surely be a section on on the Permian-Triassic carbon spike etc, and the debate over the relationship to soft and woody plant material sources. And the much debated "chert gap" and low oxygenation of Triassic. And does not chemostratigraphy extend now into other elements and the analysis of maleimides etc? References provided on request.

BIOSTRATIGRAPHY

The outline is a little bare and too brief to clarify the directions and content. The "classical " approach has, at least for the periods I am familiar with, been in vogue for scarcely ten years. In other words, the "second half of the 20th century" could be subdivided. "Classical" biostratigraphy (sic) is rapidly expanding and not unnaturally causing contradictions and leaving dissonances with other evidence - to be expected from the newness of the approach. That will make it difficult for a Guide, or article, unless written with skill and unless flexibility is built in, with cautions, with an awareness that the current approach is proceeding so quickly that it is yet to be completely established. The previous Guides of course are now very dated, but hopefully we are on the cusp of settling into a much more sophisticated and profound methology.

Would it be an idea to use major fossil groups rather than examples from each era - eg graptolites, conodonts, ammonoids, forams etc? Also, the examples should offer inter-continental correlation, because this becomes much more self-testing, rather than the much easier single basin or single continent treatment acceptable (?) for stratigraphic techniques of more recent vintage. I also suggest that in the examples - say for Permian and Triassic conodonts, due attention is paid to way the studies are integrated with many other enviromental parameters and chemostratigraphy etc But perhaps instead there should be an "Integration" article for all these different themes? What about Biostratigraphy and event stratigraphy? Surely??? And there are several other fields that could be included.

OSLO 2008

I am interested in general. I might attend.

From: Roger A. Cooper <R.Cooper@gns.cri.nz>
Subject: N/L 9 answers
Date: July 26, 2006

CHEMOSTRATIGRAPHY

I am not a specialist in this area and have no specific comment. The structure and topics listed appear to be logical and relevant.

BIOSTRATIGRAPHY

Part 1, Introduction - OK
Part 2. Concepts, methods and kinds of units. There are problems with trying to group methods into "logical" and statistical". Graphic correlation is not a statistical method, and neither is it a "logical"
method. I would divide this part into "Qualitative (classical) methods" and "Quantitative methods". Under "Quantitative methods" I would include the following techniques - unitary association (Geux and Alroy methods), graphic correlation, multivariate methods, probabilistic methods (ranking
and scaling), and constrained optimisation (Sadler's method), with a brief account of the functions (correlation, ordination, subdivision etc) and units produced by each.
Part 3 Case studies - OK
Part 4 - I don't know what the heading means, but presume that it is referring to the interface between biostratigraphy and other stratigraphic methods. Nor do I understand the meaning of several of the sub-topics in this part - I think something has been lost in translation. This section
is where stress can be laid on the value of integrated stratigraphy - the integration of a range of techniques and data. This would be a relevant topic for the guide.

OSLO 2008

I am unlikely to be able to attend the Oslo Congress.

I am interested in general
I will not be able to convene a session
My view is personal, but I consult my colleagues within GNS and within the
New Zealand community as appropriate, depending on the issue.

From: Lucy E. Edwards <leedward@usgs.gov>
Subject: Re: REMINDER -ISSC Newsletter 9
Date: July 28, 2006

General

The outlines I have seen so far do not appear to fit the model of a guide to STRATIGRAPHIC CLASSIFICATION, rather they appear to fit a textbook on various aspects of stratigraphy. Before we proceed further, we need to come to a consensus about the issues – Should we produce an opus on the various aspects of stratigraphy? (probablyyes)
Should it replace the existing International Stratigraphic Guide? (probably no)
Should changes be made to the existing International Stratigraphic Guide? (definitely yes)

Specific

One of the biggest sticking points is what is BIOSTRATIGRAPHY and what is CHRONOSTRATIGRAPHY. The outline given for biostratigraphy appears to confuse various concepts and is difficult to critique without a similar outline for chronostratigraphy.
Both Chemostrat and Biostrat appear to focus more on methods than unifying concepts (but it is really hard to tell from the outlines). Regarding Oslo 2008, I'd love to come, but do not know if I will be able to (budget too uncertain).

From: Ashton Embry <AEmbry@NRCan.gc.ca>
Subject: RE: ISSC Newsletter 9
Date: July 29, 2006

You already have my comments regarding your proposed symposium at the 2008 IGC (sent July 4).

CHEMOSTRATIGRAPHY OUTLINE

In regards to the Chemostratigraphy outline I have only a few comments. Dr Weissert's outline looks very comprehensive when it comes to isotope stratigraphy. I would hope there will be one case study that will demonstrate the use of isotope stratigraphy for correlation and unit delineation in a single basin so as to demonstrate its use for resolving local problems as well as global ones. Also I think it might be useful to include a section of element chemostratigraphy. This stratigraphic methodology is used by petroleum companies for correlation in sections where other types of stratigraphy do not yield results (eg fluvial strata). Perhaps a leader in this field could be part of the Task Group.

BIOSTRATIGRAPHY OUTLINE

Dr Thierry has produced an excellent outline for the biostratigraphy contribution. It appears all important topics will be well addressed. I am curious to know the members of the Biostratigraphy Working Group. It seems to me that Brian McGowran of New Zealand should be included and at least one prominent biostratigrapher from North America. I recently read McGowran's comprehensive book on biostratigraphy and it was terrific. It is important that the ISSC Guide not be seen as the "European Guide". This had not occurred to me before I read Catuneanu's book on sequence stratigraphy. He referred to the ISSC Guide as the European Guide in more than one place in the book. He is the current chair of NACSN so I think we have to take this potential perception problem seriously.

From: **Geza Csaszar** <csaszarg@mail.datanet.hu>
Subject: Newsletter 9
Date: July 30, 2006

CHEMOSTRATIGRAPHY OUTLINE

COMMENTS: The sketch of chemostratigraphy is not balanced. In the subheadings most frequently the carbon isotopes occur, while the Sr-isotopes are just mentioning. Not any explanatory word is written under the subheading 2. It seems to me that chemostratigraphy at the moment is composed of curves or sets of curve fragments and not yet stratigraphy in conventional sense.
SUGGESTED ADDITIONS: The base to transform curves in to stratigraphy is to establish its own terminology.

BIOSTRATIGRAPHY OUTLINE

COMMENTS: No doubt that both historically and also in principle one of the most important division of stratigraphy is the biostratigraphy but from the preliminary outline it can not be found out what is the text ratio between the historical overview (introduction) and the today biostratigraphy. I would suggest to refer only briefly for the previous two guides instead of going into datail in this matter.
I agree that case studies help in utilisation of bio- and all other stratigraphies but I am afraid that these studies makes the ISG too voluminous, and in spite of this they can be only examples and those who are willing to convert the examples into practice they shall look for more complete papers or books. Briefly saying: I have ambivalent feeling in this matter.

SUGGESTED ADDITIONS: We appreciate very much that biostratigraphy will be compared with other kinds of stratigraphy even with the geochronology. Nevertheless as geochronology is not stratigraphy we suggest to put the comparison of biostratigraphy and geochronology from the 2nd place to the last one, following the comparison of the biostratigraphy and chronostratigraphy.
Why do not correlate biostratigraphy with chemostratigraphy?
OSLO 2008 IGC
SPECIAL SYMPOSIUM ORGANIZED BY ISSC
DO YOU PLAN TO ATTEND THE CONGRESS? Yes
ARE YOU INTERESTED IN GENERAL? Yes
DO YOU VOLOUNTEER AS CO-CONVENER? Yes
ARE YOU ESPRESSING A PERSONAL POSITION? Yes No
OR AN INSTITUTION? Yes (Chair, Strat. Com. of Hungary)

From: **Geza Csaszar** <csaszar@mafi.hu>
Subject: additional remarks to chemostratigraphy
Date: July 31, 2006

Sorry for the extra notes. Expert of chemostratigraphy in the Stratigraphic Commission of Hungary sent his remarks to my home address as I asked for but my official address and I noticed only this morning. I hope, you can add them to my last letter.
1) The better understanding of the relationship between major extinction events and carbon cycle should be emphasized.
2) The changes in trace element composition of the oceanic system and their relationships with the environmental conditions and carbon cycle perturbations should be explored.
3) A synergic evaluation of oceanic and continental environmental conditions and their chemostratigraphic correlation should be included.
4) I suggest to include a combined investigation of the "new isotopes" analysed by the multicollector ICP-MS technique and the traditional ones listed in the scheme (Sr, C, O).

