

**INTERNATIONAL SUBCOMMISSION ON
STRATIGRAPHIC CLASSIFICATION (ISSC)**

OF

**IUGS INTERNATIONAL COMMISSION ON
STRATIGRAPHY**

CIRCULAR NO. 93

MAY 26, 1998

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I. SHORT VERSION OF THE GUIDE

In ISSC Circular No. 92 a final draft of the abridged version of the International Stratigraphic Guide was included. Only a few additional comments were received plus some remarks included in the ISC Consolidated Annual Report for 1996 (see below). Some of them would imply changes that go beyond the project of publishing just a short version of the last edition of the International Stratigraphic Guide (ISG). Therefore, they should be considered in order to open a discussion on the need to update parts of the ISG. A. Salvador and M. Murphy have polished the last draft of the ISG abridged version as needed and contacted GSA to see if they want to publish it. The co-editors of the GSA Bulletin seem to be favourably inclined to publish the abridged Guide in the GSA Bulletin, but a final decision has not yet been reached.

I. Chlupac

The section added by M. Murphy and contained on page 6 of the Appendix A seems to be useful and I fully agree with its incorporation in the Short version of the Guide. The Section 4B7 on page 12 of the Appendix A may be left as it is.

I.G. Sapunov

About the two items in the short version of the Guide in which is still some disagreement my position is the following:

(a) I think that the added by Mike Murphy terms give more punctuality and stability in the nomenclature and classification. Nevertheless that these terms are not included in the second edition of the Guide.

(b) About holo-, para-, lecto- etc., I wish to add the following: if we use holo-, lecto- and neostratotype, we should use not only parastratotype which corresponds to holostratotype, but also paralectostratotype and paraneostratotype which correspond to lectostratotype and neostratotype respectively.

F.F. Steininger

Appendix A, p. 6: For me it is o.k. to include Mike Murphys additional comments.

Appendix A: p. 12: I would leave the explanations as they are written here.

Further comments to Appendix A:

Perhaps this opinion could be added in Chapter 1 under F. Alternative or dissenting views:

Chapter 2: B. Categories of Stratigraphic Classification

In my opinion one should not take Chronostratigraphy and Geochronology together with Litho-, Bio-, Magneto- and other Stratigraphies which can be used for correlation of rock bodies. For me all these stratigraphies should be treated under a separate heading like Correlation Stratigraphies or Methods and also Chronostratigraphy should be treated under its own heading.

Chronostratigraphy and Geochronology have nothing to do with correlation - here we have a sort of measure for earth history expressed by the touchable rocks in geologic sections where we define the boundaries of these units by GSSP's (= Chronostratigraphy, these units are for me like the "primary meter" in Paris), the other expressing the time per se of these Chronostratigraphic units (= Geochronology). Neither Chronostratigraphy nor Geochronology have any correlation method for its own - I only can correlate or try to correlate all rocks units existing on earth to chronostratigraphic units and express by Geochronologic means the time it has taken to accumulate a certain rock body. Correlation is done by Litho-, Bio-, Magneto- and other such methods - but there is not special method which can be said is chronocorrelation.

If one would separate Chronostratigraphy from the other methods of correlation the guide would become much better understandable as I have experienced by teaching stratigraphy for a long time.

See paragraph D in Chapter 2, Chapter 9: paragraph B.1. and especially B.2. as well as D.1. and H.1. (here especially you refer to all what I stated) where this what I stated above is somehow expressed, in contrary to Chapter 3:A. Definitions and 9. Correlation: where the guide is talking about chronocorrelation in the same sense as biocorrelation, lithocorrelation etc. Can you tell me the method of doing chronocorrelation per se without litho- or biocorrelation, etc.?

Chapter 5: Lithostratigraphic Units:

Here I would add always the word lithostratigraphic:

A.: ...and their lithostratigraphic relations (not stratigraphic), the same in B.2. and B.3.

Chapter 7: Biostratigraphic Units:

Here one should add that all definitions of biostratigraphic zones (not only names but obviously also their ranges) are to be changed if the taxonomic resp. systematic concept of the taxon changes. This should especially be added in: D.2.; D.2.a. here in iii.; D.2.b. here in iii.; D.3.c. (I think that even the names used here as an example are already to be changed); D.4.c.; D.5.c.; D.6.c. and H.

Another problem in Chapter 7:

D.4. Lineage zones: a: it is dangerous to state that those boundaries approach the boundaries of chronostratigraphic units - that mixes (1) again the concepts of biostratigraphy as a correlation method with chronostratigraphy and further more also lineage zones depend on a biologic concept and changes from one taxon to another have always a certain time span involved and are not isochronous as we think boundaries of chronostratigraphic units are. I would just leave that sentence out.

b: Boundaries: in taxon range zones we have an empirical defined: first occurrence (FOD), however in lineage zones we have the evolutionary first appearance (FAD) of taxa as a very important difference between these two schemes of biozones! One should change that at least here in the short version - every biostratigrapher would tell you this.

I. To but generic names and quotation marks (see "Rotalia" beccari Zone your example) is dangerous - you are not consistent any more with what you have told before about changing of taxon names by Zoological and Botanical Nomenclature.

Chapter 9, C.2.b.: why preferable marine - this I would skip we know and use a lot of continental chronostratigraphic terms.

I also disagree strongly with the second paragraph about stages and their boundaries: at least starting with the Oligocene we have besides the Mediterranean Stages a lot of stages especially in the Paleogene and the Neogene created for the need in different geodynamic settings all over the world. For example a Messinian Stage is more or less useless in New Zealand, etc. So there is no use in Paleogene and in the Neogene of a "world wide stage concept". And by experience stage units of various stage concepts cross all the time the boundaries of higher ranking chronostratigraphic units. What is stated here should be taken into account for Series/Epoch Boundaries and higher ranking chronostratigraphic units. I just would leave out this entire paragraph.

In part D.1.: world wide is never possible for stages. See also my remarks to Appendix C in this relation.

These remarks on the Appendix C also relate to p. 38, Table 4. Here I object again against the continuous ignorance of our agreement with Prof. Cowie years ago not to use the terms TERTIARY and QUATERNARY any more (see my reasoning to Appendix C). There is no scientific reason for keeping it. If you are interested we can again write you an endless scientific statement, beginning with the historic facts about the definition the Neogene by Hoernes who already included in 1853 the Quaternary in the Neogene.

