TOWARDS HARMONY IN STRATIGRAPHIC CLASSIFICATION

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ABSTRACT. Stratigraphic classification is the systematic zonation of the strata of the earth's crust with reference to any of the many different properties or attributes which rock strata may possess. It is an essential step for us, both toward the scientific and philosophic understanding of the rocks of the earth's crust and toward their economic utilization.

This concept of stratigraphic classification is extremely simple, and offhand it is hard to see why there should be any problems other than the strictly geological ones involved in the accurate scientific identification of stratigraphic characters and the selection, tracing, and definition of units based on variations in these characters. That there are other problems, and even some degree of confusion and controversy, seems to result principally from the following:

1. Lack of a clear concept of what is being classified.
2. Lack of adequate standards of reference for specific stratigraphic units.
3. Attempts to zone strata according to two or more different characters using only one set of units.
4. Lack of precise and uniform terminology.
5. Proliferation of unnecessary terms.
6. Influence of preconceived notions on stratigraphic classification handed down from the early stages of the development of stratigraphy.
7. Intolerance by specialists in one field of stratigraphic classification toward potential contributions of other fields.

Great progress is being made toward general agreement on principles of stratigraphic classification and toward uniformity of usage in terminology. The work of the International Subcommission on Stratigraphic Terminology, as well as that of the several national commissions on stratigraphic nomenclature is showing excellent results. Recent questionnaires distributed to stratigraphers throughout the world, as well as other samplings of thought and opinion, reveal a very encouraging trend toward harmony on points of stratigraphic classification and terminology which only a short time ago were confused by very diverse viewpoints. A summary of the conclusions arising from 75 replies to a recent world-wide questionnaire of the International Subcommission on Stratigraphic Terminology is particularly illuminating. Some areas of controversy still remain, but the goal of reasonably close international accord appears definitely attainable. An interesting variation in views on stratigraphic classification lies in the concept of the USSR Stratigraphic Commission of a single kind of stratigraphic classification resulting in a single set of units based on natural stages in the development of the earth's crust, in contrast to the multiple kinds of stratigraphic units to which most of the rest of the world appears to subscribe.

Stratigraphic classification is the systematic zonation of the rock strata of the earth's crust with reference to any of the many different properties or attributes which rock strata may possess. It is an essential step for us, both towards the scientific and philosophic understanding of the rocks of the earth's crust, and toward their economic utilization. It is a manifestation of our almost instinctive recognition that the best approach to understanding is by means of analysis—by breaking things down into their component parts whenever we cannot adequately grasp them as a whole—and in order that eventually we may more truly grasp them as a whole.

Stratigraphic classification thus involves, firstly, the analysis of strata with respect to the distribution of any selected property or attribute (lithology, chemical content, fossil content, etc.) and, secondly, the grouping of strata into unit bodies, each representing in itself a more or less similar or unified development of the property or attribute in question, and each bounded by varia-
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Tions in the presence or development of this property or attribute. (A hierarchy of units, that is, a classificatory system with units of differing rank, may be usefully employed for certain properties or attributes to express different degrees of magnitude or different degrees of detail in uniformity with respect to the quality in question.) A high purpose of stratigraphic classification is thus to be able to recognize the variations in any of the many properties and attributes of the rocks of the earth's crust, to be able to mutually communicate regarding these variations, and to be able to employ them to the best advantage, scientifically and economically. Only if all rocks were absolutely uniform in all characters, including mode of origin and age of formation, would there be no need for stratigraphic classification.

This concept of stratigraphic classification and its purpose is exceedingly simple, and off-hand it is hard to see why there should be any problems or controversies about it, other than the strictly geological or technical ones naturally involved in the accurate scientific identification of stratigraphic characters and in the selection, tracing, and definition of units based on variations in these characters. That there have been other problems, and perhaps even some degree of confusion and controversy, seems evident from the literature and is perhaps even indicated by the call for the present S.E.P.M. symposium on Concepts of Stratigraphic Classification and Correlation. It may be worth while therefore to explore with you what, in my opinion, are probably the principal reasons for such disagreements as may exist.