From: **Mike Johnson** <mjohnson@geoscience.org.za>
Subject: Response to ISSC Newsletter No. 9
Date: July 31, 2006

As regards chemostratigraphy and biostratigraphy (or cyclostratigraphy and sequence stratigraphy for that matter), these are not burning issues for the South African Committee for Stratigraphy (SACS) at this point in time and I do not believe that we can make a meaningful input right now. As far as SACS and the Council for Geoscience (Geological Survey of South Africa) are concerned, the traditional categories of lithostratigraphy, biostratigraphy and chronostratigraphy, as elaborated in the 1994 ISG and the 1996 edition of our own national stratigraphic code, still serve us adequately in practice. All the published maps produced by the Council for Geoscience depict lithostratigraphic units, with the legends showing how these relate to the international eons, eras and periods. We also continue to use our local subdivision of the Precambrian into Swazian (>3100 Ma), Randian (3100-2650 Ma), Vaalian (2650-2050 Ma), Kheisian (2050-1600 Ma), Namaquan (1600-1000 Ma) and Namibian (1000-545 Ma) on our maps - as well as Tertiary and Quaternary of course! Sequence and seismic stratigraphy are widely used in offshore drilling and exploration, but there have been no serious attempts to formalise the sequence stratigraphic units recognised here and SACS has therefore not found it necessary to lay down rules for their definition and nomenclature.
As senior editor, I have been heavily involved in the compilation of "The Geology of South Africa", a comprehensive new 690-page multi-author reference work which will be published shortly. There are 33 separate chapters prepared by specialists on the various segments of the South African geological column, covering some 3600 million years of Earth history. Once again, traditional lithostratigraphy, with the international time scale providing the chronological framework, has been the consistent point of departure for all contributing authors (except for the chapter on the offshore Mesozoic basins). The only formal biostratigraphic subdivisions featured appear in the chapter on the Karoo Supergroup, with eight formally named vertebrate-based biozones in the Beaufort Group and Elliot Formation.
I am not planning to attend the 2008 IGC in Oslo. However, I am due to retire before then, so I cannot speak for my (as yet unnamed) successor.

From: **Albert Brakel** <abrakel@netspeed.com.au>
Subject: Re: Newsletter n.9 request for comments
Date: July 31, 2006

In Newsletter n.9 you asked for comments on the Chemostratigraphy and Biostratigraphy outlines. The outlines seem quite reasonable to me, but I have to say I have no special expertise on these subjects. I will not be able to attend the Oslo 2008 IGC, but I am of course interested in the outcome of the Special ISSC Symposium.
The Newsletter has been circulated to the other members of the Australian Stratigraphy Commission. However, it is too

early for any responses to have been received, because many people are away on field work at this time of the year, or (as in my case) they have been catching up on the backlog of work after attending the Australian Earth Sciences Convention in Melbourne.

From: Jan Zalasiewicz <jaz1@leicester.ac.uk>
Subject: Re: REMINDER -ISSC Newsletter 9
Date: July 31, 2006

CHEMOSTRATIGRAPHY: In general this outline looks fine. I wonder, though, whether other isotopes (that show secular changes in composition in strata) might also be mentioned. Notably, there's neodymium (with its widely-used epsilon values), and more recently interesting results have been obtained with, say, osmium.
BIOSTRATIGRAPHY: Some of the terms are unfamiliar to me (e.g. 'logical biostratigraphy'). Is it worth spelling out some of the different methodologies/approaches more specifically? For instance, there's the use of local climatically-forced immigrations/emigrations of taxa (rather than evolutionary originations and extinctions) in the Quaternary. And, in the more statistically-oriented sections, the use of the CONOP methodology by Roger Cooper and Peter Sadler (I think) in the construction of correlations in the latest ICS chart. Otherwise OK.
OSLO 2008. I would like to attend this, both personally and to represent the Geological Society of London Stratigraphy Commission. I could help with convening any appropriate meeting (say on chronostratigraphy?)

From: Manfred Menning <menne@gfz-potsdam.de>
Subject: Questionary and more
Date: July 31, 2006

CHEMOSTRATIGRAPHY OUTLINE
SUGGESTED ADDITIONS…
In a few days a special volume with 15 articles will be published in Palaeo 3 on Chemostratigraphy in the Late Palaeozoic (our DCP 2003 is the stratigraphic base and the 16th article): see Science Direct, Palaeo3, Articles in Press, No. 47, Preface of Werner Buggisch and 12 of the other articles you can find there. Perhaps you can choose an additional example usable for our guide. The contents are attached as PALAEO319.
It should be mentioned in the preface of our guide that it is necessary to distinguish between a) chemostratigraphy using stable isotopes and b) radio-isotopic dating (geochronometry, one of the geochronological methods) using unstable isotopes.
BIOSTRATIGRAPHY OUTLINE
COMMENTS…Chapter 4 may destroy the consistency of our guide because no other stratigraphic method will include a comparable chapter. Biostratigraphy is, for me, by far the most important geochronological method which is used both for regional and global dating. However, chapter 4 should be deleted because it mixes methods under the title "Biostratigraphy".
Instead, we need a chapter on "Integrative Stratigraphy" which we are using to create a) Time Scales and b) Global Correlation Charts and Regional Correlation Charts as, e.g., the DCP 2003. (Regional) Correlation charts are the most important tool for many stratigraphers.
The numerical calibration of the global time scale is an integration of radio-isotopic data and orbitally-climatically induced sedimentary cycles. Those time indications are combined mainly by biostratigraphic and magnetostratigraphic means. After numerical calibration of a time scale (global, regional) the duration of biozones (global, regional) can be estimated.
OSLO 2008 IGC
DO YOU PLAN TO ATTEND THE CONGRESS? Yes
ARE YOU INTERESTED IN GENERAL? Yes
DO YOU VOLOUNTEER AS CO-CONVENER? Yes No
ARE YOU EXPRESSING A PERSONAL POSITION? Yes "Folgen": a new multigenetic regional geochronological category (preliminary title)
OR AN INSTITUTION?(it depends from elections 2007)
Suggested addition:
Special Symposium within the General Symposia on Stratigraphy: "Devonian-Carboniferous-Permian Correlation 2008" (preliminary title)

From: **Ki-Hong Chang** <khchang@knu.ac.kr>
Subject: [RE]REPLY -ISSC Newsletter 9
Date: August 1, 2006

I am of the view that such highly specialized disciplines as chemostratigraphy should be left free from IGCP guide, but I would rather cooperate you to help you to go ahead. The future will judge.
In p. 6 on Chemostratigraphy, on 13th line, the sentence "Oxygen isotope stratig...." may had better go above (12th

line) so that it is the first one under Carbon isotope stratigraphy.
I will see what amendment shall have been made in future.
Oslo 2008 IGC, I do not know yet whether I can participate there or not.

From: Jacques THIERRY <jacques-thierry2@wanadoo.fr>
Subject: Comments on Newsletter
Date: August 12, 2006

CHEMOSTRATIGRAPHY OUTLINE
COMMENTS:
Recommendations

If "no internationally well established strategy exists" *in chemostratigraphy* for "future nomenclature of defined units", I agree that the "*first step should be an integration of reference isotope stratigraphies into stratigraphic charts*" and "*only in a second step a common nomenclature should be established*". But, this integration of "informations" and "data", that is to say basisc knowledge , should not be delivered too early to non-specialists; it must be restricted first to a "chemostratigraphy task-working group" within ISSC.
Such a recommendation is suggested regarding what happened with radiometric ages. As an example, these ones have been always extrapolated to stage boundaries despite they have been mesured within "stage units", unfortunately quite enough few biostratigraphic control ("anchoring points"). The actual dilemna is that people don't know what time scale they can use facing their chronostratigrahic and biostratigraphic data.
This must not be done again with chemostratigraphic data.
SUGGESTED ADDITIONS:
It seams to me that what is proposed in this chapter is too restricted to isotopic data which are linked to palaeoclimatic interpretations. According to his speciality, Helmut Weissert has focused his discussion on isotopes which are nowadays the most used in stratigraphy, that is to say O, C and Sr, leaving what is generally called trace elements *senso lato* (S, Ir, Mn, Fe etc …). It is true that since several years, the role of isotopic geochemistry of O, C and Sr has been enhanced in stratigraphy and palaeoceanography. I think it should be necessary to recall the role ot the other above cited trace elements, even if they are more linked to other stratigraphic approaches like sequence stratigraphy for instance.
In paragraph 3c, it seems to me that it would be judicious to add a discussion on the Palaeocene/Eocene boundary in conjunction with what concerns the Toarcian event; the C isotopic evolutions are the same and the proposed scenario are enough identical (clathrates production). Paleocene/Eocene boundary has been abundantly studied prior to the Early Toarcian and the cenozoic results seems to be more elaborated than for Mesozoic.
2008 OSLO IGC
DO YOU PLAN TO ATTEND THE CONGRESS ? Yes (possible !may be !) because I don't yet know if I could be free at these dates … which fall within possible family summertime holidays !
ARE YOU INTERESTED IN GENERAL? Yes
DO YOU VOLOUNTEER AS CO-CONVENER? Yes and No (?); this decision depends of the state of the art of the "New guide" … ! If it would be quite ready, I may assist the planned Special Symposium within the General Symposia on Stratigraphy … perhaps with a talk on "New developments on biostratigraphy" depending what has been written in the "New Guide".
ARE YOU EXPRESSING A PERSONAL POSITION? Yes
OR AN INSTITUTION? No because I have not yet spoken of the IGC to several the Comité Français de Stratigraphie (CFS) or other French eologic institutions. Moreover, till Summer 2008, the board of the CFS (and other institutions) will be renewed and I don't know what the responsables will decide.