Besides there are some numerical ages which have to be changed according to our latest results for the Paleogene and Neogene: see also Berggren et al. 1995: C/T-Boundary: 65.00 Mill.Y.; Pliocene/Pleistocene Boundary: 1.8 Mill.Y.

Chapter 10:

In this chapter one should differentiate between Chronostratigraphy and Geochronology and the other stratigraphic correlation procedures.

Chronostratigraphic units: Here in the paragraph on Chronostratigraphy you should not mention magnetostratigraphy in the same context as litho-, bio- and others. In my opinion magnetostratigraphy is the only method which can provide synchronous time levels - I just would skip it here because in the third paragraph behind this you also express this opinion.

Again: the following paragraph on Chronostratigraphic units speaks for itself and justifies my opinion that chronostratigraphic units should be treated apart from all the other stratigraphic units - this would make everything much easier to understand.

ISC Consolidated Annual Report for 1996 (attached to ISC Circular 1997-2 of April 16th, 1997)

Revision of certain points would be desirable. In the ISG there is sometimes confusion between nomenclature and terminology and the chapter on magnetostratigraphy should be rewritten in order to take into account important publications as the one of Hailwood (1989). Also the "new" subdivision of the Proterozoic, ratified by IUGS in 1989, should be included.

II. SEQUENCE STRATIGRAPHY

The WG on Sequence Stratigraphy has been quite active. Amos Salvador, Co-Chairman of the WG has distributed Memo 7 (Feb. 8, 1997), Memo 8 (August 15, 1997) and Memo 9 (Jan. 12, 1998). He also maintained an exchange of letters and information with N. Morton, Convenor of a Working Group on Sequence Stratigraphy of the International Subcommittee on Jurassic Stratigraphy.

Most comments by ISSC members to Appendix B of ISSC Circular No. 92 have been sent to the WG on Sequence Stratigraphy. A few are included below.

A progress report on the activities of that WG, prepared by A. Salvador is included as Appendix A. ISSC members are encouraged to comment on these or other matters concerning the classification and nomenclature of unconformity-related stratigraphic units.

Send your comments to: Amos Salvador, Department of Geological Sciences - C1100, The University of Texas at Austin, TX 78712, USA. Fax: 512 471-9425; E-Mail: amos.salvador@mail.utexas.edu (with copy to the ISSC Chairman).

A. Brakel

Existence of a WG in Sequence Stratigraphy "is of particular interest to me because AGSO (Australian Geological Survey Organisation) has asked me to develop a classification and nomenclature scheme for sequence stratigraphic units, for use in their national database of geological units. This database is critical to AGSO's other databases as an authority table, so there is some urgency in resolving both this matter and that of igneous intrusive units, and both must be finalized within two years".

M.R. Johnson

Few SACS (South African Committee for Stratigraphy) members have been actively involved in a practical way with sequence stratigraphy and most of us therefore feel that we are not in a position to make a meaningful contribution to the "correlative conformity" debate. Support was, however, expressed for the principle that a correlative conformity should represent an isochronous stratigraphic surface, while a single terminology for stratigraphic units bounded entirely or partially by unconformities was also favoured. Because of the practical difficulties involved in tracing correlative conformities into the deeper parts of basins the opinion was expressed that such boundaries will play

a relatively insignificant role in the demarcation of sequence stratigraphic units, thus obviating the need for a dual nomenclature. In practice the extrapolation of a conformity away from the point where an unconformity dies out is, in one member's experience, more often that not based on a preconceived model used to explain the distribution of facies in a basin rather than on hard evidence for isochroneity in the form of (for example) a tuff layer or diagnostic horizon.

I.G. Sapunov

About the five questions in Appendix B (to ISSC Circular No. 92) "Activities of the WG on sequence stratigraphy", my answers are negative, but I must note that my experience in this field of stratigraphy is insignificant.

F.F. Steininger

No comments but my opinion: either we go ahead with "Unconformity Bounded Units" or with "Sequence Stratigraphy" -doing both will create lots of misunderstandings! Since one has - against a lot of reasoning before the second edition of the guide decided to publish Unconformity Bounded Units - what to do now?

III. DRAFT OF A POSTER ON GUIDELINES FOR NEW LITHO-STRATIGRAPHIC UNITS

Appendix B to ISSC Circular No. 91 of July 5, 1996, included a proposal by J.B. Waterhouse for a poster on lithostratigraphic principles. Comments and suggestions were requested then and in ISSC Circular No. 92. Thus far only one comment has been received, which is included below. The question is if there is agreement to go ahead with the poster. If so, suggestions about its presentation (size, format, etc.) and possible avenues of publication are welcome.

I.G. Sapunov

I wish to comment the following: a) In general the guidelines are beneficial, because they turn to worldwide unification of the most important procedures by introducing new formal lithostratigraphic units; b) I don't agree with paragraph "C" under the title "Name". Instead of "C" - The name is accompanied either by unit -bed, member, formation, group or dominant lithological rock type; to be "C" - The name (= toponym) is obligatory accompanied by an unit term - bed, member, formation, group (for instance: Ginci Formation). It is possibly but not obligatory, to include a dominant lithological rock type in the term (for instance: Ginci Limestone Formation, but not Ginci limestone(s); c) I propose some of the elements of the "Description" to be not obligatory, such as genesis and significance for paleogeography and geologic history.

IV. GEOLOGICAL MAP OF THE WORLD AND GLOBAL STRATIGRAPHIC CHART

Several comments were received from ISSC members on the draft of the Global Chart and questionnaire included as Appendix C to ISSC Circular 92. Those comments were sent to Prof. J. Remane, ISC Chairman, and are included below.

A new meeting of the Intercommission Working Group of ICS, CGMW and Unesco (P. Bouysse, J. Dercourt, A. Faure-Muret, J. Remane, F. Repetto and ISSC Vice-Chairwoman, M.-B. Cita,) took place on December 11, 1997 at Paris. New advances on this topic are included in this Circular under **ICS News** and in Appendix B.