1. A common source of confusion is the lack of a clear concept of what is being classified. I believe that most of us agree that there may be many different lines of stratigraphic classification and many different kinds of stratigraphic units, depending on the particular characters or attributes of rock strata which are under consideration. Thus rocks may be classified stratigraphically according to their lithologic character, according to fossil content, according to mineral character, according to geologic age or time of origin, according to chemical properties, according to seismic properties, according to environment of origin, and according to numerous other properties which vary through the sequence of strata making up the earth's crust. Some categories of classification are, of course, vastly more important and more useful than others. Perhaps the most of us will need to use only one or two or three or four of these, but let's be broadminded enough to recognize that others do exist which may be usefully employed for certain purposes. No one need use any which do not appear useful to him. Obviously, however, if a number of people, scattered widely over the globe, are going to be engaged in classifying strata into units, it is necessary that it be clear to each just exactly what property or attribute the other is classifying in any particular case and what the units which each has named represent, before anyone else can hope to intelligently use these units. When a unit is employed, therefore, it should be clear whether this unit is a body of strata representing a certain lithology, a certain assemblage of fossils, a certain environment of deposition, the range of a certain fossil, a certain interval of geologic time, or whatever else; since unless this is done, it becomes completely impossible for anyone else to even begin to recognize, identify, or trace this unit elsewhere.

2. A second source of confusion is a lack of adequate standards of ref-
ference for specific stratigraphic units. Admittedly it is often difficult to describe in words adequately the feature or features on which a unit is based and hence the stress which must be placed on standard reference sections of rocks for the definition of most kinds of stratigraphic units. This is the most stable anchor which we can have in this oft-disturbed sea of stratigraphic classification. It is as essential to stratigraphic classification as types are to biologic classification, or as Bureau of Standards references are to physical measures. I have emphasized previously the almost ridiculous situation in our science where tons of paper and innumerable man-years have been wasted in futile controversies about where to draw boundaries between certain series, certain stages,—when no type or standard section of rocks has ever been established or accepted as a reference for these units. Here is a crying need with respect to world-wide chronostratigraphic (time-stratigraphic) classification—the need for establishment, by some internationally recognized authority of standard reference rock sections for our major time-stratigraphic units. A similar need for standard reference sections exists for most other kinds of stratigraphic units.

3. A third source of confusion lies in the frequent attempts to zone strata according to two or more different characters using only one set of units. This might be considered funny if it weren't so tragic. Is it possible that anyone would try to set up standards or units for the measurement of two different properties using only a single set of units? Would you try to measure both weight and distance in terms of pounds? Or count the different fruits in a mixed fruit basket in terms of oranges? Well, maybe not, but some have proposed that a lithologic unit—a formation—should not be differentiated from a time-stratigraphic unit. Others have proposed that the same set of units should be used for biostratigraphic divisions as for time-stratigraphic divisions, inferring that fossil zones are the only time-stratigraphic units. There is here a

1 Some have proposed that the standards of reference for chronostratigraphic units should be defined in terms of biologic features or stages in biologic evolution. However, such features, divorced from specific rock sections, cannot in themselves constitute adequate basic standards of reference for chronostratigraphic units since we are not justified in assuming, (a) that the chronostratigraphic range of any biologic feature will ever be fully known, (b) that even when known such range will be the same over the whole world through all different facies developments of rock strata, (c) that evolution in all lines or in any one line proceeded everywhere at the same pace or in exactly the same direction, (d) that the first or the last known occurrence of any biologic feature in any one region marks the same point in geologic time as the first or last known occurrence in all other regions, and (e) that the age according to such biologic features will accord with absolute age determinations which may eventually be worked out by radioactive methods. The fallacy of such biologic standards for chronostratigraphic units is readily seen in the obvious fallacy of the proposed designation of the base of the Cambrian system (a supposedly isochronous surface) as coinciding with the first known occurrence in any specific region of fossil evidences of organized life.

The only reliable objective standard to which we can go back for reference with respect to any chronostratigraphic unit is a designated sequence of strata and the scope in geologic time which it represents. Some have objected that unconformities with their corresponding hiatuses in geologic time may exist in such sequences. However, probably most sequences of strata include some hiatuses in deposition, if we accept a short enough time interval as a hiatus, but this does not affect the over-all span of time represented by the sequence of strata. Desirably, for purposes of ease and accuracy in extension and identification elsewhere, the standard section of a chronostratigraphic unit should be as complete as possible and should carry as many useful criteria (biologic and other) for time correlation as possible. Desirably also, the top and the bottom of the standard section should not be marked by unconformities but should be horizons in a continuously deposited sequence of sediments.
fundamental lack of comprehension that, however close the relation, we are
dealing with two intrinsically different things. Surely, the weight of a pile of
bricks in pounds may be proportional to its height in feet and the age of a
sequence of strata may be determined by its correspondence to a certain fossil
zone, but this is not always so, nor inevitably so, and there is no more necessary
relation between fossil content and age than between weight and height. Noth-
ing useful is lost and much confusion is avoided if we keep distinct characters
separate in our classificatory systems. If we are talking about the age of strata,
let's say so; if we are talking about their fossil content, let's say so. They are
not the same thing.