From: **Algimantas Grigelis** <grigelis@geo.lt>
Subject: OSLO_2008
Date: August 21, 2006

There is my reply and support of ISSC symposium in Oslo, 2008:
OSLO 2008 IGC
SPECIAL SYMPOSIUM ORGANIZED BY ISSC
NEW DEVELOPMENTS IN STRATIGRAPHIC CLASSIFICATION
DO YOU PLAN TO ATTEND THE CONGRESS? Yes No
ARE YOU INTERESTED IN GENERAL? Yes No
DO YOU VOLOUNTEER AS CO-CONVENER? Yes No
ARE YOU ESPRESSING A PERSONAL POSITION? Yes No
OR AN INSTITUTION? Yes No

3. NEW DEVELOPMENTS IN STRATIGRAPHIC CLASSIFICATION BY MARIA BIANCA CITA

Author's address
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Abstract
This article is a presentation of a new initiative of the IUGS International Subcommission on Stratigraphic Classification (ISSC), which was created in 1952 at the 19th International Geological Congress in Algiers. The production of an international stratigraphic guide has been since the beginning a principal objective of the Subcommission. Two International Guides have been published so far (Hedberg, 1976 and Salvador, 1994), plus an abridged version (Murphy and Salvador, 1999)
Stratigraphy underwent an unprecedented, extremely rapid development in the last two or three decades resulting from the introduction and application of new techniques, from the multidisciplinary approach, and from the availability of a vast data set by long term successful scientific programs such as DSDP-ODP-IODP, and regional, national or world paleogeographic synthesis as Tethys, Paratethys. A revision of the ages published in the existing guides in the light of the new highly specialized and diverse subdisciplines that are currently used for the definition of GSSPs (Global Stratotype Sections and Points) therefore seems timely.
Starting from the first Workshop organized by ISSC during the 32nd International Geological Congress held in Florence 2004, a new "bottom up" approach was initiated, with the appointment of several task-groups in order to prepare a series of articles dedicated to the various stratigraphic subdisciplines.
The role of the Subcommission chair is that of a scientific coordinator of the series, entitled NEW DEVELOPMENTS IN STRATIGRAPHIC CLASSIFICATION. The articles include examples illustrating the application of the principles to case studies from different parts of the world and from different ages.

Background
Stratigraphy still is a core business of geology today, as it has always been since the beginning of geologic thinking, some three centuries ago.
In the last twenty to thirty years, stratigraphy underwent an unprecedented, incredibly rapid development as a result of:

- the application of geophysical methodologies to analyze the record of the Earth's magnetic field that provide proxy data allowing correlations of terrestrial and marine successions, resulting in the development of magnetostratigraphy

- geochemical methodologies that allow the recognition and precise correlation in the oceanic realm of trends, cycles, and events independent of ecological or bioprovincial factors, giving rise to the development of chemostratigraphy

- the interpretation of the lithostratigraphic successions in terms of sequences controlled by relative sea-level changes, resulting in the development of sequence stratigraphy

- the interpretation of the cyclically modulated lithostratigraphic successions as controlled by extraterrestrial forcing factors, leading to the development of cyclostratigraphy.

On the other hand, the extraordinary development of stratigraphy derives from the enormous data set originated by the exploration (since 1968) of all the worlds oceans by the DSDP-ODP programs with 1257 drillsites. By this, our state of knowledge has been revolutionized for the time interval postdating the Middle Jurassic. A similar or even stronger scientific revolution for the Quaternary was caused by ice coring in Antarctica and in the Arctic region. The multidisclinary approach as applied to continuous successions never available before resulted in an very high time resolution and in the possibility to cross-correlate the sections with multiple criteria.

Brief history of the International Subcommission of Stratigraphic Classification

Within the International Union of Geological Sciences (IUGS), stratigraphy is represented by an International Commission on Stratigraphy (ICS), presently organized in 15 subcommissions , basically one for each system or period as follows: one for the Precambrian, one for each major subdivision as Ediacarian, Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian, Triassic, Jurassic, Cretaceous, Paleogene, Neogene, and Quaternary, plus the Subcommission on Stratigraphic Classification.

The latter was founded at the 19th International Geological Congress (IGC) held in Algiers in 1952. The first chair was Hollis D. Hedberg, a successfrul oil company scientist and manager, and an inspiring professor of stratigraphy at Princeton University. He chaired ISSC from 1952 to 1977. Thanks to his continuous efforts and a large international cooperation he was able to arrive at a largerly agreed-upon acceptance of some basic principles such as the distinction of several categories of stratigraphic subdivisions (litho-, bio-, chrono), the definition of the basic chronostratigraphic unit (stage) with a fixed base identified in the field, and the hierarchical organization of the units.

It took several dozens of circulars disseminated by surface mail over a time span of approximately twenty years to arrive at the publication of the International Guide for Stratigraphic Classification (Hedberg, 1976). This important work had a strong influence on the development of modern stratigraphy and was followed in many countries, notwithstanding the difficulties to apply the strict rules for the definition especially of the lithostratigraphic units in highly deformed areas or to very ancient successions.

From his Introduction we quote…"The purposes of the Guide are to promote international agreement on principles of stratigraphic classification and to develop a common internationally acceptable stratigraphic terminology and rules of stratigraphic procedure"…. and …. "The recommendations of this first edition are based on the current consensus of members. Future editions will undoubtedly introduce changes dictated by the tests of time and usage and will need to evolve with new views and methods".

Hedberg's successor was closely related to him. Indeed, Amos Salvador, who chaired ISSC from 1977 to 1992, had a long and successful carrier in an important oil company before being appointed at the Texas University in Austin. Salvador edited the second edition of the International Stratigraphic Guide (ISG), which mimics in large part the first edition, with minor changes and two important additions, i.e. the chapters on Unconformity Bounded Stratigraphic Units and on Magnetostratigraphy. He also included a glossary (Salvador, 1994).

Salvador's successor was M.A. Murphy from the University of California, who co-authored with Salvador the abridged version of the Guide, published on EPISODES in 1999 (Murphy and Salvador, 1999). Murphy resigned in 1994, reportedly for difficulties arisen with the ICS directory concerning the definition of GSSPs (Global Stratotype Section and Point).

Murphy's successor was Alberto Riccardi from the Museo de la Plata in Argentina, a well known stratigrapher specializing in Jurassic ammonites, who had to resign from his position in 2002

because he was elected councelor of IUGS, the two positions being incompatible according to the IUGS by-laws
I (Maria Bianca Cita), was vice-chair of ISSC when this happened, and had to take over after Alberto Riccardi when the Hedberg Scientific conference on "Sequence stratigraphic and allostratigraphic principles and concepts" was organized by AAPG, jointly with NACSN and ISSC, and when the first workshop of the International Commission on Stratigraphy was organized by Stan Finney in Urbino (Italy) .
Having been an individual member of ISSC for a long time, an organizational member (as chair of the Italian Commission on Stratigraphy), and for several years an ex-officio member (as chair of the Neogene subcommission), I was familiar with the variegated and sometimes very difficult community of professional stratigraphers. So, after having been re-elected for the term 2004-2008 according to the new ICS statutes, I tried a new approach.

32nd IGC, Florence 2004: the turning point

For over fifty years ISSC has worked through correspondence. Official meetings were organized in occasion of the International Geological Congresses: attended by a few stratigraphers, they had the character of business meetings, with no real science involved.
When the program for the 32nd IGC was distributed, I convened, with Alberto Riccardi, an ISSC workshop on "Post Hedberg developments in stratigraphic classification", the first ever since the creation of the subcommission. The workshop was very successful. We had keynote presentations, position papers, and free contributions. We had lively discussions and a friendly atmosphere between veterans of the subcommission and "new entries", and we started to develop a strategy of "bottom up" instead of "top down" approach to stratigraphic classification.
Two editions of the ISG have been published and are well known within the geological community. However, if we compare their contents, the definitions and the procedures with the definitions of the GSSPs submitted recently, we cannot avoid to notice sharp discrepancies. In fall of 2006, ISC members (= chairs of the various ISC subcommissions) have to cast their vote for the Drumian stage of the Middle Cambrian (Babcock et al., 2006) and for the Serravallian stage of the Middle Miocene (Hilgen et al., 2006). The excellent documents prepared by the subcommissions include terminologies not considered in the ISGs and display an integrated stratigraphy scenario that appears very distant from the original definitions. For the Serravallian, for instance, the leading factor for correlation is considered to be the astrocyclic tuning, a parameter ignored by the existing official guides.

I am fully aware that there is a strong resistance in several milieux against the idea of a new guide. What we are trying to do now is to publish a series of articles, each focussed on a single subdiscipline of stratigraphy and developed with a team work approach.

Format and procedures

Starting from the Florence 2004 Workshop and the motto "Let us work as a team", without any financial support, on an uniquely voluntary basis, we appointed Task group leaders for two important themes that were already identified by Riccardi during his chairmanship: Sequence stratigraphy and Cyclostratigraphy.
The Working Group on Sequence stratigraphy was appointed in 1995, with A. Salvador as coordinator. It consisted of fifteen members, mostly North-Americans and several connected with oil companies, where this methodology first developed and is applied with great success. Four members of the WG were also members of ISSC. Twenty-three memos were distributed from 1995 to 2001 among the WG members, but not to ISSC. A Hedberg scientific conference was organized

in Dallas in September 2001. Notwithstanding all these efforts, no consensus was reached on the definition of the basic units, and the working group was disbanded.

The Working Group on Cyclostratigraphy was appointed in 1998 and consisted of three scientists active in the field. Frits Hilgen, André Strasser, and Walther Schwarzacher. None of them was an ISSC member. They produced two reports and a questionnaire. The first report and enclosed questionnaire was distributed in July 2000 to a large community that included the ISSC members. Responses to the questionnaire and comments were distributed to ISSC members: who noticed their heterogeneous and often contradictory nature. A second report on "Concepts and definitions in cyclostratigraphy"was prepared, taking into account the responses. It was distributed in 2002 but did not get any reaction.
The topic was presented and discussed at the SEPM-sponsored conference held in Sorrento (Italy) in the spring of 2001 (Fischer et al., 2004; d'Argenio et al., 2004).