I. Chlupac

The column for Subperiod/Subsystem seems to be superfluous in the chart: The Upper/Late and Lower/Early Cretaceous belongs into the column Series/Epoch. As far as I know, from the Subcommittee on the Ordovician System, the Ordovician Subcommittee accepted at its Las Vegas Meeting (June 14, 1995) the subdivision of the Ordovician into three Series divisions (Lower, Middle, Upper, see Ordovician News No. 13 - 1996). The units of lower rank (Tremadoc to Asghill) becoming, consequently, the stages. This is in full agreement with the stratigraphical praxis.

The Silurian chronostratigraphic units Llandovery to Pridoli should be of the same rank as the Devonian and Ordovician units of corresponding value and volume. It means that they should be also regarded as Stages and not Series. The units Rhuddanian to Ludfordian are markedly smaller (and of little value in praxis) and their lowering into the rank of Substages will be more practical and corresponding their relative value.

C. Holland

I feel very strongly indeed that the status of the Pridoli should not be changed. Our classification in the Silurian is now well established and in successful use all over the world. The Pridoli is of historical importance as representing that originally confused part of stratigraphy revealed by the Silurian-Devonian Boundary Committee. It is left undivided into stages at present as the time is not ripe for these. In any case, it does not matter if it remains undivided. We cannot expect uniformity of size of divisions from system to system. To place the Pridoli as a stage within the Ludlow Series would cause endless confusion in the literature.

Secondly, as our Silurian System has four series it is found to be very convenient to refer to the Llandovery and Wenlock as Lower Silurian and the Ludlow and Pridoli as Upper Silurian. These could be put as informal divisions in your Subsystem column.

M.R. Johnson

Most of the issues raised are not of concern to South Africa since we are not host to any boundary stratotypes (GSSPs) in the Phanerozoic nor were any of the units defined here. We do, however, feel strongly that "Tertiary" should not be discarded and I would also prefer to see a simple early/(middle)/late subdivision retained at series/epoch level.

Although I gather that it has been a long-standing ICS practice not to use the term "Tertiary", SACS (South African Committee for Stratigraphy) committee members feel strongly that it should not be omitted from a Global Chronostratigraphic Chart. At a recent meeting of our Task Group for Biostratigraphy similar sentiments were expressed. You may remember that in ISSC Circular No. 86 (January 13, 1993) Amos Salvador included the results of several literature searches which he had undertaken and which overwhelmingly supported the continued use of Tertiary. It was therefore retained in Table 4 (Major Units of the Standard Global Chronostratigraphic/Geochronologic Scale) in the 1994 edition of the International Stratigraphic Guide. The Geological Survey of South Africa (now the Council of Geoscience) continues to use Tertiary on all its geological maps - it would in fact be difficult to assign a Paleogene or Neogene age to many of our terrestrial Tertiary deposits. I see that the latest (3rd) edition of the CGMW's International Geological Map of Africa also retains Tertiary. I cannot see any problem with a scheme in which the Tertiary System embraces the Paleogene and Neogene Subsystems; provision is in fact made for two subsystems in the case of the Carboniferous.

A second aspect of the chart I find worrying is the gradual replacement of the simple early/middle/late (or early/late) subdivisions with names which those of us who live outside Europe and are not full-time palaeontologists are going to find it very hard to remember. For example, up to now we in South Africa have been debating which local lithostratigraphic units belong to the Early, Middle and Late Jurassic. Will we now be expected to use the terms Lias, Dogger and Malm, which are never used in this part of the world outside of specialist palaeontological literature (and may be not even there)? Although the 1989 Global Stratigraphic Chart by and large retained the familiar lower/(middle)/upper terminology for the pre-Paleogene systems, the rot has already set in the case of the Silurian!

The geological time scale compiled by Gradstein and Ogg (Episodes, 1996, v. 19, nos. 1 & 2) for the Phanerozoic conveniently includes the designations early, (middle) and late throughout. However, it would appear that they are not meant to be part of the formal hierarchy. Does this mean we must now write “late Devonian” rather than “Late Devonian”? This will be confusing, since it is current practice for Late Devonian to refer to an exact time interval (embracing the Frasnian and Famennian) whereas late Devonian has a vague, imprecise connotation.

C. Pomerol

A critical examination of recent publications relating to the stratotypes of the Paleocene stages shows that those of the Thanetian and Selandian overlap with a marginal difference of the order of 1 Ma or even less. As a result these stages cannot satisfactorily be differentiated on the type sections alone. We propose therefore to return to a bipartite subdivision of the Paleocene to include a lower or Danian stage, and an upper or Thanetian one (chosen in preference to the junior term of Selandian). The boundary between the two stages being chosen to lie approximately between the zones P2 and P3, NP4 and NP5 and Sde (=Viborg 1) and Csp (=Viborg 2) so that the stratotypes of the Danian on the one hand and the Selandian and Thanetian on the other, shall lie below and above these limits [Abstract in: Bignot G., Curry, D. & Pomerol C., 1997, N.Jb. Geol. Paläont. Mh., pp. 114-128]

A.C. Riccardi

1.1. Typography appears to be correct.

1.2. Letter symbols for major chronostratigraphic units appear to be correct.

1.3. Hierarchy: I do not agree with the introduction of the Subperiod/Subsystem column, and especially that Late/Upper should be placed there. Late/Upper should remain as Epoch/Series. One hierarchic level is enough between periods/systems and ages/stages! Thus for the Jurassic we should have the Early/Lower, Middle/Middle and Late/Upper Epochs/Series as it has been usually used for the last 30 years. We do not need Lias, Dogger and Malm. In this sense the 1989 GSC is superior.

A. Salvador

The elimination of the Tertiary is inconsistent (why not eliminate also the Quaternary?) and utterly unrealistic: geologists all over the world will continue to use “Tertiary” no matter what the ICS proposes.

To me, terms in any terminology are just means of communication. If a term is used extensively throughout the world, if it is used consistently with the same meaning, and if the term means the same thing to everybody, the term is obviously useful and should be considered a valid and formal term. “Tertiary” is used extensively and with the same meaning, both its base and top have been properly defined with boundary stratotypes approved by the ICS, and should, therefore, be part of the formal stratigraphic terminology. If even more reasons are needed, the Guide recommends the preservation of traditional and well-established terms.

