

Layer by Layer: An account of the North American Commission on Stratigraphic Nomenclature

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ABSTRACT: Since the beginnings of the science, geologists have sought conventions to assist organizing and communicating the complex and fragmental elements of Earth's history. In North America in 1941 a standing, international, representative commission was proposed for the purpose of recommending stratigraphic procedure and nomenclature. The resulting North American Commission on Stratigraphic Nomenclature (NACSN) continues to develop its instructions in the form of a widely accepted "code" that is actively reassessed to reflect scientific advances.

NACSN is an organized forum in which fundamental principles and methods are evaluated. The story of the Commission's work to develop useful guidance should help practitioners understand its products and, though them, the discipline itself. An account of NACSN is offered in tribute to the many geologists who contributed so diligently and profoundly as Commissioners for more than six decades.

PURPOSES

This is a story about attempts to find ways of capturing, in words, the history written in rocks. Scientific investigation requires organization of subject matter, and geologic material and data are especially diverse. Classification, as unambiguous and informative as possible, is essential to the science and to communication. The North American Commission on Stratigraphic Nomenclature (NACSN) not only recommends the *methods* by which rock bodies may be formally identified (named), but also it addresses the *fundamental principles* by which the rocks may be organized. In these matters, the Commission and its precursors and related bodies have debated and recorded significant methodologies of the science of geology, influenced its practices, and encouraged advancement through tested procedures and means of communication. The definition and significance of classification in the philosophic sense that it has guided NACSN's efforts has been discussed, for example, by Hill (1963) and Simpson (1963).

The accomplishments of NACSN in assisting investigators as they organize observations and communicate findings, albeit with some false starts and corrections, may be properly attributed to a small group of persons (Commissioners and appointed committee members) sincerely dedicated to our science. Those persons constitute not an autocratic, bureaucratic mass (and certainly not a governmental entity), but are practitioners appointed or elected systematically as representatives of the geologic community by the scientific organizations (the principal geologic societies and agencies of North America) that comprise the Commission. Prior to 1978, NACSN was the American Commission on Stratigraphic Nomenclature (ACSN), and this name change, too, is part of its history.

The purpose of NACSN is to facilitate scientific progress by addressing needs found in basic geologic procedure. The purpose of this "account" is to record more than 60 years of accomplishment and, especially, to acknowledge the individuals who have contributed so generously to the effort.

An important test of the products of the Commission is *utility* (NACSN 1983; 2005). The individual participants in the process have not lacked personalities and experiential biases, but the fact that NACSN in essentially its present form has been perpetuated for over 60 years and has generated widely accepted results is evidence that the parent organizations, sometimes representing diverse concepts, have achieved the intended useful results.

The geologic community should know that the recommendations of NACSN are not imposed as constraints upon them by some anonymous, authoritarian body. Rather, it is their colleagues who have worked diligently to sort and organize *their own* practices, expose them to scrutiny, and accept and record informed and representative judgments about utility. It is thought that the community it serves would derive some satisfaction from information about the evolution of NACSN and, importantly, that its products would be even more acceptable if the sources were identified and clarified. Therefore this account of the background and role of NACSN is offered to further explain the Commission to the community it serves and, also, to acknowledge the individuals who have influenced the discipline of geology itself by developing standards for organizing and communicating results.

THE STRATIGRAPHIC CORE OF GEOLOGY

Elegant and eloquent definitions of geology and stratigraphy may be found in many basic texts. The unique quality of geology as a discipline is study of the *history* of Earth. Inherent in this is emphasis on time. The organization of the components of Earth in time is the realm of stratigraphy. Thus, most geologic study, both theoretical and applied, is conducted in the context of stratigraphy. The point is, stratigraphy is at the heart of geological science and the methods employed in stratigraphic investigation have been found by generations of geologists to be essential to their efforts.

Because of this basic importance, methods of procedure have long been developed, debated, and tested within the geologic

community. Some of those methods have been found sufficiently useful as to be worthy of codification. The existence of a “code” suggests unusual and special significance: For example, in geology, stratigraphy and paleontology have such rules, and the taxonomic rules of biology and botany provide other examples.

Nomenclature, as in North American Commission on Stratigraphic *Nomenclature*, is thus seen as far more than names. The names are results of systematic scientific investigation and convey useful information.