In order to revitalize the situation and face the problem of providing some official guidance to these subdisciplines of stratigraphy that are reaching an increasing importance both for their high time resolution and for the correlation potential, I took the decision, after extended consultations and negotiations with leading international scientific personalities, to a) appoint Task group leaders for subdisciplines that were not considered in the previous ISGs, and b) to appoint Working group leaders for subdisciplines or categories already treated but requiring a revision.

The first two Task group leaders appointed were Ashton Embry from the Geological Survey of Canada, an "old" ISSC member with a large experience in sequence stratigraphy both in outcrops and in subsurface (not a member of the previous WG), and André Strasser, a "new entry" of the subcommission, for Cyclostratigraphy. All three members of the previous WG on Cyclostratigraphy were invited to join the subcommission when I took over. Only Schwarzacher declined.

In order to avoid the risk of a second failure in a globalized world where it seems impossible to reach a consensus on whatever subject, I asked the Task group and Working group leaders to prepare a concise and well documented article, consisting basically of three parts: an incipit with a short historical background, basic concepts and methodologies; at least three real-world examples or case studies from different parts of the world and from different time slices; and a discussion on the applications of the method, pointing out the strong points versus the weak points in an integrated stratigraphic scenario. An appendix with a glossary of the terms used was added following the suggestion of the reviewers.

The procedure agreed upon within the Subcommission was to first distribute an outline of the future text, with one month on-line review time. We look for comments and additions or corrections. No answer means acceptance. All answers are collected by the chair who transmits them to the leader, once the review deadline is over. At this point the Task group leader can start writing, with the help of the members of his group. When the first draft is ready for distribution (by e-mail) we give a two months on-line review time for comments, additions, and corrections to be addressed to the chair that forwards them to the Task group leader who then modifies the text accordingly. The final text is then submitted to the chair for a final revision.
The system worked very well for the first contribution, which will serve as a template for the series.

EPILOGUE

The two International Stratigraphic Guides (Hedberg, l976; Salvador, 1994) were authored and edited by the chairmen of the IUGS Subcommission on Stratigraphic Classification of the

International Commission on Stratigraphy. Stratigraphy underwent an incredibly rapid growth and developed several innovative subdisciplines in the last 20 to 30 years. Consequently, an update is required, also with reference to the efforts to complete and refine the geologic time scale.

A new approach is used: a series of research articles under the auspices of the ISSC, where the chair acts as scientific coordinator. I thank the editor-in-chief of NEWSLETTERS ON STRATIGRAPHY, Prof. Michael Kosinowski, and Dr. Naegele of the E. Schweizerbart'sche Verlagsbuchhandlung for agreeing to publish the series, and the authors of the first contribution Strasser, Hilgen, and Heckel for the excellent work done.

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4. GSSPs APPROVED: DRUMIAN AND SERRAVALLIAN

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES

INTERNATIONAL COMMISSION ON STRATIGRAPHY

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4 Sept, 2006

IUGS Secretariat
attention: Hanne Refsdal
Geological Survey of Norway
N-7491 TRONDHEIM
NORWAY

Request for IUGS Ratification of the GSSP defining the **base of the Drumian Stage** of the **CAMBRIAN System**

The International Commission of Stratigraphy has approved the following Global boundary Stratotype Section and Point (GSSP) defining the base of the Drumian Stage of the Cambrian System.

The Global boundary Stratotype Section and Point (GSSP) for the base of the DRUMIAN STAGE (= middle stage of the third series of the Cambrian) is defined at the base of a dark-gray thinly laminated calcisiltite layer, 62 m above the base of the Wheeler Formation, along the ridge crest (39°30.705´N, 112°59.489´W) of a section known informally as "Stratotype Ridge" in the Drum Mountains, northern Millard County, western Utah, USA. This level coincides with the lowest occurrence of the agnostoid trilobite *Ptychagnostus atavus*. Secondary indicators near the lowest occurrence of *P. atavus* are: just below the GSSP is the base of the Laurentian polymerid trilobite *Bolaspidella* Zone, and the base of a parasequence which records a minor eustatic deepening event; and just above the GSSP is the LAD of the cosmopolitan agnostoid trilobite Ptychagnostus gibbus, the base of the Baltic-Gondwanan conodont *Gapparodus bisulcatus-Westergaardodina brevidens* Zone, and a significant negative carbon isotopic excursion.**

The details of this GSSP are explained in the enclosed proposal. This proposal had been revised following an initial ICS Executive review (Summer, 2006), then transmitted to ICS for final voting during August 2006.

The votes received from the Full Commission were **17 "Yes"(100%)** (*details, and summary of remarks are on the next pages*). One member did not respond.

The previous voting by the Cambrian Subcommission was 100% "Yes" (17 voting; *2 people did not reply)*. Details with copies of comments are at the end of the Drumian GSSP document.

The ICS hereby submits this GSSP for the base of the Drumian Stage of the middle Cambrian to the IUGS for ratification at their next meeting. We also attach the set of comments on the proposal by ICS voting members. If ratified, then a modified form of this proposal will be published in *Episodes*.

Sincerely,

Jim Ogg

James G. Ogg ***(Secretary-General of the ICS)***

VOTE SUMMARY

On the Global Stratotype Section and Point (GSSP)

Defining the DRUMIAN Stage (third series of the CAMBRIAN System) in Utah, USA

TOTALS **17 Yes (100%), with a few remarks**

1 vote was not received

Office	Name		Vote Comments
Chair	Gradstein	**YES**	
Vice-Chair	Finney	**YES**	*[See recommendations, and response of working-group chair at end of this document]*
Secretary	Ogg	**YES**	
Quaternary	Gibbard	**YES**	"A most impressive proposal for a good GSSP."
Neogene	Hilgen	**YES**	"My vote is positive. I remain to have some reservations about the carbon isotope excursion although clarification by Loren Babcock put my heart largely at rest. Anyhow it is only a secondary correlation tool and the selected level and section

			received wide support from the Cambrium community in view of overwhelmingly positive votes by the members of the subcommission."
Paleogene	Molina	**YES**	
Cretaceous	Premoli Silva	**YES**	
Jurassic	Morton	**YES**	*[See comments at end of this document*
Cambrian	Orchard	**YES**	
Permian	Henderson	**YES**	**"**I think the GSSP level should be indicated as coinciding with the "FAD" of the agnostid trilobite… as opposed to the "first occurrence" as stated above. Stating that it is the first occurrence implies that the first occurrence in other sections will also serve to define the same level when in fact it may be somewhat younger. Many guides now distinguish between FO and FAD. A local first occurrence may or may not coincide with the first appearance datum; the FAD is generally considered to be the true first occurrence so far as current precision allows. ICS should consider the language necessary to make these definitions precise. Although the FAD does not define the GSSP it most certainly coincides with it at the GSSP and essentially defines the point."
Carboniferous	Heckel	**YES**	
Devonian	Becker	**YES**	*[See recommendations, and response of working-group chair at end of this document]]*
Silurian	Rong Jiayu	**YES**	
Ordovician	Chen Xu	**YES**	
Cambrian	Peng Shanchi	**YES**	"Indeed, the Durm Mountains section is one of the excellent sections in the world for the P. atavus level, and had got full support from the Voting Members of the ISCS. I sincerely hope the proposal will got passed in the ICS vote."
Ediacaran	Gehling	**YES**	
Precambrian	Bleeker	*[none received]*	
Classification	Cita	**YES**	

September 27, 2006
Dear ICS chairs,
The Neogene Subcommission has approved (100% yes of ballots received) the attached Serravallian GSSP proposal (mid-Miocene).
Attached is the ballot for voting on the Neogene Subcommission's proposed GSSP for the Serravallian Stage. Any pre-voting questions or remarks should be sent to Frits Hilgen (and a copy to me, plus all ICS chairs if appropriate). The voting will close in one month (25 October), but an earlier decision can be relayed to IUGS in advance of our Annual Report.
James Ogg (ICS secretary)

SERRAVALLIAN GSSP POSTAL BALLOT RESULTS

The proposal and postal ballot form were sent to 21 SNS Voting members. The quorum of about 86% (18 votes out of 21) was reached. All votes are positive except for one which is positive but with some reservations.

VOTE

ON THE GLOBAL STRATOTYPE SECTION AND POINT (GSSP) DEFINING THE

Base of the **SERRAVALLIAN Stage** of the Middle MIOCENE

The Global Stratotype Section and Point (GSSP) for the Base of the SERRAVALLIAN STAGE (Middle Miocene) is defined in the Ras il Pellegrin section located in the coastal cliffs along the Fomm Ir-Rih Bay on the west coast of Malta (35°54'50"**N,** 14°20'10"**E). The proposed GSSP is at the formation boundary between the Globigerina Limestone and Blue Clay in this section and coincides with the major Mi-3b global cooling step in the oxygen isotopes. This event is close to the last occurrence of the calcareous nannofossil *Sphenolithus heteromorphus*, previously considered as guiding criterion for the boundary, and falls within the younger half of Chron C5ACn. The associated major glacio-eustatic sealevel drop corresponds with sequence boundary TB2.5 of Haq et al.'87. The GSSP level has been astronomically dated at 13.82 Ma.**

5. MEMORIAL OF ACADEMICIAN V.V. MENNER

I am pleased to reproduce here a paper published by Yuri Gladenkov, and to add a few personal memories of a few meetings I had with this outstanding scientific personality (see page 30).