The ICS should not try to dictate what terms stratigraphers throughout the world must use. It can recommend certain terminology, but ultimately the stratigraphic terminology should be determined by the test of usage through the passage of time. And there should be no question in anybody’s mind that the term “Tertiary” is universally used in stratigraphic work.

I summarized the evidence for the extensive use, worldwide, of “Tertiary” in geological publications in ISSC Circular No. 86 of January 13, 1993. I had searched time charts, geologic maps, 18 widely read geological journals, and GEO-REF (a geological literature database compiled by the American Geological Institute) for the use of “Tertiary”, “Paleogene”, and “Neogene” from 1980 to 1992.

I have now searched GEO-REF again, this time for the years 1992 to 1997 (inclusive). Following are the results:

* Number of times that the terms appear in the title of about 50,000 publications that GEO-REF incorporates:

Tertiary: 1,547
Paleogene: 449
Neogene: 875

This does not indicate, however, if “Paleocene” and “Neogene” are used by themselves, as systems of the Cenozoic, or as subdivisions of the Tertiary System.

* Number of times that the terms are used as descriptors (indexing words in the publications as chosen by GEO-REF indexors):

Tertiary: 18,351
Paleogene: 7,520
Neogene: 9,233

The extent of the use of “Tertiary”, “Paleocene” and “Neogene” correspond fairly closely to that previously recorded for the period from 1980 to mid-1992.

* In addition, I search this time for the number of times that the terms had been used in the titles of books published from 1992 to 1997:

Tertiary: 342
Paleogene: 75
Neogene: 227

The Tertiary/Paleogene and Tertiary/Neogene ratios vary from 1.51 to 3.44, essentially as for the period 1980-1992. And no evident increase or decrease of the use of “Tertiary”, “Paleocene”, and “Neogene” could be detected when looking at the numbers year by year.

I did not go this time over individual issues of specific journals to record the number of times that “Tertiary”, “Paleogene”, and “Neogene” appear in the title of papers, in time charts, stratigraphic sections, or in legends of maps or cross sections, but from the frequent use of many journals in the course of my work, I can say that “Tertiary” is still in very common use.

In view of this evidence, it seems to me absurd to not show the Tertiary as a system in the proposed Global Stratigraphic Chart. Every major chronostratigraphic (time) chart that I have seen in the last few years, including some very recent ones, shows the Cenozoic Erathem comprising the Tertiary and Quaternary systems. It is not a question of either “Tertiary” or “Paleogene” and “Neogene”; we need them all to be able to express various degrees of precision in stratigraphic assignation and dating. The Tertiary should be a system in parallel with Quaternary. The Paleogene and Neogene should be sub-systems.

Will the proposed chart not recognize a term used in the title of hundreds of papers and books, and chosen as thousands of descriptors or keywords for these papers and books? Are these hundreds, if not thousands, of authors all over the world all be using an improper, informal term?

As I have mentioned many times before, to not use the term “Tertiary” in global chronostratigraphic charts is not only ludicrous, it is unrealistic and futile. Geologists all over the world will continue to use the term even if the ICS chart does not show it because it is considered an informal term. It is also inconsistent: why eliminate “Tertiary”, but retain “Quaternary”?

I hope that when the chart is published, it will be accompanied by a discussion and explanation of the terms used in it. This is essential.

I.G. Sapunov

Please don't use Lias, Dogger and Malm instead of Lower-, Middle- and Upper Jurassic. My point of view was good clarified several decades ago by W.J. Arkell.

F.F. Steininger

ad 1.1: you remarked under
“Informal stage names”:

“traditional European stage names can not be applied worldwide, but ...”

Agree completely with this statement, especially in the Cenozoic from Oligocene to Miocene, Pliocene and Pleistocene,

Therefore I propose for Oligocene, Miocene, Pliocene and Pleistocene (here you did it already partly) the following subdivision:

Oligocene: Early/Lower (=Rupelian) and

Late/Upper (=Chattian: who knows in New Zealand what to do with Chattian?)

Miocene: Early/Lower (=Aquitanian: nobody can tell you what that means in the Mediterranean or elsewhere besides the Bordeaux Basin and Burdigalian - the same case)

Middle/Middle (=Langhian, Serravallian)

Late/Upper (=Tortonian, Messinian - also without meaning outside the Mediterranean)

Pliocene: Early/Lower (=Zanclean)

Middle/Middle (Piacenzian)

Late/Upper (Gelasian)

Pleistocene: Early/Lower (your **M** - whatever that means)

Late/Upper (Eemian - whatever that means in China for example!)

see also your questions under 2.1.

Holocene: subdivision if necessary as above!

By doing so you would escape questions like you put in 2.2. about the Aquitanian. Especially from Oligocene upwards most of the larger basins went through a different geodynamic evolution and it is therefore that local chronostrat. stage systems are used and are best for these local efforts of correlation. Therefore my philosophy on the Oligocene and the Neogen is the opinion to define Early, Middle, Late and into this we can fit easily the local stage systems.

ad 2 and 2.1. and 2.2:

Why do you use again:

TERTIARY and QUATERNARY: we have for years cleared that situation, Cowie adopted it to dismiss these terms on the official scale published years ago and now you are going backwards again, why?

(1) These terms are old Arduino terms from the 18th century and nobody for instance uses PRIMARY anymore for the Paleozoic or SECONDARY for the Mesozoic.

(2) They do not reflect modern opinions on the chronostrat. Subdivision of the Cenozoic by Paleogene and Neogene -either forget about Paleogene and Neogene or skip - in my opinion much better - the terms Tertiary and Quaternary.

(3) We have pointed out since a long time that Hoernes, who coined the term Neogene did include all the Pleistocene in it and all the Holocene. (see our comments in the first volume on the P/N in Gior. Geol. and in Berggren et al. 1996 etc. etc.). That was also for Cowie reasoning enough to skip these two really unnecessary terms.

ad 2.3:

Selandian: see Berggren et al. 1995, (there you can find all the reasoning) should be used for lower / Late Paleocene.

ad 2.6:

I find it inconsistent to use Scythian as a Serie or Epoch and continue with Middle and Late. Why do you not forget this term Scythian!

ad 2.8:

Did you ever look at the GSSP of the base of the Carboniferous - this is in my opinion a total failure in any direction!