A particularly common source of confusion results from the attempt to ex-
press with one and the same set of units both a physically discernible character
and a feature of a purely interpretational nature. Thus the determination that
a certain body of strata is characterized by a certain fossil assemblage is a
relatively stable observational fact. The conclusion that this fossil assemblage
indicates a certain geologic age or a certain environment of deposition is more
a matter of interpretation which may vary considerably depending on individ-
ual viewpoint or may change drastically with the general development of our
knowledge. Fossil content, age, and environment are three different things.
Each of these may bear closely on the others, but each represents a separate
property or attribute of the strata which cannot necessarily be expressed by
the same set of units as the others. As another example, I will admit that
along with many others I used to think of a formation as both a lithologic and
a lithogenetic unit. I am now convinced that strictly speaking we are not justi-
fied in combining even these two concepts, one dominantly objective and the
other dominantly subjective, to be expressed by a single type of stratigraphic
unit. Lithogenesis may commonly control physical lithology, and lithogenetic
evidence may commonly be an important aid to choice of boundaries and to
tracing of a lithologic unit, but fundamentally they are two different things and
units based on mode of genesis will not necessarily coincide with those based
on observed lithology or vice versa.

Another interesting example of confusion resulting from lumping two con-
cepts under one set of terms is evident in the common usage of the term
"fossil zone," *Fulanus smithi* Zone for example. Thus, one group of paleontol-
ogists would interpret *Fulanus smithi* Zone as the body of strata characterized
by a certain assemblage of fossils of which *Fulanus smithi* happened to be a
prominent member. Another group would understand *Fulanus smithi* Zone to
mean the total body of strata in which the species *Fulanus smithi* occurred
regardless of its associates. (Moreover, in neither group would there be uni-
form opinion as to whether actual specimens of either *Fulanus smithi* or the
assemblage fossils would have to be present for strata to be included in the
zone, or whether simply supposed time equivalence would qualify strata for
inclusion.) The two concepts are both quite useful, though quite different, but
it is most interesting that supporters of each seem almost outraged to think
there could be any other interpretation than their own. Most people queried
on the point admit, as I do, that you just can't tell what is meant by *Fulanus
smithi* Zone. The need for distinct terms to separate the two concepts—a body
of strata unified by the occurrence of a certain assemblage of fossils and a body
of strata unified by the stratigraphic range of a certain fossil form—seems obvious, and to fill this need the terms assemblage-zone and range-zone have been proposed.

4. A fourth source of confusion is the lack of precise and uniform terminology. Once concepts are clear we then need a precise and uniformly accepted terminology to express them. Much time which could profitably have been spent on more important problems of stratigraphy has been wasted through the use of vague or variably defined terms. Here arises the question of whether or not we should necessarily stay with old terms which were originally poorly defined, which are presently used with quite variable significance, and which are no longer adequate for our needs. In my opinion, all language is dynamic and should be the servant rather than the master of those who use it. Whether an old term should be revived, re-defined, or replaced is largely a matter of how best these interests of communication and understanding can be served in any particular case. I do not feel there is anything sacred about mere priority of usage—even that of an International Geological Congress 60 years ago.

An example of a term which, in my opinion, has become so variable in meaning as to have lost much of its usefulness is the term biozone. It was originally defined by Buckman (1902) as a time term to express the time during which a fossil form existed. Some still follow this usage. Others use biozone to refer to the total body of strata in which a certain form occurs. Still others use biozone to refer to all strata of the same age as the life-span of the certain fossil form regardless of whether the form itself is present in these strata or not. Because of the vague significance of biozone, the fact that almost nobody uses it in the sense of its original definition, and because of the ingrained nature of other current discrepant usages of the term, I would strongly favor replacing it by the more descriptive term range-zone, defined as the body of strata characterized by and representing the total range of occurrences of some one particular species, genus, or other taxonomic entity. I believe this is more practicable than any attempt at redefinition of biozone, and I would suggest that those who wish to express clearly the concept defined in the preceding sentence will find range-zone a more useful and less equivocal term than biozone.