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Original Russian Text © Yu.B. Gladenkov, 2006, published in Stratigrafiya. Geologicheskaya Korrelyatsiya, 2006, Vol. 14, No. 5, pp. 115–118. **DOI:** 10.1134/S0869593806050091

Stratigraphy: Lessons of the Past and Ways to the Future (to Centenary of Academician V.V. Menner)

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A jubilee is frequently a good occasion to review achievements in a particular branch of science and outline the current problems. This is exactly the case of actions undertaken at the Geological Institute of the Russian Academy of Sciences (GIN RAS) and devoted to centenary of academician V.V. Menner, an outstand- ing scientist who contributed much to development of geological science, primarily to progress in strati- graphic research. In connection with this date, the International Sci- entific Conference "Stratigraphic Problems at the Commencement of 21st Century: New Ways and Approaches" was held at the GIN RAS, November 24– 25, 2005. The program of the conference included, first, debatable problems of general stratigraphy, for exam- ple, new approaches to revision of the International stratigraphic scale and, second, problems of stratigra- phy application in deciphering stages of the Earth geo- logical history. Invited reports at the conference have been presented by apprentices and followers of V.V. Menner, on the one hand, and by known experts from abroad, on the other. Among the latter, there were Prof. F. Gradstien from Norway, chairperson of the International Commission on Stratigraphy (ICS), Prof. K. Osagawara from Japan, chairperson of the Regional Committee on the Pacific Neogene Stratigraphy (RCPNS), Prof. Kolfschotten from the Netherlands, a member of the International Subcommission of Quaternary Stratigraphy (ICS). Russian stratigraphic community was represented by known experts in the Precambrian (M.A. Fedonkin, M.A. Semikhatov, B.S. Sokolov), Paleozoic (A.Yu. Rozanov, T.N. Koren, A.S. Alekseev), and Mesozoic (A.A. Shevyrev) stratig- raphy. General problems of stratigraphy and contribu- tion of V.V. Manner to its development in the 20th cen- tury represented topics of reports by Yu.B. Gladenkov, A.I. Zhamoida, F. Gradstein (in co-authorship with J.G. Ogg), and M. Kolfschotten (together with F. Gib- bard). In their presentations, V.A. Zakharov, K. Ogasa- wara, N.Yu. Bragin, Vl. V. Menner, A.S. Tesakov, and V.A. Aristov considered the problems of paleogeography, paleobiogeography, and geological evolution. By the beginning of the conference, the Publishing House *Nauka* issued the book *Biosphere–Ecosystem–Biota in the Earth Past (Paleobiogeographic Aspects)* prepared by scientists from the Department of Stratigraphy, GIN RAS, specially to this date (editors in chief Yu.B. Gla- denkov and K.I. Kuznetsova).

All the presented reports were dedicated to V.V. Menner and his blessed memory. That is why, I would like to remember V.V. Menner as a personality who determined to a large extent the development of stratigraphy in Russia during the past century. Many biographic papers and memoirs are devoted to V.V. Menner. Therefore, I wish to present my recollections as answers to the following two questions: (1) why Menner's name was so significant in geology of the 20th century and (2) why he had such a great scientific prestige and influence?

Generally speaking, Menner was a devotee, who dedicated his life and talent to the selected profession— geology and stratigraphy, which he treated with the striking love and spiritual passion. He dedicated his scientific activity primarily to stratigraphy, to the "queen of geology," N.S. Shatsky said. Everybody, who knew Menner, remembers his professionalism and fabulous erudition. At the same time, we should always remember his other important feature: he was one of unique scientists, who towered above the diverse facts constructed building of the general "stratigraphic ideology," i.e., a system of views that determined essence and worldwide significance of stratigraphy.

What was characteristic of Menner in his everyday activity? As nobody else, he was able to see stratigraphic problems of his time. At the same time, being an optimist in science, he could see ways for solving these problems. Moreover, he was able to organize any work, find and train active persons interested in science, and engendering a creative atmosphere around him (and emanating decency, I should add), he promoted quick solution of different problems. His personal example, unselfish relation to the work, and

keenness enhanced always the potential of all investigations. As a talent person, Menner went always in advance of all new and actual scientific ideas. Menner was a person of his time and lived, as is said in a poem, with his fate and epoch that was politically not simple. He was born to the family of white-collar workers on November 24, 1905, during the first Russian revolution. He was 12 years old at the commencement the October revolution in 1917. The subsequent history of Russia was marked by well-known periods of totalitarianism (the horrible 1930s, ruefully memorable session of the All-Russian Academy of Agricultural Sciences of 1948, and other events), stagnation, and perestroika (Menner passed away in 1989). In those times, many scientists were condemned to become conformists, although the best of them never lost their dignity, honor, and decency. Menner was undoubtedly among the latter.

Menner graduated from the Moscow University (Nature Department of the Physical-Mathematician Faculty) in 1927 and immediately started his scientific work. In the terminal 1920s–1930s, he was a post-graduate student and worked then in the Mining Academy, Moscow Geological–Prospecting Institute (MGPI), and at the Geological Institute, his home of science since 1934. In different years, he headed the Stratigraphic Department (later sector), Laboratory of Phanerozoic Stratigraphy and was its deputy director of the Geological Institute. In 1930, he was conferred with the rank of the Candidate of Science in Biology and, later, in Geology. In 1960, Menner successfully defended his doctoral dissertation dedicated to actual problems of stratigraphy, correlation of different-facies sequences included. Parallel to the work at the Geological Institute, he was engaged for a long time in pedagogical activity first in the MGPI and since 1966 at the Moscow State University. In 1966, Menner was elected a full member of Academy of Sciences of USSR.

The period of 1950–1980 was an epoch of intense development of geology in the USSR. As is known, these years were marked by a large-scale geological survey, prospecting works, and commencement of reference drilling, which required the reliable stratigraphic basis. Menner contributed much to this activity primarily as one of the leaders, who could train a cohort of stratigraphers armed with advanced methods and able to head many directions of geological studies. His disciples worked in different regions of the USSR and abroad, participated in various geological projects, the creation of many regional stratigraphic schemes included. Their contribution to geology is evident, for example, from the only fact: they published approximately 300 fundamental monographs and books, many belonging to the golden fund of domestic geology. The example of the Geological Institute alone shows which directions stimulated by scientific and practical requirements of that time were developed under the leadership of Menner. In the 1960s–1970s, study of macro- and microfossils was of prime importance at the institute that was necessary for development and substantiation of many regional and local stratigraphic schemes. This required application of new methods and approaches based, for example, on the concept of polytypic species, phylogenetic lineages, etc. Much attention was paid to both benthic and planktonic fossils.

Many researchers engaged in these studies united subsequently to form the Laboratory of Phanerozoic Stratigraphy headed by Menner. Taking into consideration needs of geological practice, the Laboratory of Micropaleontology was organized, and its chief D.M. Rauser-Chernousova headed it many years. Later on, the Laboratory of the Upper Precambrian appeared with B.M. Keller in charge. Scientists from these laboratories carrying out investigations in urgent, frequently pioneering directions. It is not incidental that they became often leaders in different scientific fields. It is suffice to mention I.N. Krylov with his colleagues and their contribution to the study of Precambrian stromatolites, V.V. Missarzhevskii and others who studied oldest skeletal fossils, B.B. Nazarov who discovered a world of Paleozoic radiolarians, and many others. Menner supported all the studies concerning stratigraphy of continental sedimentary sequences. The Laboratory of Paleobotany (headed first by M.F. Neiburg and then by V.A. Vakhrameev) concentrated its efforts on genesis of flora. The Laboratory of Quaternary Geology headed by V.I. Gromov contributed much to the Quaternary stratigraphy based on vertebrate studies.

It should specially be noted that Menner always encouraged research of all the stratigraphically promising paleontological groups, new and nontraditional ones included (conodonts, radiolarians, nannofossils, diatoms, dinocysts, and others). That is why young scientists were permanently invited to work at the institute, to maintain a high professionalism of research.

By the way, many of these young scientists became later on the leaders of laboratories and other structural units of the institute.

The 1970s–1980s are the years of further development of stratigraphic studies at the Geological Institute. These years coincided with geological mapping and prospecting works, which were in progress, and with the commencement of deep-sea drilling in oceans.