J.B. Waterhouse

I am astonished how imperfect our global stratigraphic chart is. The Cenozoic and Jurassic, Permian, Devonian and Silurian stand up. The rest appear to leave much to be desired. At the very least, it would appear timely for ISSC to propose an overall nomenclatural scheme, addressing the matters of subperiods (scrap them?), the preferred type of name to be used for series (rule out upper, middle and lower?), the content of stages. And yes, the possible introduction of substages. Going beyond this, perhaps we could consider that the ISSC has a potentially very useful role to play as overviewer of the entire chart. The working groups on each period of course have quite enough to do with their own period, and immediately adjoining system boundaries. Would it be timely for the ISSC as whole, or a subcommittee from within the ISSC, work with either Chairpersons, or a few selected individuals, to push the chart forward? Of course any such cooperative output need not to be considered the ultimate last word. But it might serve to focus on gaps and obvious flaws, and make some timely adjustments, and accelerate the development of a worthy time scale.

In response to questions raised in Appendix C, p. 3

Triassic

This is a bit beyond the scope I suppose of the present concern. I have a substantial 7 part series coming out on lower and middle Triassic ammonoids, (3 parts out), and point out that Ladinian, Anisian, Olenekian and Induan really stand as subseries, divided into a number stages, made up in turn of substages.

Permian

Classic European subdivisions, such as Rothliegende of Germany and Tatarian (=Tartarian) of Russia lack marine sequences and therefore are of limited use for international correlation. The Zechstein of Germany has marine faunas only in the lower part. The marine Kazanian of Russia remains a useful stage, equivalent to Wordian, but is followed by non-marine beds.

Carboniferous

Useful as the Pennsylvanian and Mississippian Subsystems are, they stand out on their own, and so it seems they will have to be abandoned for the sake of consistency. I would regard the series listed for Carboniferous as basically stages, although the Moscovian and Visean are substantial units. Much Russian work has grouped Gshelian-Kasimovian as one unit (=series?) and Moscovian-Bshkirian as another (=separate series). Incidentally I assume the split of each of these units (i.e. Gshelian, etc.) into two is a matter of form only? The Moscovian is normally divided into four, for example.

Winter H. de la R.

1. Chronostratigraphy is restricted to depositional basins on individual plates that existed during their time spans. Only the time equivalents of such basins can be correlated geochronometrically and calibrated to a close approximation on other contemporaneous plates (tectonostratigraphic terranes). Exact chronocorrelation is an ideal theoretical limit.

2. The time equivalence of a chronostratigraphic unit is called a geochronologic unit, which has a specific timespan and which can only be measured or calibrated approximately.

3. The objective of the ICS accordingly (Appendix D) may be restated as follows: "To strive towards the true global chronological order of maximally preserved (stratotype) regional lithostratigraphic units of all ages by chronocorrelation, effected by direct methods of geochronometry or by calibration to time of other categories of stratigraphy, in order to interpret and map earth history". Refinement of this mission statement should be invited and debated.

4. Chronocorrelation is not stratigraphy (ISSC Guide, 1995, p. 10). Strata are not described: only the time deduced from analysis of strata.

5. The sea-level fluctuation chart is also not a category of stratigraphy but a technique designed to link stratigraphy globally to tectonic history.

6. The mission statement (3) is not restricted to the Phanerozoic by biostratigraphy.

V. ISC NEWS

Since ISSC Circular 92 was printed and mailed the ICS Bureau distributed Circulars 1997-2 (April 16th, 1997), 1997-3 (Aug. 27th, 1997), 1998-1 (Feb. 6th, 1998) and 1998-2 (April 9, 1998). Relevant information included in those circulars is reproduced below:

ICS Bureau meeting at Neuchatel on April 11-13th, 1997.

The Bureau considered the main conclusions of the ABRD meeting (25th July, 1995) and decided to take actions on the following points:

- A list of undefined GSSPs should be created, and each should be given a deadline.

-The following new goals for the Subcommissions are suggested: Database on fossil ranges, bio-events and other events should be established, isotope and other events and sea-level curves should also become a more important place in the programs of the Subcommissions.

- The Bureau discussed the necessity of making the participation of ICS bodies in IGCP and other international research projects more visible. (ISC Circular 1997-2).

New ISC 2nd Vice Chairman

In a meeting with ICS Chairman at Beijing, Prof. Cordani proposed the nomination of Prof. Antonio Carlos Rocha-Campos, University of Sao Paulo, Brasil, as the new 2nd Vice Chairman of ICS (ISC Circular 1997-2). The ISC Bureau welcomed this proposal, as Prof. Rocha Campos has been Chairman of the Gondwana Subcommission for several years.

Guidelines for the establishment of Global Chronostratigraphic Standards.

The revision prepared by the ISC Bureau and discussed by the Full Commission was published in Episodes 19(3), pp. 77-81 (ISC Circular 1997-2).

GSSP

The IUGS Executive Committee at its January 15-18 1997 meeting ratified the GSSP for the base of the Darriwilian Stage (Ordovician System) at Huangnitang (China), the GSSP for the base of the Piacenzian Stage (Neogene System) at Punta Piccola in the Rossello section (Italy) and the new Statutes of ICS. (ISC Circular 1997-2)

The ISC Bureau has decided to establish a list of undefined GSSPs, and each GSSP should be given a deadline (ISC Circular 1997-2).

Revision of the Global Stratigraphic Chart

Concerning the meeting between ICS and the Commission on the Geological Map of the World at the end of January 1997, it was decided to have a final meeting in Paris, December 1997, to finalize the first edition of the revised Global Chart. It has been decided that every fourth year, before the International Geologic Congress the Global Chart shall be updated taking into account GSSPs defined in the meantime.

Following the previous meetings (see ISSC Circular 92, p. 6-7) a new meeting of the Intercommission Working Group of ICS, CGMW and Unesco (P. Bouysse, M.-B. Cita, J. Dercourt, A. Faure-Muret, J. Remane, and F. Repetto) took place on December 11, 1997 at Paris. As informed in ISC Circular 98-2 (April 9, 1998) a revised draft of the Chart was discussed, together with a first draft

of the Explanatory Note, established by the Chairman of ICS using the input received from ICS Subcommissions (see Appendix B). Thereafter, the final draft of the Chart was established. The lay-out was worked out by A. Faure-Muret, who used the same colours and letter-symbols as in the Geological Map of the World. This draft of the Chart was extensively discussed on the meeting of CGMW at Paris on Febr. 9, 1998. It was decided that this final draft of the Chart be recirculated in the Full Commission of ICS for a last control, together with the draft of the Extended Explanatory Note. The final document will then be worked out on a meeting of the Intercommission Boundary Working Group in June 1998, taking into account the comments received from ICS Subcommissions.