5. A fifth source of confusion results from the proliferation of unnecessary terms. Too many terms for stratigraphic units may have as bad or worse consequences than too few. Simplicity of terminology is an invaluable advantage if it can be attained without sacrifice to understanding. I see no reason why this cannot be done.

The word zone is in common use in many languages as a general term for a stratigraphic unit of any kind. It is defined with remarkable adequacy for stratigraphy in even so general a reference as Webster’s Dictionary, as “a belt, layer, or series of layers of rock . . . characterized by some particular property, action, or content.” Thus we commonly speak of lithic zones, mineral zones, fossil zones, marine zones, calcareous zones, sandy zones, shaly zones, tar zones, oil-producing zones, etc. Zone is a simple and useful word for this general purpose. With an adequate prefix, or adjective, or modifying phrase, to indicate the particular classificatory category in which it is being used, it can satisfactorily serve as a basic unit for most kinds of stratigraphic classifi-
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...cratic. Larger or smaller scale units can be called super- or sub-zones. Some would, of course, restrict zone to biostratigraphic classification, but I see no reason for such restriction. Biostratigraphic zones are clearly differentiated from others by the fossil name preceding the term or merely by the prefix, as fossil-zone, fossil assemblage-zone, fossil range-zone, Didymograptus Range-zone, etc.

I must confess some dismay at the number of stratigraphic terms with which the literature has been flooded. If a new term helps to make an important concept clear, I am in favor of it, but it seems to me that many of the terms which have been introduced, instead of clarifying a possibly valuable thought, serve rather to hide it behind a strange and unnecessary name, and thus tend to obscure rather than to illuminate.

Thus, what is a Teil-zone? It is supposed to be the range-zone of a fossil at some particular locality as distinguished from its total range-zone. Well, for this concept to have any meaning you have to name the locality and if you do that, why isn’t range-zone on the Rocky River section just as simple as Teil-zone on the Rocky River section and a lot more expressive? I myself have not found too much use for such terms as Teil-zones, tectozones, lithostromes, biostromes, topo-zones, formats, monothems, geoliths, bioliths, sequences, etc., although I have no particular objection to them if anyone finds them useful.

6. A sixth source of confusion and controversy lies in preconceived notions on stratigraphic classification handed down from the early stages of the development of stratigraphy. Under this heading I refer particularly to certain inheritances from the early history of stratigraphy which, even though they may be no longer generally accepted, still impede our present procedures in stratigraphic classification. This is, of course, no criticism of past workers, but only an indication of the progress of the science. Probably what we arrive at today will stand no better in the future.

As an example is the tendency to believe that the classic time-stratigraphic divisions (systems, series, stages) established largely in Europe during the last century constitute “natural divisions” of the earth’s stratigraphic column which can be recognized as such around the world. This is, of course, an inheritance from the early influence of Cuvier, d’Orbigny, and others, who interpreted the local breaks in faunal successions due to unconformities or changes of environment as evidence of world-wide catastrophes which drastically changed the composition of the earth’s organic life. Although few would now openly subscribe to this extreme segmentation of the stratigraphic record, nevertheless many almost unconsciously endow the boundaries of these original time-stratigraphic units with a world-wide significance far beyond their real nature of quite arbitrary, though reasonably satisfactory and convenient, divisions of the more or less continuously developing record contained in the earth’s sedimentary strata.

7. Finally, among unnecessary sources of confusion has been the intoler-

* A format has been defined as the body of strata between two marker beds. It seems to me that if this body of strata has a unified lithology, differentiated from that above and below, then it is simply a lithostratigraphic unit; if the marker horizons are time horizons or closely approach time horizons, then the intervening body of strata is a chronostratigraphic unit—an informal stage or substage perhaps. If the body of strata has none of these or other unifying attributes then of what use is it and why name it?
ance by specialists in one field of stratigraphic classification toward potential contributions of other fields. Here I am speaking particularly about those few biostratigraphers and paleontologists who seem to feel that paleontology should have a monopoly on time-stratigraphic classification and age dating of rocks. They apparently believe in the closed shop and no painter or carpenter or teamster ever more jealously tried to restrict his trade to union labor than do such paleontologists try to limit age dating and time-stratigraphic classification to paleontologic criteria.