V.A. Krasheninnikov was an enthusiast of oceanic studies in the institute. Menner understood immediately the methodical significance of materials from the World Ocean. On the one hand, they demonstrated practical possibility of wide correlations based on zonal units (biostratigraphic zones appeared to be traceable over spacious regions in low latitudes of the Atlantic, Pacific, and Indian oceans). On the other

hand, these materials substantiated recognition of subglobal stratigraphic units (zones), which are smaller as compared with stages and correspond to periods approximately 1 m.y. long (nobody could dream about such a detailed stratigraphy in the initial 20th century). It should specially be noted that Menner kept him- self abreast of new stratigraphic methods, which were immediately introduced into practice of geologicalstudies at the Geological Institute. For example, he promoted organization of the Laboratory of Paleomagnetism (headed by P.N. Kropotkin), which conducted
intense magnetostratigraphic investigations. He stimulated also isotopic studies in the institute (V.V. Cher- dyntsev, V.I. Vinogradov) and was among those who supported seismostratigraphic studies of a specially organized group (A.E. Slezinger).
Elaboration of detailed stratigraphic schemes based on different methods and a high professionalism of stratigraphers was, probably, the main result of activity by Menner and his disciples of the Geological Institute in the 1960s–1980s. The professionalism was largely grounded by the methodological and theoretical stratigraphic basis formed with an active participation of Menner. He kept abreast of achievement of his foreign colleagues engaged in similar studies. Owing to his pioneering activity, important methodical works by K. Danber and D. Rodgers, O. Schindewolf, R. Harland, A. Hallam, and H. Hedberg were translated into Russian. Menner organized discussions of new methods and repeatedly estimated their value in his papers.
His role in discussion and publishing of the International Stratigraphic Guide (1976) and Stratigraphic Code of Russia (1992) can hardly be overestimated. He worked much on problems of stratigraphic classifica- tion and elaborated the basis of stratigraphic concepts, which influenced stratigraphic studies at the Geological Institute and everywhere in this country. Owing to high geological and biological erudition of Menner, his ideas gained recognition abroad as well. His approaches to different-type stratigraphic classifications were welcomed by international scientific community.
At the same time, developing ideas of classical or traditional stratigraphy (subdivision and correlation of geological sedimentary sequences), Menner encouraged always the use of stratigraphic data for revealing natural stages in geological evolution of the Earth. It is not incidental that he repeated often that stratigraphy is a part of historical geology. In his opinion, any stratigraphic scheme is a reflection of the past history of a paleobasin and its biota. In fact, he called to the study of fossils on the ecosystem base. He was an ally of V.I. Vernadsky ideas of studying living matter in different ecosystems and the biosphere as a whole.
Recently, the Vernadsky's doctrine of biosphere is gaining a worldwide appreciation. Many of its concepts are used in practice of scientific research. For example, we became aware that processes in biosphere are permanent and irregular, that laws governing development of living and inert matter are different, that the organic self-development is nonlinear, etc. At the same time, the living matter is specific, possessing a high adaptability to environments, a high rate of evolution, etc., and we can define important functions of organic communities (energy, transport, destructive, environment- forming, informational, and others). Different-scale closed, semiclosed, and open ecosystems represent main domains of the biosphere. Ecosystems tend to retain their structure and functional properties (stability, elasticity, plasticity, and others) under influence of external factors. Special attention is now paid to coevolution (a directness in development of different bio- sphere domains) and synenergetics (coordinated action of many elements of a system). At the same time, it appeared that the universal property of ecosystems is their emergent evolution (properties of a system are not a simple sum of its constituting elements).
Of extreme importance for stratigraphers is secular evolution of the biosphere and ecosystems, which is primarily reflected in succession of biotic communities. Recent attempts are aimed at defining specific factors, the so-called selectogens responsible for the directed evolution. Some of them (autogenetic) are responsible for directions of phylogenetic changes, while the others (ectogenetic) control changes along the evolutionary axis, e.g., changes in density of populations, their distribution, and others.
Developing his doctrine of the biosphere, Vernadsky admitted openly that he is not a biologist and regards the life phenomena from the viewpoint of geochemistry. In other words, his concept of living matter is lack- ing biological essence (for example, a consideration of taxa development or their communities, and so on). That is why the works concerning, to variable extent, the specific evolution of biotic constituents in the bio- sphere are so important. Inherent of this evolution are stages, periods and phases of transformations in biotic communities and taxa development, which are manifested in subglobal and regional extinctions to certain extent. Menner was one of scientists who worked much on the problems of stages in evolution of the organic world, regarding them as related to development of that or another ecosystem (or basins). In this connection, he wrote in the 1950s–1960s that stratigraphy is rooted in the geological history of basins and organic world. That is why he stressed significance of paleogeographic reconstructions and paleobiogeography. It is not incidental that he referred often to experience of A.P. Karpinsky, A.D. Arkhangelsky, N.I. Andrusov, R.F. Gekker, V.P. Kolesnikov, and others in relevant investigations. Being interested in achievements of hydrobiology (works by L.A. Zenkevich, K.V. Beklemishev, E.F. Gur'yanova, and others), he always

recommended to use materials on recent biogeography in paleobiogeographic interpretations.
Several large paleogeographic–paleobiogeographic investigations were accomplished under supervision of Menner. For instance, these were reconstructions by Kh.S. Rozman and M.N Solov'eva for the Paleozoic, K.I. Kuznetsova and M.A. Pergament for the Mesozoic, E.D. Zaklinskaya and V.A. Krasheninnikov for the Cenozoic. Works in the sphere of paleobotany (V.A. Vakhrameev, S.V. Meyen, and others) and Quaternary geology (V.I. Gromov, K.V. Nikiforova, and others) were of the same significance for him. Menner himself was the editor of the *Atlas of Lithologic-Paleo-*
geographic Maps and other publications on this theme. Menner comprehended well that stratigraphy of the terminal 20th century, being busy with traditional investigation of stratigraphic units and their boundaries, turns progressively to understanding the stages in geological development of the Earth and biosphere. This tendency was subsequently realized in new ideas of "dynamic" or "biospheric" stratigraphy. At present, many geologists consider stratigraphy as a record of past biospheres and their states, or of past ecosystems in the regional sense. In practice, this leads to development of stratigraphic schemes of a new generation and
even to works on calendars of geological (biotic and abiotic) events coordinated with the chronological scale, or to compilation of paleogeographic and paleobiogeographic maps, which depict for different chronological levels the distribution areas of biotic groups and trends of their changes with time. Of importance by such reconstructions is, besides the analysis of separate taxa, primarily, consideration of biotic communities and their changes controlled by evolutionary processes, on the one hand, and by ecological reorganizations in
paleobasins (or ecosystems), on the other. The time has come, when these reconstructions can be done based on a high-resolution stratigraphic scale that was impossible 30–40 years ago.
One more point to be added. We witness development of different stratigraphic aspects associated with the system analysis. Many researchers comprehend that operational principles of stratigraphy are consistent with the general system laws. As a whole, the hypergene geosphere of the Earth is possessing all the features of system organization. All its systems develop in a cyclic and irreversible discrete-uninterrupted manner.
By the way, precisely the system analysis offers a new approach to interpretation of stratigraphic units and their boundaries. From this standpoint, the stratigraphic unit encompasses sediments deposited during the period, when a system was in the state of dynamic equilibrium, while the unit boundaries correspond to records of events responsible for replacement of one quasistable state of the system by another.
Among well-known scientific figures of the Geological Institute such as N.S. Shatsky, A.V. Peive, A.L. Yanshin, and N.M. Strakhov, Menner is at a merited place. He was in fact a founder and leader of scientific stratigraphic school in the Geological Institute, had simultaneously a great prestige in the country and abroad. He was one of the most prominent figures in the International Union of Geological Sciences in the past century. Menner will be always in our memory as an outstanding scientist, talented science manager, excellent teacher, and splendid decent person. It is undoubted that his scientific ideas will be alive in the future.

1971 European Micropaleontological Colloquium. The first time I met Academician Menner was in USSR, when for the first time the European Colloquium was organized beyond the "iron courtain". Purpose of the meetings was to run a series of excursions led by local experts to sample classical localities. Each participating country had a fixed number of representatives, and the program was run in Crimea (for the Mesozoic with special reference to the Cretaceous and for the Paleogene) and Moldavia (for the Neogene and Quaternary). Everything was strictly organized by INTOURIST, including visa, prepaid air tickets, vouchers, etc. I could not leave Milano with my numerous Italian collegues because of a family gathering that I could not miss (my parents 50 wedding anniversary). Arriving in a very foreign country all by myself without any previous experience in Russia was quite an adventure, including the transportation from the International Airport to the National one, the departure in the middle of the night with a subsonic Tupolev with only two passengers, the arrival to Simferopol under a hurricane, the reunion with the group just in time to start for the excursion to the area of Bakshisharai. Menner was there to guide the large group that included all the big names of the time.
We saw and sampled beautiful sections straddling the Cretaceous/Tertiary boundary, met a number of Russian collegues, visited Yalta, had an excursion on the Black Sea, transferred to Kischiniov in

Moldavia to visit Neogene outcrops and the Dnieper Valley. The micropaleontological school was very strong in Russia and names like Rausser-Chernoussova for the Paleozoic, Subbotina for the Cretaceous, Krasheninnikov for the Paleogene were well known worldwide, notwithstanding the enormous difficulties of communications.
Menner seemed like a shepard in the field, and gave excellent explanations on whatever subject. This happened just one year after DSDP Leg XIII, the first deep-sea exploration of the Mediterranean, and although nothing was published yet, Academician Menner was well aware of the Messinian salinity crisis and the deep basin desiccation model. So, when I and Ted Barr, who was investigating the possible origin of the Sahabi channel in Cyrenaica, asked if it was at all possible to meet with Ivan Choumakov in Moscow, where we stopped on the way back to our countries, he was extremely helpful and interested. With an official limousine we went with him to the Academy of Sciences, at the Geological Institute where we met Choumakov, the geologist who studied the location of the Assuan dam crossing the Nile river 1200 km upstream of the delta. He showed us the geophysical and drilling data that brought him to conclude that the Mediterranean sea level had to be at least 1500 m below world wide sea level prior to the Pliocene, in order to explain the exceptional erosion recorded in the substrate. So, I was impressed by Menner's knowledge, by the open mind he showed in this controversial issue.