The ISC Circular 98-2, with this information, has been distributed to all officers of ICS bodies by e-mail, including its attachments 1-5 (1, reduced A4 colour-printout of the final draft of the Global Chart; 2, A3 printout of the Global Chart without coloration; 3, Draft of the Explanatory Note; 4, List of GSSPs; 5, Minutes of the meeting of the Intercommission Working Group at Paris on Dec. 11/12, 1997). Attachments 2-4 are here included as Appendix B. The final document will include the Global Chart, the Extended Explanatory Note, a list of GSSPs and selected references of publications which are important for the understanding of boundary definitions. The last three items will make up a fascicle of max. 16 pages, which means that there will be the possibility to discuss the most important of the remaining problems in international chronostratigraphic nomenclature. These problems may also be illustrated by comparative tables, although the intention is NOT to provide general correlation schemes between various regional scales. Input is also asked for the list of Selected References. Several points are worth to be considered for the Explanatory Note: As there is an obvious heterogeneity in the hierarchy of subdivisions, do we need subsystems? and should series/epochs have proper names or not?

In order to avoid further delay in the publication, it has been decided not enter in a detailed discussion of numerical ages of chronostratigraphic boundaries. The ages indicated in the Chart will in the first place be those favoured by G. Odin. This is a personal contribution. If one or the other SC would prefer to use different ages, they will be published alongside with the data proposed by G. Odin.

Comments, remarks and criticism should be sent directly to the Chairman of ICS to be received not later than June 15, 1998

Protection and free access to GSSPs

The ISC Bureau discussed the problem of preservation and free access to the GSSP sections. The International Stratigraphic Guide (1994, p. 91) clearly expresses that there must be easy access to the sections, which "offer reasonable assurance of free study, collection, and long-ranged preservation". It is further emphasized that "marking in the field, hopefully of permanent nature, is desirable. A more detailed list of requirements for the GSSPs are presented in the Guidelines of ICS (Remane et al. 1997, p. 80).

The Bureau suggested that the Subcommittee that proposes a new GSSP, supplement the GSSP proposal with a written document from the appropriate national authorities, stating that the section and the site of the section will be protected in perpetuity against damage and destruction and that there will be free access for all scientists to visit, study, describe and collect the section. There should be no fee or administrative cost to pay for doing so and that instructions and rules for sampling at the GSSP be prominently displayed at the outcrop site.

Permanent marker for GSSPs

In its April 11-13th, 1997 meeting the ISC Bureau discussed M.B. Cita suggestion to create a permanent marker for GSSPs. It was considered a bronze plate with a sign of IUGS, the name of the GSSP and an explanatory note. The 1st Vice-Chairman will produce a model that will be sent to the Subcommissions.

GSSPs and the GEOSITES project

ISC Circular 1997-3 (Aug. 27th, 1997) included an “open letter” from W.A.P. Wimbledon (IUGS Geosites WG Chairman) concerning involvement of the ICS Subcommissions in the IUGS global inventory of geological sites, and the links between stratotypes and conservation. They are looking to include GSSPs, but also to demonstrate some of the many other complementary sites and areas, perhaps to show facies or faunal variations, and to show the history of science and the development of thinking. They hope to compile a meaningful list of related sites - a plexus of sites which really demonstrate variation in space and time. This is seen as a chance to advertise key sites, and employ it where possible to promote protection.

International Stratigraphic Lexicon

Its reactivation had to be abandoned as a call for volunteers in 1994 was not successful and there are no funds for the creation of a WG or Subcommission (ISC Circular 1997-2).

ICS e-mail

The ICS Bureau has set up two ICS e-mail lists as follows: List 1 (ICS-Chairmen@listserv.netropolis.net) includes all of the ICS Bureau and all Subcommission Chairmen; List 2 (ICS-Officers@listserv.netropolis.net) includes the above list and all of the officers of the various subcommissions.

When you send a message, or are replying to one sent to you through the above addresses, your message will go to everyone on the e-mail list, as the ICS mail list is specifically designed for open community dialogue and for information dissemination.

The ICS Bureau (Circular 1998-1) suggested the following topics/problems for an ICS mail list dialogue: 1) Towards which specific goals or directions should we guide the science of stratigraphy? 2) How can we better coordinate between the various aspects of Stratigraphy? 3) What is the urgency of bringing to completion the several decade project of inter- and intra systemic boundary definition? 4) Science versus tradition in stratigraphic definition; 5) What are some of the commonalities in boundary definition between the various boundary working groups? 6) Are there depositional environments of choice for boundary definition? 7) How can we better interface between time-stratigraphic tools in stratigraphy (i.e., biostratigraphy, isotopic stratigraphy, fission track, etc.)? 8) We could place the various Subcommission Annual Reports on the mail ICS list for perusal and discussion.

VI. MISCELLANEOUS

A. Glossary of stratigraphic terms

In ISSC Circular No. 92 it was mentioned an old project of the Subcommission, i.e. to produce a glossary of stratigraphic terms in several languages. It was pointed out that it was time to discuss the translation of the English Glossary included in the last edition of the ISG. As a result some comments were received (see below).

Now it would be important to know if there are volunteers to actively work in this matter.

I.G. Sapunov

I wish especially to note the importance of your idea for the preparation of a glossary of stratigraphic terms in different languages (but not only congress languages!) - as many as possible! Long ago during the times of the preparation of the first edition of the Guide (1976), I strongly proposed a preparation of a glossary of stratigraphic terms in different languages to be included as an annex in the Guide. But at that time the Subcommittee did not agree.

F.F. Steininger

As far as I believe a very important item. The Austrian and the German Stratigraphic Commissions have been working on this subject and these opinions will be published.

B. Other possible units of stratigraphic classification

As indicated in ISSC Circular No. 92, there is a need to explore other possible units of stratigraphic classification (e.g. chemostratigraphy, cyclostratigraphy, event stratigraphy, etc.). Only one ISSC member expressed his opinion on this issue (see below).