This again is evidently a heritage from the past and the early days of stratigraphy. It is definitely out-moded and out-dated now. The potential contribution of the paleontologist to stratigraphy is greater now than ever before; in dating, in correlation, in ecologic interpretation, and in other ways. But we now see many other keys to local time-stratigraphic classification and, through radio-active determinations, even to geochronology. With everything we have, our precision is still far from satisfactory and certainly our system of time-stratigraphic classification should not be tied inflexibly to paleontology, but should leave the way open to use everything we can. The evolutionary sequence of fossils may always be superior to any other means for geochronologic dating of fossiliferous sediments, but we already know that other methods can contribute greatly to dating and to time-stratigraphic correlation even in the fossiliferous rocks, and certainly they provide the only hope for the great mass of non-fossiliferous or poorly fossiliferous strata.

So much for some of the sources of confusion, and even controversy, with respect to stratigraphic classification. In general, however, great progress is being made towards agreement on principles of stratigraphic classification and towards uniformity of usage in terminology.

Recently, through the International Subcommission on Stratigraphic Terminology, I have received replies from some 75 stratigraphers all over the world and representing some 40 different countries, to a rather comprehensive questionnaire on stratigraphic principles and terminology. (Thirty of the answers to the questionnaire were from members of the Subcommission and most of the other 45 were from members of the International Commission on Stratigraphy.) The results are very encouraging.

Obviously, stratigraphic principles and even stratigraphic terminology are not subjects which can be legislated or decided by vote and a mere preponderance of affirmative or negative answers to a question does not make the answer right or wrong. At the same time, considering the composition of the group polled, I do feel that the results carry considerable weight. I have therefore attempted to summarize briefly for you a few of those conclusions, supported by at least 80 percent of the replies, which seem particularly important or which indicate impressive uniformity of opinion on points which only a short time ago might have seemed highly controversial. I must, however, emphasize that the consensus shown here is only that of a particular group of stratigraphers and that while 40 countries are represented in the replies, this representation is by no means proportional to the geological population of the countries involved, nor can the replies from any one country necessarily be considered as representing the mass of opinion in that country. Moreover, as I will discuss later, the indicated degree of unanimity of opinion is largely for answers from
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countries outside of the USSR. My summary of a few of the conclusions suggested by the results of the questionnaire is as follows:

1. It is highly desirable to work toward international uniformity in stratigraphic classification and terminology. The establishment of a new international code under the auspices of the International Geological Congress should be an objective.

2. Stratigraphy deals with the form, arrangement, distribution, origin, and chronologic succession of rock strata. All classes of rocks—igneous and metamorphic as well as sedimentary—fall within the scope of stratigraphy and stratigraphic classification.

3. Stratigraphic classification is the grouping of rock strata according to normal stratigraphic sequence into units with reference to any or all of the many characters, properties, or attributes which rocks may possess. There are thus many kinds of stratigraphic units. Of these the most commonly used are lithostratigraphic, biostratigraphic, and chronostratigraphic units. Table 1 summarizes a recommended scheme of classification and terminology.

4. The term zone, adequately prefixed or modified, appears to be the most acceptable term for a general basic unit in all kinds of stratigraphic classification, and particularly in those kinds which do not already have more specialized unit terms.

5. The designation of specific type or reference sections of rock strata which may serve as standards of reference is essential to the adequate definition of almost all kinds of stratigraphic units.

6. A lithostratigraphic unit is a body of rock strata which is unified with respect to adjacent strata by consisting of a certain lithologic type or combination of lithologic types. The units of lithostratigraphic classification in order of descending rank are group, formation, member, and bed, (or their translated equivalents in other languages). The extent of a lithostratigraphic unit is controlled by the extent of the definitive lithologic features on which the unit was based in its standard reference section. Its boundaries may cut across time horizons, across the limits of fossil ranges and across the boundaries of any other kind of stratigraphic unit.

7. A biostratigraphic unit is a body of rock strata which is unified by certain features of its fossil content. There are two principal kinds of biostratigraphic units: the assemblage-zone or cenozoone, consisting of the body of strata characterized by a certain assemblage or association of fossil forms; and the range-zone or acrozone, consisting of the body of strata representing the total range of occurrence of some one particular species, genus, or other taxonomic entity. Both the assemblage-zone and the range-zone are limited in extent to the actual known occurrences of the assemblage or taxonomic entity concerned. The term zone, if standing alone without prefixes, is inadequate for more than very general usage in biostratigraphic terminology since it does not differentiate between the assemblage and the range concepts. The boundaries of biostratigraphic zones may cut across time horizons,
Table 1
Stratigraphic Classification