1975 Bratislava. Neogene Commission/Committee for Mediterranean Neogene Stratigraphy. Academician Menner was chair of the International Commission on Stratigraphy and formalized SNS, with Raimondo Selli as first chair.
Big congress with hundreds participants. Parterre de rois. Organization very formal. No oral or poster presentations. Like a convention, with working groups meeting separately or jointly in a very politically oriented way. We were at a time really critical for the transition from the Lyellian style of defining the Neogene stages on the basis of the percentage of species present in the various fossiliferous localities existing in the Museums or University collections versus the extant ones to the modern style followed by CMNS to work on measured sections from continuous, open marine, pelagic facies successions containing microfossils (essentially calcareous plankton). After negotiating with him and finding some difficulties, finally I succeded to have two oral presentations (one by Nakagawa, Niitsuma, Kitamura et al.) who did a very detailed field work in northern Italy on the classical sections of the Langhe and northern Apennines to detect the magnetic reversals, and one by Ryan and co-workers who interpreted these data and correlated the paleomagnetic reversals and datum planes identified in various microfossil groups by the first continuously cored successions of the equatorial Pacific.
I was just starting with the IGCP Project 96 "Messinian Correlation" and thought it was important for the audience, that largerly consisted of scientists from the eastern countries, to be acquainted with a multidisciplinary approach to stratigrtaphy, with physical methods helping to precisely correlate the pelagic successions.
Once again I highly appreciated Academician Menner's attitude of a modern oriented, knowledgeable, open minded scientist, and a strong personality.

1983 Moscow. INQUA Congress. Menner was chairing ICS. Nikiforova was the project leader of IGCP Project 41 "Neogene/Quaternary boundary".
After several years ofresearch and after studying three possible positions for the Neogene/Quaternary boundary, all positioned in correspondence with a reversal of the magnetic field: Brunhes/Matuyama, Olduvai, Gauss/Matuyama, the voting commission decided for the second option, with the GSSP located in the Vrica section of Calabria (southern Italy). I was staying in the students lodgements of the Lomonossov University, where other Italian collegues like the

vertebrate paleontologists Azzaroli and Torre from Florence, and the geomorphologists Coltorti and Cremaschi were staying, and one day I received a formal invitation to join Academician Menner's home for dinner. I was escorted by Yuri.. (I do not remember his family name, but it was not Gladenkov).. It was not really close, but at a walking distance and we went along the alley bordered by apple trees to the apartment house occupied by government officers. Large, comfortable but without elevator.
V.V. Menner and his family were exquisite hosts. Other guests were Paul Choubert and Anne Faure Muret from Paris. It was a fantastic party with a dinner table prepared with old family silverware and crystalware, porcelain and broidered linen. After the first part of the meal with delicious appetizers and various dishes, we were invited to move to the drawing room for a drink. Then we moved again to the dinner room, where everything started with a new table cloth, new dishes and silverware... The dinner lasted over two hours, and the conversation was of outstanding interest. There I learnt that Menner and Choubert were school mates and grew together until when Choubert's family decided to move to France, at the time of the revolution. Whereas Menner remained. He was born in Russia but his father was from Germany. The father was an engineer, and was called to build the Transiberian railway. A pioneer work, very difficult and hard, requiring exceptional intellectual and physical capacities. So the Russian Choubert and the originally German Menner, both very successfull in their career as geologists, maintained a close, friendly relationship for a lifetime. Choubert and Faure Muret are worldwide known for the exploratory work they did in Morocco, especially in the High Atlas. They mapped these unexplored areas when there were no roads yet, and helicopters were not used for geological mapping.

These are the memories I have of Academician V.V.Menner, an outstanding personality, an excellent organizer and a respectable scientist.

Maria Bianca Cita

6. GSA'S BEST REFERENCE WORK AWARD ASSIGNED TO "GEOLOGICAL TIME SCALE 2004" (GRADSTEIN ET AL.)

From: iugs.secretariat@ngu.no
Subject: **IUGS Bulletin #17**
Date: October 27, 2006 2:55:06 PM GMT+02:00
To: maria.cita@unimi.it

The International Commission on Stratigraphy - ICS - has produced an electronic version of the international standard Cenozoic-Mesozoic-Paleozoif bio-magneto-sequence time-scale charts. This Java package,called TS-Creator, can be freely downloaded from www.stratigraphy.org and from http://norges.uio.no. The undertaking was funded by industry, CHRONOS and the NORGES Project. Details of this popular piece of geo-software may be found with the actual program, in Geoarabia vol. 11, no.3 (2006), and with a forthcoming issue of Episodes.

We are also pleased to report that during the Geological Society of America's Annual Meeting and Exposition in October 2006, the ICS will be presented the "Answari Award" from GSA's Best Referente Work Award Committee for their work "Geologic Time Scale 2004" (Gradstein et al.) Congratulations on this achievement!

7. NEW WORKING GROUP ON LITHOSTRATIGRAPHY APPOINTED

Following long negociations and a meeting held during the annual convenction of GSA on October 25, 2006 a strong Working Group has been appointed with Brian Pratt (Canada) as WG leader, and Stan Finney (USA), Werner Piller (Austria) and Mike Easton (Canada) as members. Their combined experience in sedimentary and metamorphic successions, and their willingness to offer their expertise to the success of the ISSC project on "New Developments in Stratigraphic Classification" are highly appreciated, and gratifying.
We just look for a prompt start!

8. BOOKS RECEIVED

Erlauterung zur Stratigraphischen Tabelle von Deutschland 2005 (ESTD 2005). Manfred Menning and Andreas Hendrich Editors. Newsletters on Stratigraphy, volume 41, no. 1-3, 405 pp. (in German)

Stratigraphic code of Russia. Third edition. Appproved by Interdepartmental Stratigraphic Committee of Russia Octoober 18, 2005, 95 pp.VSEGEI Press, St. Petersburg, 2006 (in Russian)

9. PAPERS RECEIVED

Cita Sironi M. B., Capotondi L., and Asioli A., 2005. The Tyrrhenian stage in the Mediterranean: definition, usage and recognition in the deep-sea record. Rend. Fis. Acc. Lincei, s. 9, v. 16, pp. 297-310.

Cita M. B., Capraro L., Ciaranfi N., Di Stefano E., Marino M., Rio D., Sprovieri R., and Vai G. B.. Calabrian and Ionian: A proposal for the definition of Mediterranean stages for the Lower and Middle Pleistocene, 2006. Episodes vol. 29, no. 2, p. 107-114.

Menning M., Alekseev A. S., Chuvashov B. I., Davydov V. I., Devuyst F.-X., Forke H. C., Grunt T. A., Hance L., Heckel P. H., Izokh N. G., Jin Y.-G., Jones P. J., Kotlyar G. V., Kozur H. W., Nemyrovska T. I., Schneider J. W., Wang X.D., Weddige K., Weyer D., Work D. M., 2006. Global time scale and regional Stratigraphic reference scales of Central and West Europe, East EEurope, Tethys, South China, and North America as used in the Devonian-Carboniferous-Perrmian Correlation Chart 2003 (DCP 2003). Palaeogeography, Palaeoclimatology, Palaeoecology 240, p.318-372.

Salvador A., 2006. The Tertiary and the Quaternary are here to stay. AAPG Bulletin, v. 90, p. 21-30.

10. LAST MINUTE ARRIVAL: BIOSTRATIGRAPHY. A PROGRESS REPORT BY J. THIERRY

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Since the presentation of the preliminary outline on « Biostratigraphy - concepts and applications » in the I.S.S.C. Newsletter n° 9 (p. 8-9) in June 2006, 20 colleages have sent comments and suggestions to Maria Bianca Cita who forwarded all to the Biostratigraphy Working Group leader. I thank all them for the interest they have to biostratigraphy. All comments and suggestions has been considered with attention and the majority will be taken in account to improve the first version of the full text which is in preparation.

To inform them and the whole members of the I.S.S.C., I indicate below (*in italics*) in a classified digest which follows the sections of the biostratigraphy outline what would be modified and exposed.

General comments and suggestions on « Biostratigraphy » discipline and about the biostratigraphic outline itself.

- Following the proposal of the I.S.S.C. Chairwoman M. B. Cita, the full text on Biostratigraphy, like all approaches in stratigraphy, which sections are in progress below the responsability of Task Group or Working Group leaders (Lithostratigraphy, Sequence stratigraphy, Chemostratigraphy, Chronostratigraphy, etc ...), will not fit the model of a guide to stratigraphic classification. Rather it must fit a textbook on various aspects of stratigraphy. The section on Cyclostratigraphy, recently proposed by A. Strasser, F.J. Hilgen and P.H Heckel, can be considered as a model to reach a consensus for the several sections. The target is to produce an opus on the various aspects of stratigraphy which would made changes to the existing International Stratigraphic Guide but which must not replace the existing International Stratigraphic Guide.

- Many colleagues consider that such contribution has to emphasize that biostratigraphy is to be considered as the superclassical fundamental branch of stratigraphy and by far, the most important geochronological method to be used both for regional and global dating.

- One of the biggest sticking points to be clearly explained must be what is Biostratigraphy and what is Chronostratigraphy. Subsequently, Biostratigraphy and Chronostratigraphy sections must have a similar outline, and subsequently Biostratigraphy section must focus more on methods than unifying concepts.

- Biostratigraphy section must forget about the superclassical fundamental branch stuff. It has to concentrate on why and how this approach helps to sustain each branch of stratigraphy, for instance Sequence stratigraphy, as being the measuring tool of local basin analysis, because any interruption in deposition can and has dated the sequence of events needed by many geologists.

- The Biostratigraphy Working Group is not yet complete. Comments suggest that it is strongly recommended to appoint a working group of 3-5 qualified scientists, widely international and possibly including I.S.S.C. members to provide case-studies. Following that, the leader is taking care that its members would represent a panel of countries and prominent biostratigraphers,

specialists of different fossil groups, in order that the « Guide » would not be seen as a « European Guide ». This potential perception problem has to be taken seriously.