Now I am trying to interest other people to organize one or several working groups on these subjects. Advise and suggestions are welcome.

J.B. Waterhouse

As you mention, there may indeed be the need to address stratigraphic and nomenclatural procedures regarding chemostratigraphy, event stratigraphy, cyclostratigraphy, etc. The letter from Amos Salvador in Appendix B seems to reinforce this need. In the past lithologic subdivisions in the Guide have been established on the basis of many decades of geological procedure. But for these new categories, there is little precedent, and guidance is all the necessary to achieve a consistent set of procedures that will stand the test of time. In particular, there seems to be considerable need for attention to be paid to the delineation of standards, and the need to reinforce or buttress standards from adequate and independent sequence analyses.

C. "Chronostratigraphy: advances in problem exposition and solution"

In ISSC Circular No. 92 were included seven statements sent for discussion by R. de la Winter. Thus far, the following comment was received:

M.R. Johnson

Most members of SACS (South African Committee for Stratigraphy) either did not understand what Prof. Winter was getting at or also felt that they were not qualified to comment on the matters under discussion. Those who did comment disagreed with Prof. Winter's 3rd statement to the effect that chronostratigraphic categories are limited to tectonostratigraphic terranes and cannot be correlated globally. Prof. Winter has been zealously propagating his views in local geological publications for a number of years now and I have been trying my best to respond to each article and point out the untenability of his ideas. The essence of his position seems to be that unconformity-bounded sequences are the only true chronostratigraphic units, thus giving rise to what he terms "sequence chronostratigraphy". However, since sequences are restricted to single depositional basins it naturally follows that chronostratigraphic units are similarly restricted. He thus concludes that "chronostratigraphy [as traditionally understood] should not longer be considered to be a stratigraphic category" (response to Appendix B, ISSC Circ. No. 92) and that "naming global time intervals is an unnecessary burden and confusing, because the intervals are subject to change as knowledge is gained" (pers. comm., 15 May 1997). If these premises are accepted it is clear that "a standard global (chrono) stratigraphic scale cannot exist" (response to Appendix B, ISSC Circ. No. 92). I cannot see any national or international stratigraphic bodies ever adopting such viewpoint, but Prof. Winter

will no doubt continue to exploit to the full the platform which ISSC membership has afforded him for propagating his philosophy.

D. Second edition of the International Stratigraphic Guide

I am glad to inform that the Guide was reprinted (500 copies) by the GSA. It is now for sale at \$36.00 (\$28.80 for GSA members).

VII. PUBLICATIONS ON STRATIGRAPHIC CLASSIFICATION, ETC.

Following is a list a publications on stratigraphic matters kindly sent to me by some ISSC members:

- Bignot G., Curry, D. & Pomerol C., 1997. The resistible rise of the Selandian. *N. Jb. Geol. Paläont. Mh.*, 1997, H. 2, pp. 114-128.
- Reguant, S., 1996. The biostratigraphic and lithostratigraphic paradigms as tools for the stability for the global stratigraphic scale. *N. Jb. Geol. Paläont. Mh.* 1996, H. 9, pp. 559-572.
- Reguant, S., 1996. Para un catálogo crítico de las unidades litoestratigráficas (y afines) del Paleógeno surpirenaico y de la Cuenca del Ebro. *Geogaceta*, 20(1): 70-72.
- Reguant, S., 1996. A reappraisal of 'International Stratigraphic Lexicon' and the need for the creation of named units critical catalogues. *Acta Geologica Hispanica*, 30 (1995), 4:1-9.
- Remane, J., Bassett, M.G., Cowie, J.W., Gohrbandt, K.H., Lane, H.R., Michelsen, O. and Naiwen, W., 1996. Revised Guidelines for the establishment of global chronostratigraphic standards by the International Commission on Stratigraphy (ICS). *Episodes*, 19, 3: 77-81.
- Takayanagi, Y., 1994. Magnetostratigraphic polarity units. *Gekkan Chikyu (Earth Monthly)*, vol. 16, no. 3, p. 138-142. (Review, in Japanese).
- Takayanagi, Y., 1995. International Stratigraphic Guide. *Journal of the Geological Society of Japan*, vol. 101, no. 7, p. 553-554. (Review, in Japanese).
- Takayanagi, Y., 1995. Notes on biostratigraphic units. *Journal of the Geological Society of Japan*, vol. 101, no. 12, p. 1007-1010. (Review, in Japanese).
- Winter, H. de la R., 1997. Time in Stratigraphy. *Geobulletin*, 40, 3: 9, 16.
- Winter, H. de la R., 1997. Episode- en chronometrisie tydperk-tabelle: implikasies vir provinsies soos die Kaapvaal. *Tydskrif vir Natuurwetenskap en Tegnologie* 16, 3: 108-118 (with an English summary, pp. 118-121).
- Zhamoida, A.I., 1996. Second Edition of the International Stratigraphic Guide. *Stratigraphy and Geological Correlation* 4(5): 506-513. A detailed review of the Guide, including comments on similarities and differences with the Russian Code.
- Zhamoida, A.I., Kovalevsky, O.P. & Moissejeva, A.I., 1996. *Stratigraphic Codes. Theory and practical use.* Russian Academy of Sciences, The A.P. Karpinsky All-Russian Geological Research Institute, Interdepartmental Stratigraphic Committee of Russia, Transactions, 23, 144 pp. VSEGEI Press, St. Petersburg. [In Russian, with an Abstract and table of Contents in English]. "The book gives information on the activity of the International Subcommittee on Stratigraphic Classification and national stratigraphic surveys, gives a review of the existing national and regional stratigraphic codes, as well as International Stratigraphic Guides known by 1995. Nineteen categories of stratigraphic units are characterized, recommended by different codes. The key notions and the most important terms of general stratigraphy are considered using the materials from the Codes, as well as the subject and tasks of general stratigraphy, relationships between categories of stratigraphic units, criteria for distinguishing and drawing of their boundaries, issues of stratigraphic nomenclature and correlation. The experience of practical use of stratigraphic Codes is summarized, and the basic requirements to them are formulated. The book is intended for geologists, stratigraphers, professors and students of higher educational establishments; it can serve as a reference book".