DISCOVERY

The methods and expressions of stratigraphy are essentially as old as the science of geology. It is intriguing to consider time as a *discovery* in the sense recognized by Boorstin (1983). References to the Greek philosophers are obligatory in textbooks. We must pay passing, but sincere, even reverent, tribute to Nicholas Steno, and, of course, acknowledge William Smith before moving on to trace the origins of NACSN.

This paper in no way pretends to be a history of geology or of its sub-discipline stratigraphy. Reference to such matters is intended only to establish the broad context in which NACSN originated and continues.

An excellent summary of the origins of stratigraphy is presented by Morello (2003). It builds and elaborates on the finding of McIntyre (1963, p. 1): “Prior to [James] Hutton, geology did not exist, and I think it is generally agreed that the science was created in the fifty years between 1775 and 1825.” Morello finds the “birth of modern stratigraphy” in this same interval.

The beginnings of the 19th century represented a fruitful period for the development of a new scientific value of stratigraphy also because during this time the Wernarian “geognosy” underwent profound criticism and revision. At the same time, the paleontological record began to be interpreted in terms of both the history of the Earth’s crust and of the history of life (p. 263).

The volume edited by Vai and Cavazza (2003) for the 32nd International Geological Congress (IGC), with major articles by Gian Battista Vai, is an exquisite account of the formative history of geology and stratigraphy. Vai’s paper “Giovanni Capellini and the Origin of the International Geological Congress” (2003) conveys an understanding of how the need to connect European practices to North America and codify common geological map symbols, nomenclature, and colors led to founding the IGC in 1876, following the meeting of the American Association for the Advancement of Science (AAAS) held at Buffalo, New York (in 1876). The remarkable story of William Smith recently has been brought to the attention of the lay, as well as the geologic, community (Winchester 2001).

In such works the reader will find more information and references on the origins of the sub-discipline of stratigraphy itself.

Note 5 of ACSN indicates the sensitivity of the early Commission to its international roots (ACSN 1948 (Flint and Moore)). It is particularly instructive about the intense discussions then underway over distinctions between time-rock and age units. Note 5 is densely documented and referenced and traces the international origin of stratigraphic practice:

The 2nd International Congress (Bologna 1881) adopted recommendations of a commission appointed by the 1st Con-

gress (Paris 1878) for the purpose of formulating a uniform scheme of stratigraphic classification and terminology of units...The 8th International Geological Congress (Paris 1900) reaffirmed adoption of most of the units...” (p. 372-373).

Organizational Role of State Geological Surveys

The state geological surveys have played prominent roles in developing and recording stratigraphic practice due to necessity. They were the first organized governmental units in the U. S. with public responsibilities for the study of bodies of rock. Further, that the boundaries of states do not usually coincide with geologic features required intelligible communications between the several jurisdictions. In the origins of NACSN there is evidence of strong participation driven by the particular concerns of the state geological surveys. Accordingly, the roots of NACSN may be traced, at least in principle, to the early state surveys. Kohlstedt (1976) noted: “Many of the state surveys had been authorized in the mid-1830s, and the geologists were formulating final reports at the close of the decade. It was a critical time to establish uniform nomenclature and classification systems” (p. 66).

Discussions of these subjects contributed to the formation of the Association of American Geologists in 1840. That organization became the Association of American Geologists and Naturalists in 1842. Famous geologists, such as Edward Hitchcock, Sr., Benjamin Silliman, Sr., and Henry D. Rogers, were prominent and active in the evolution of AAGN into the AAAS in 1847.

Practices of the U. S. Geological Survey

According to Cohee (1974), not long after its establishment in 1879, the U. S. Geological Survey (USGS) published in 1882 a “...general scheme of classification and a color scheme for geologic cartography” which evolved by 1890 into “...the first published rules of nomenclature and classification [by USGS].” Cohee also informs that the 24th Annual Report of USGS (1902) contained “...the first extensive code of regulations” (p. 20).

The Geologic Names Committee of the USGS was formed in 1899 to review and guide stratigraphic usage within the USGS. Its reports, such as “Stratigraphic Nomenclature in Reports of the U.S. Geological Survey” (Cohee 1970; 1974) are helpful historical records although they carry the notation “For Official Use Within the Geological Survey.” Products of the Committee used throughout geology include the monumental “Lexicon of Geologic Names of the United States” (Wilmarth 1938) and its subsequent updates, up to and including the online lexicon at ngmdb.usgs.gov/Geolex/geolex_home.html.