1. Introduction.

- Brief historical overview on biostratigraphy.

- The text ratio between the historical overview and the today biostratigraphy will be balanced.

* From the birth of biostratigraphy to the mid 20th century :
  survey of macrofossils and their prominent part as fossil-index.

- Concerning the birth of biostratigraphy it will be briefly discussed on the origin of the biostratigraphic approach and about the « pioneers », their concepts and results in biostratigraphy, until the fourties.

* The second half of the 20th century :
  publication of the « Guides » and codification of biostratigraphy ; construction of numerous zonal schemes ; microfossils in biostratigraphy and the rise of micropaleontology in the petroleum and academic research.

- For the second half of the 20 th century until the eighties, it will be likewise briefly refered to the previous two « Guides » or other « Codes » instead of going into detail in this matter. But, it seams necessary to point out : on the one hand, the multiplicity of zonal schemes which arose during that time, based on numerous fossil groups including microfossils ; on the second hand, the rise of micropaleontology and its prominent role in petroleum and academic research, in parallel with the macrofossil zonations.

* To day situation of biostratigraphy :

- Covering approximatly the last two decades, today biostratigraphy will mainly concern the correlations between various fossil groups zonal schemes (and other approaches in stratigraphy ?) which allow parallel zonal schemes and « integrated biostratigraphy » ? (see below section 4)

- Evolution of concepts and methods
  * From Classical (descriptive) Biostratigraphy to Quantitative (logical and statistical) Biostratigraphy.

- This section will be written according to the classification of the several biostratigraphic approaches described in the second part of section 2 (see below).

* To day current use and procedures in biostratigraphy.

2. Concepts, methodologies and kinds of biostratigraphic approaches and units.

- Comments on this section emphasize problems if trying to group methods into « logical » and « statistical » ; as an example, graphic correlation is not a « statistical » method, and neither it is a « logical » method. So, it is suggested to divide this part into « Qualitative (classical) methods » and « Quantitative methods ».

« Quantitative methods » would include the following techniques, unitary associations (Guex and Alroy methods), graphic correlation, multivariate methods, probabilistic methods (ranking and scaling), and constrained optimisation (Sadler's method), with a brief account of the functions (correlation, ordination, subdivision, etc ...) and units produced by each. As far as possiible, the working group will follow such valuable suggestions.

- Biostratigraphic units of the Classical biostratigraphy.
  * Biozone, the basic unit of biostratigraphy : definition of different kinds of biozones.
  * The biozone and the expression of time.

- It has been remarked that many biostratigraphic zones are diachronous ; it is sometimes true, but this depends on the fossil group on which are based the so called zones. Such a problem will be evoked and discussed in this section.

- Of course, the biostratigraphic units defined in the several « Guides » and « Codes » are strictly descriptive units without time implications, and once time relationships of rocks bodies defined on biostratigraphy are considered, then one is dealing with chronostratigraphy. This is one of the most important points to be discussed either in this section and working group or in the chronostratigraphic ones. When are we (possibly ?) crossing the threshold between biostratigraphy and chronostratigraphy ? When are we approximating (possibly ?) a real expression of time ? ... if not with integrated stratigraphy ? (see below suggestions for a section devoted to integrated stratigraphy).

* Use of different kinds of biostratigraphic units

- Several comments point out that Acme Zone, Abundance Zone, Lineage Zone, Concurrent Range Zone and so on are, and were, almost never used. Even the drawings in both the « Guides » and « Codes » showing spindles, phylogenies and stratigraphic ranges portray conceptually different things.

So, here is the place for them to downplay the various kinds of zones, especially the rarely used types of biozones that reside in the « Guides » and « Codes ». Some are forced and rather contrived attempts at finding biozonal indicators, and nowadays would not make much sense given how much more we understand of paleoenvironmental settings.

Finally, it is suggested by several colleagues that these types of biozones can be mentioned only in the historical part, and not here, but the chapter should focus on what has proven to be the most useful and meaningful methods. The working group leader assk colleages to send him references where different kinds of biozones are clearly defined using different fossil groups. Considering the answers, a decision will be taken.

This section would be too the right place to treat briefly but adequately special aspects of biostratigraphy as mammal ages, pollen zones, etc ..., discussing their global versus regional or local (basin-wide) significance.

- Biostratigraphic units of the logical biostratigraphy.

* Definition and use of Unitary Associations and biochronozones.
* Relations and comparison with classical biostratigraphic units.

- Biostratigraphic units of the statistical biostratigraphy

- It is pointed out that some people have explored statistical biostratigraphy (e.g. P. Sadler) but in reality it seems to several colleagues that, for the most part, the practical biostratigrapher who has used that sort of thing works on what is there rather than what might be there or what should be there, but has not been found yet, etc ... Statistical treatment would not work without regard to the facies. Some very fine case studies are out there (it is suggested to ask to R. Cooper for Ordovician Graptolites).

* Overview of Graphical, Semi-empirical, Probabilistic and Multivariate methods.
* Relations and comparison with classical biostratigraphic units.

3. Case studies

Alike in last June, case studies are not yet selected. The following comments have been proposed for this section :

- Case studies must be focused in regional and global biozonal schemes.

- Some colleages appreciate the proposal to illustrate the four eras which suggests that Quaternary is an Era, a fully historical and justified rank.

- As far as Palaeo-, Meso-, and Cainozoic are concerned it is correct that biostratigraphy is unavoidable for GSSPs. The question, for the Quaternary and its subdivisions, neither GSSP nor biostratigraphy are unavoidable (may be useful but not necessary).

- It would be an idea to use major fossil groups (e.g. graptolites, conodonts, ammonoids, forams, etc ...) rather than examples from each era. Also, the examples should offer inter-continental correlation, because this becomes much more self-testing, rather than the much easier single basin or single continent treatment acceptable (?) for stratigraphic techniques of more recent vintage.

- In the examples (say e.g. for Permian and Triassic conodonts) due attention is paid to way the studies are integrated with many other enviromental parameters and chemostratigraphy, etc ... But perhaps instead there should be an « integration" article for all these different themes ? What about Biostratigraphy and event stratigraphy ? Surely ? And there are several other fields that could be included.

- Case studies help in utilisation of bio- and all other stratigraphies ; but these studies would make (possibly) the I.S.G. too voluminous, and in spite of this they can be only examples and those who are willing to convert the examples into practice they shall look for more complete papers or books.

The working group leader appreciates all these constructive comments ; as far as possible, the majority of these will be taken in account in the first version of the full text.

4. Biostratigraphy facing other kinds of stratigraphy

This section has been highly debated.

Someones don't agree to put it here, asking to strongly modify or delete this part from the biostratigraphy chapter :

- Section 4 may destroy the consistency of our guide because no other stratigraphic method will include a comparable section; section 4 should be deleted because it mixes methods under the title « Biostratigraphy ».

- It appears that the paper will not be restricted to biostratigraphy but instead will include chronostratigraphy. Same remark for the entire last section with headings such as « Biostratigraphy and Geochronology », « Biostratigraphy and Chronostratigraphy », etc ... It should be necessary to delete this section.

- What the heading means ? but presume that it is referring to the interface between biostratigraphy and other stratigraphic methods. Nor do I understand the meaning of several of the sub-topics in this part. Did these parts and subtopiccs to be deleted ?

- Someones do not agree with expressions (Point 4) such as: « the ever up-to-date relative dating... », « the still obvious calibration ... », « the necessary estimation of the duration... », « the necessary calibration of ..., « the unavoidable part of ... ».

These expressions will be deleted.

On the contrary, others suggest to preserve and complete this section ; someones propose to change its title or to create a separate section called « Integrated Stratigraphy » :

- This section is where stress can be laid on the value of integrated stratigraphy - the integration of a range of techniques and data. This would be a relevant topic for the guide.

- Add correlation between biostratigraphy with chemostratigraphy.

- Suggested additions: biostratigraphy and chemostragraphy; biozones and isotope excursion events.

- In this part, biostratigraphy will be compared with other kinds of stratigraphy even with the geochronology. Nevertheless as geochronology is not stratigraphy, put the comparison of

biostratigraphy and geochronology as the last one, following the comparison of the biostratigraphy and chronostratigraphy.

- The numerical calibration of the global time scale is an integration of radio-isotopic data and orbitally-climatically induced sedimentary cycles. Those time indications are combined mainly by biostratigraphic and magnetostratigraphic means. After numerical calibration of a time scale (global, regional) the duration of biozones (global, regional) can be estimated.

- Part 4 is a little confused as different methods are mixed together. I suggest restricting the paper on the biostratigraphic methods only, and adding a new chapter titled « Integrated Stratigraphy » in which the various stratigraphic methods are compared, integrated and correlated with the aim to create Time Scales.

- We need a chapter on « Integrative Stratigraphy » which we are using to create a) Time Scales and b) Global Correlation Charts and Regional Correlation Charts (e.g., the DCP 2003). Regional Correlation charts are the most important tool for many stratigraphers.

* Introduction.
* Biostratigraphy and lithostratigraphy.
* Biostratigraphy and sequence stratigraphy.
* Biostratigraphy and chemostratigraphy :
* Biostratigraphy and cyclostratigraphy.
* Biostratigraphy and chronostratigraphy.
* Biostratigraphy and geochronology.
* Conclusion: Regional and Global Correlation Charts ; pluri-calibration of the Geological Time Scale.

5. Glossary

Somebodies require a glossary explaining the significance of the major terms commonly used by biostratigraphers plus simple concepts.