VIII. MEMBERSHIP MATTERS

The following Organizational Members have changed their representatives to ISSC:

Australia

Dr. A.T. Brakel, Australian Geological Survey Organisation, is the new Australian Stratigraphic Names Committee (SNC) National Convener. He replaces Dr. Collin Gatehouse. We thank Dr. Gatehouse for his contributions to ISSC activities.

Bulgaria

Prof. T. Nikolov, Chairman of the Bulgarian National Committee for Geology and President of the National Commission on Stratigraphy of Bulgaria has informed that Prof. P.V. Tchoumatchenco, Geological Institute, Bulgarian Academy of Sciences will act as liaison between the Bulgarian Stratigraphic Commission and ISSC. We thank Dr. Yanaki G. Tenchov (Geological Institute, Bulgarian Academy of Sciences), previous Bulgarian representative for his contributions to ISSC activities.

Japan

Professor Tadashi Sato, Chairman of Japanese National Committee of Geology, informed that the Committee recommends Professor Kazuo Amano, Ibaraki University, as the Japanese representative in the ISSC. Prof. Amano is a stratigrapher, graduated in Geology from the Geology and Paleontology Institute of Tohoku University, where he obtained his PhD in 1979. He is expected to chair the Stratigraphic Nomenclature Committee to be established by the Geological Society of Japan. We welcome Prof. Amano to the ISSC and look forward to his participation. At the same time we thank Dr. O. Fukuta, previous official representative of Japan for his contributions to ISSC.

NACSN

Professor Alfred C. Lenz (Department of Earth Sciences, University of Western Ontario, London, Canada), Chairman of the North American Commission on Stratigraphic Nomenclature (NACSN) has informed that in the October, 1997 meeting of the NACSN a representative (and alternate) to ISSC were elected. The NACSN representative is Dr. Norman Lasca, Department of Geosciences, University of Wisconsin at Milwaukee, WI, USA, and the alternate is Dr. Bruce R. Wardlaw, U.S. Geological Survey, National Center, Reston, VA., USA. We thank Dr. D.G. Cook (Geological Survey of Canada, Calgary, CANADA), previous NACSN representative for his contributions to ISSC activities.

APPENDIX A (TO ISSC CIRCULAR NO. 93)
ACTIVITIES OF THE WORKING GROUP ON SEQUENCE STRATIGRAPHY
(BY AMOS SALVADOR)

The last report of the ISSS Working Group on Sequence Stratigraphy (WG), included in ISSC Circular No. 92 of March 25, 1997, dealt with two of the main issues that the WG has been discussing: the so-called “correlative conformities”, and the desirability of consolidating the various schemes of classification and nomenclature of unconformity-related units.

There is now general agreement among WG members that the correlative conformities, never clearly defined before, are chronohorizons -isochronous surfaces originating at the horizons in the stratigraphic section where the bounding unconformities of a sequence die out, or can no longer be recognized at the degree of resolution of the available stratigraphic tools, and extending basinward into areas of apparent continuous deposition. The correlative conformities are ideal, interpretative surfaces depending for their recognition and tracing on the availability and degree of resolution of diagnostic criteria of chronocorrelation (time correlation). When such criteria are not available, the correlative conformities cannot be recognized and traced.

The results of a questionnaire distributed to the WG members (and also included in ISSC Circular No. 92) and an extensive search of the literature of sequence stratigraphy confirmed that except for interpretations of reflection seismic profiles, the correlative conformities of the bounding unconformities of a sequence are at best difficult to recognize and trace and are, therefore, seldom discussed in the literature. The authors of many papers dutifully define “sequence” as a stratigraphic unit bounded by unconformities or their correlative conformities, but the correlative conformities of the sequences under discussion are not mapped and their definition and the criteria for their recognition and tracing are, therefore, not specified.

The WG recognizes, however, that sequence stratigraphy can have considerable more meaning in regional stratigraphic work if the sequences can be extended and mapped over the entire area of a basin, not just if they are limited to its periphery where the unconformities bounding the sequences can be clearly recognized. For this reason, some WG members support the extension of sequences into areas of apparent continuous deposition following the correlative conformities of their bounding unconformities as a very desirable option, but an option not always achievable, and not essential, therefore, in the definition of a sequence. This alternative would consider a sequence as an unconformity-bounded unit that, when the proper tools of chronocorrelation are available, may be extended basinward along chronohorizons synchronous with the horizon where the unconformities bounding the sequence die out (the correlative conformities of the unconformities). When a sequence is recognized and mapped as bounded only by unconformities it is an objective unit; when bounded by both the unconformities and the corresponding correlative conformities, it becomes a hybrid unit partly objective and partly interpretative. This is considered by some as a drawback. If accepted, however, this definition of a sequence could make possible the consolidation of the various schemes of classification and nomenclature of unconformity-related stratigraphic units into a single, simple, and flexible scheme with the sequence as its basic unit. The use of allostratigraphic unit-terms and of synthem, which have received very limited acceptance and use in

stratigraphic work 15 and 23 years after they were first proposed, could in this way be discouraged.

Another possible alternative is to recognize a twofold scheme of classification and nomenclature for unconformity-related units: one for objective units, bounded everywhere by unconformities, and another for units - hybrid units - whose definition and characterization involve both objective definition and a certain degree of interpretation - genetic implications, for instance.

The WG will be considering these two alternatives and their corresponding terminologies.

The WG has also started to look into the definition of terms essential to the proper definition and characterization of the units of sequence stratigraphy: unconformity, angular unconformity, disconformity, paraconformity, stratigraphic discontinuity or break, conformity. I will report on the results of this inquiry in the next ISSC circular.

INTERNATIONAL SUBCOMMISSION ON STRATIGRAPHIC CLASSIFICATION
APPENDIX B (TO ISSC CIRCULAR NO. 93)
DRAFT OF THE GLOBAL STRATIGRAPHIC CHART
(BY THE INTERCOMMISSION WG OF ICS, CGMW and UNESCO)

**INTERNATIONAL SUBCOMMISSION ON STRATIGRAPHIC CLASSIFICATION
APPENDIX C (TO ISSC CIRCULAR NO. 93)
ISSC LIST OF MEMBERS**

May, 1998

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