Interests of the States, federal agencies, industry, and academic research began to more clearly converge at the beginning of the 20th Century. This process may well have been strongly stimulated by evolving subsurface techniques of the growing petroleum industry and the formation of the American Association of Petroleum Geologists (AAPG) in 1917.

The 1933 or “Ashley” Code

At the suggestion of AASG, representatives of AASG, USGS, AAPG (American Association of Petroleum Geologists), met in 1930 (or 1929?) to begin work on what developed into the 1933 “Code.” The influences and requirements of subsurface geology propelled by petroleum exploration in the first several decades of the 20th Century revived interest in the principles of stratigraphic practice. The 1933, or “Ashley,” Code (Ashley et al.

1933) provided guidance and inspired debate for almost three decades. The “Introduction” of the 1933 Code is instructive in its history and remarkable for the delicacy with which its subject matter was approached. The authors clearly recognized the need to respect varied opinions and seek consensus.

George H. Ashley was State Geologist of the Fourth Geological Survey of Pennsylvania from 1919 to 1946. Ashley placed emphasis on an “Atlas of Pennsylvania,” a state geologic map, and on a cooperative program with the USGS. His interests and his leadership within the AASG may have carried him into the chairmanship of the group that drew up what came to be known as the “Ashley Code.” Certainly the State Geologists, represented by Ashley, R. C. Moore, and C. N. Gould had strong interests in codifying stratigraphic classification. The resulting document is recorded formally as:

ASHLEY, G. H., et al., 1933. Classification and nomenclature of rock units. *Geological Society of America Bulletin*, 44: 423-459.

It was subsequently also published by the AAPG. Ashley, as a leader and as first author of the publication, gave his name to the “Code,” but it may be noted that at the first meeting of the committee of the four organizations in April 1930, C. N. Gould (Oklahoma) was elected chairman and R. C. Moore (Kansas) secretary. The order of the authors of the document is alphabetical.

A procedural aspect of the 1933 Code probably originating in the mission of the AASG delegation was that rules should be developed with *no* intention to “...adjudicate specific, controverted questions of nomenclature...” (Ashley et al. 1933, p. 426). This seems to have been agreed at a January 1931 meeting in Toronto and has been a guiding policy for such activities to the present day.

FOUNDING THE COMMISSION

In 1941, Raymond C. Moore, State Geologist of Kansas, acting on behalf of AASG, wrote to William C. Mendenhall, Director of USGS and to the presidents of AAPG and GSA and the Director of the Geological Survey of Canada (GSC) suggesting a “Proposed Permanent Commission on Stratigraphic Nomenclature” (Moore to Mendenhall, May 21, 1941).

Literature and minutes between 1933 and 1941 suggest growing frustration based on perceptions that the rules of 1933 lagged the science and the practical concern that organizations might be imposing stratigraphic terms unacceptable to other jurisdictions. Upon adopting the 1933 Code, the committee had resolved to refer questions of interpretation to the National Research Council (NRC) Committee on Stratigraphy. Thus, the need for a standing body had been recognized; however, at this distance it seems doubtful that interpretation of the Code was a high priority at NRC. Moreover, internal operating procedures and the national, not international, nature of NRC suggest impediments.

Further stimulation for a new organization was a by-product of the project commonly referred to as “GSA Correlation Charts” that was undertaken at roughly the time interest in a stratigraphic commission was developing. As explained by Krumbein and Sloss (1963):

The Committee on Stratigraphy of the National Research Council has, from time to time, published time-stratigraphic correlation charts representing the systems, their subdivisions,

and their rock and biostratigraphic components in North America (p. 388).

Individual charts appeared in the GSA *Bulletin* between 1941 and about 1962. Such broad efforts, as with the later AAPG “Correlation of Stratigraphic Units of North America (COSUNA), demonstrate the need for accepted rules and conventions and draw attention to stratigraphic procedures.

A significant part of the correspondence between Moore, Mendenhall, and others about arranging to begin a stratigraphic commission is preserved in the *Journal of the American State Geologists* for 1941 and 1942. A meeting was held at Boston, December 29-30, 1941, that included representatives of the organizations proposed by Moore. (The attendance is recorded in Appendix 1.) B. F. Hake, Secretary, and R. C. Moore, President of AASG, prepared a report of the meeting for the AASG *Journal* stating in part: “The conference committee agreed that the appointment of the proposed Commission is in the best interests of the science of geology in North America” (p. 10).