<table>
<thead>
<tr>
<th>Characters or Attributes of Rock Strata</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lithology</strong> (Lithostratigraphic Classification)</td>
<td>Informal</td>
</tr>
<tr>
<td>zone bed(s)</td>
<td>Group Formation Member Bed</td>
</tr>
<tr>
<td><strong>Fossil Content</strong> (Biostratigraphic Classification)</td>
<td>zone</td>
</tr>
<tr>
<td><strong>Geologic Age</strong> (Chronostratigraphic Classification)</td>
<td>stage</td>
</tr>
<tr>
<td><strong>Mineral Content</strong></td>
<td>zone</td>
</tr>
<tr>
<td><strong>Other Characters</strong> (Chemical, Electrical, Seismic, Environmental, etc.)</td>
<td>zone</td>
</tr>
</tbody>
</table>

Sub-zones and Super-zones may be recognized.

across formation limits, and across the boundaries of any other kind of stratigraphic unit.

8. A *chronostratigraphic* unit is a body of rock strata which is unified by representing the rocks formed during a specific interval of geologic time. The boundaries of a chronostratigraphic unit as they are extended away from its type or reference section are by definition isochronous surfaces (i.e., surfaces having equal time value everywhere). While fossils, lithology, radioactive data, unconformities, regressions and transgressions, and other stratigraphic criteria serve as our only guides to approximating the correct position of such isochronous bounding surfaces, these surfaces and the chronostratigraphic units which they delimit are fundamentally independent of all physical bases for stratigraphic subdivision and may cut across the boundaries of any of the other kinds of stratigraphic units.

9. Fossils provide one of the most useful criteria of geologic time, and particularly of geochronology, but many other criteria are also usefully employed in chronostratigraphy, such as, observed sequence of beds, tracing of bedding planes, ash falls, lava flows, bentonites, paleoclimatic changes, etc. The progress in radioactive methods of dating stratified rocks is particularly promising and is such as to justify adherence to chronostratigraphic principles which will be compatible with such absolute age dating as well as with methods of relative dating.

10. Although fossils play an extremely important role in chronostratigraphy, there is a fundamental difference between chronostratigraphic units and biostratigraphic units, and the terms used for these units should be distinct one from the other. A chronostratigraphic unit may frequently coincide in its type section with the scope of a biostratigraphic unit but the extent of the biostratigraphic unit away from the
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11. The generally accepted hierarchy of chronostratigraphic terms in descending order of rank is as follows: system, series, stage, and substage (or their translated equivalents in other languages).

12. It is considered desirable that competent committees be set up under the aegis of the International Geological Congress to attempt the task of designating specific standard reference stratigraphic sections for each of the systems, series, and stages, without which these cannot have adequate meaning.

In conclusion, with respect to the results of the questionnaire, attention should be called to an interesting variation in stratigraphic philosophy between stratigraphers in the USSR and those of much of the rest of the world. According to the USSR Stratigraphic Commission there is only a single kind of stratigraphic classification. This portrays "natural" stages in the development of the earth's crust and the evolution of the organic and inorganic world. Stratigraphic classification is seen by the USSR Commission as the hierarchical grouping of sedimentary, metamorphic and igneous rocks into a single set of units with relation to "natural" steps in the historical development of the earth. The USSR Stratigraphic Commission does not recognize several distinct kinds of stratigraphic units, such as lithostratigraphic, biostratigraphic, and chronostratigraphic units, but considers the criteria for these only as aids in arriving at the single scale of "natural" stratigraphic units. This single scale comprises a hierarchy of units which in order of descending rank are given names which would translate to the English terms: group, system, section, stage, and zone.

It appears to me that the difference in concept of stratigraphic classification reached by the USSR Commission as compared with that of most of the rest of the world lies principally in a different route of approach. The USSR Stratigraphic Commission would appear to start with the assumption that there are "natural" steps or stages in the historical development of the rocks of the earth's crust and that all of the physical and organic characters of the rocks when adequately worked out must accord with these "natural" divisions. Most of the rest of the world, I believe, would favor taking a more objective approach, classifying strata independently along various different lines of observed or interpreted characters without the perconceived conclusion that these would all accord with any "natural" over-all grouping of strata. Our course is inductive; the Russian course is deductive. Since ours is the more elementary and conservative approach, I am hopeful that in the interests of international harmony the USSR Commission may be willing to go along with us even though they may feel that we are groping with too cautious steps toward a conclusion which they have already attained.