The 1941 conference at Boston may be considered to mark the initial date of agreement to establish a stratigraphic commission as envisioned by Moore, but the duties and limitations on the representatives imposed by World War II delayed implementation of the agreement. In addition to the demands of wartime service, it was simply impractical for diverse and dispersed persons to travel to meetings.

AMERICAN COMMISSION ON STRATIGRAPHIC NOMENCLATURE

The first meeting of the American Commission on Stratigraphic Nomenclature (ACSN) was held, at last, at Chicago on December 27 (some references say 29), 1946. “ACSN” is used herein until “North” is added to the name of the Commission; “ACSN” and “NACSN” are used for citations as the new name simply continued and subsumed the original. Note 1 of ACSN (ACSN 1947a (Moore)) is instructive about the need for the Commission and the efforts to establish that body. Noting the Ashley or 1933 Code was formulated by a joint committee of AAPG, AASG, GSA, and USGS, Moore states:

This so-called Stratigraphic Code, commonly cited as the Ashley *et al.* (1933, 1939) report, has been published three times and has been used widely as a guide by individual workers and geologic editors. The value of the Code as a comprehensive, concisely stated presentation of generally accepted views on stratigraphic principles and procedures has been recognized despite its incompleteness and imperfection of treatment in various places (p. 513).

The joint committee was not continued in 1932, but, rather, it suggested questions be referred to the Committee on Stratigraphy of the National Research Council. The need for a dedicated permanent body was evidently obvious by 1941 and the Commission was implemented in 1946. Hollis Hedberg recalled “...the determined and sustained effort of R. C. Moore really brought about the birth of ACSN” (Hedberg, personal communication, January 15, 1988).

It is noteworthy that when circumstances permitted, the first Commissioners wasted no time in organizing the body that they intended to support the needs of the geologic community. The first Note was titled “Organization and Objectives of the Stratigraphy Commission” (ACSN 1947a, (Moore)). With the establishment of an appropriate, sanctioned mechanism, ACSN,

provision was made for organized, continuing discussion of stratigraphic principles and practice, and for broadcasting the results. The first Notes and Reports and, particularly, the preserved correspondence suggest that this allowed release of energy and advances constrained first by lack of organization and then by war.

In its first *Note* ACSN addressed its “Organization and Objectives”:

The purposes of the Commission are to develop statements of stratigraphic principles, to recommend procedures applicable to classification and nomenclature of stratigraphic units, to review problems in classifying and naming stratigraphic units, and to formulate expressions of judgment thereon (ACSN 1947a, p. 515).

The organizing, or charter, organizations were: AASG, AAPG, GSA, GSC, and USGS. Later, the Canadian Society of Petroleum Geologists (CSPG), Geological Association of Canada (GAC), Asociacion Mexicana de Geologos Petroleros, Sociedad Geologica Mexicana, and Instituto do Geologia de la Universidad Nacional Autonoma de Mexico were added and the name changed in 1978 to *North American Commission on Stratigraphic Nomenclature* (NACSN) to reflect its consideration of geologic practice throughout the continent. In 2007, SEPM the Society for Sedimentary Geology (SEPM) and the newly formed Servicio Geologico Mexicano were also added.

The member organizations are assigned one to three positions. The Commissioners are appointed according to the procedures of the member organizations, generally for three-year terms. Commissioners unable to attend a meeting of NACSN may appoint “Alternates.” Provision has also been made for “At Large” Commissioners, originally to fill otherwise vacant positions, then after 2006 amendment of the Bylaws, more generally as found desirable by two-thirds vote of the Commission. The NACSN in 2006 consisted of 26 Commissioners representing nine designated organizations; two positions were vacant, so two were appointed to the vacancies and two others for special interests, making a total of four Commissioners-at-large. Commissioners are appointed or elected by their organizations, but express opinions and vote as individuals; they may of course elect to consult the body they represent according to its own internal procedures.

Meetings of NACSN are held at least yearly during Annual Meetings of GSA, as that is generally convenient for most Commissioners. Publication, from the outset, with few exceptions, has been in the *AAPG Bulletin* because it has the greatest circulation worldwide, especially among those concerned with stratigraphy. With the evolution of a journal dedicated specifically to stratigraphy, NACSN voted to publish in *Stratigraphy* beginning in 2005.

NACSN advises the geologic community of its deliberations and actions through publications in several series, particularly *Notes* dealing with activities and proposals, and *Reports* containing conclusions and amendments. Although the *Notes* include records of each Commission meeting, those accounts are edited for brevity and more detail may be found in Minutes distributed to Commissioners and archived for each meeting. Some delegations, notably AAPG’s, also publish reports in the journals of their organizations.

It should be very clear that meetings of NACSN are open and that many persons not appointed as Commissioners attend or have been asked to volunteer service as advisors and committee members, especially in the process of developing the 1983 and 2005 Codes. Meetings and publications are the vehicles for debate and records of actions. A representative of the International Subcommittee on Stratigraphic Classification (ISSC), normally its chairperson, is regularly invited to NACSN meetings.

Geologists wishing to contribute to the continuing process of developing guidance in the form of a stratigraphic code are welcome to bring their ideas to the Commission. An understanding of the purpose and background of the Commission is helpful in assuring that proposals receive appropriate and efficient consideration.

Two points are critical: (1) The Commission is concerned with *formal* nomenclature, and (2) it offers instructions, but *not* enforcement. It deals with procedures and related philosophy involving formal nomenclature, but it does not hold plenary powers. The principal virtues of formality are clarity and stability. Informality accommodates experimentation and uncertainty. One is not a higher form of expression than the other, they simply answer different needs. Enhanced precision, communication, and, indeed, discipline are, however, benefits derived from formality. Informality favors innovation.

The recommendations of NACSN (*i. e.*, the Code) carry only the force assigned by adopting organizations and their editorial practices. The remarkable extent of the influence of NACSN under these key conditions substantiates the need for its products and is a partial justification for recording its evolution.

FROM PRINCIPLES TO PROCEDURES

The fundamental conflict inherent in classification itself is that it is both a method and a conclusion. This is essentially the objective/subjective, quantitative/qualitative, and descriptive/genetic argument. An ideal classification requires complete knowledge of the subject and conveys not only its unambiguous identification, but also information about its origin (*cf.* Grabau 1913). However, measurement and identification tools are needed to develop the requisite knowledge and some form of hierarchical ranking (systematics) is part of the study process. Further, relative and absolute time aspects of geology as historical science must be considered (Simpson 1963). Add also the conflicts of exclusive-pigeonhole vs. continuously-variable (end member) systems (Rogers 1950) or ordering (Hempel 1952; 1959), and it is clear that differences of opinion and the potential for miscommunication are inherent in the organization and identification of things as complex as bodies of rock. Hill’s (1963) comments are pertinent:

To classify, one must recognize the differences and likenesses as well as gradations between things, processes, and concepts. Classifications are particularly difficult in geology because geologic things, processes, and concepts are many and complex; they usually need to be fixed in space and time...since the historical science of geology is concerned with the antecedents of natural phenomena, the most significant classifications are interpretive and, accordingly, subject to error both in formulation and application (p. 164-165).

The conflicts are mitigated somewhat by the potentials of formal and informal nomenclature, but free discussion in such theaters as NACSN is necessary to continuously improve evolving procedure and, thereby, nomenclature.

Basic Initial Decisions

Correspondence and published papers on basic units, especially on the roles of time, biostratigraphy, stage, subsurface information, and other such matters that are now generally accepted as resolved, began almost immediately with the formation of ACSN. Debate was carried forward vigorously in meetings, publications, and correspondence. It is of major significance that the new Commission provided an orderly forum for discussion of stratigraphic principles. That forum was generally accepted and the concepts were exposed to the scrutiny and debate of the general geologic community as never before. For example, the very nature of the *formation* was subject to early debate. The 1933 Code (Article 5) states "...the formation is a generic unit, which may represent a long or short period of time." Rogers reported in 1948, however, "I think we are in agreement on what is probably a more fundamental point: we agree that a formation should be defined by lithology, not by time" (ACSN 1948c, p. 380). Not all geologists adhere to this point today, and many students are not informed that this is an example of a basic conscious and conscientious decision of the principal geologists of that day.

The 1933 Code did include igneous and metamorphic rocks, but under special headings. Later codes simply included all rocks as subject to basic principles of stratigraphy. Similarly, subsurface units were considered to "...have a special status..." in 1933, because information about them was considered limited and inferior in comparison to outcropping rocks.

In a long, detailed memorandum (date omitted on available copy, but probably 1947), Richard Foster Flint discussed the use of *stage*, tracing its roots to the 2nd International Congress of 1881, concluding: "It is recommended that the Stratigraphic Code be revised so as to recognize *stage* as a time-rock unit only and to define *age* as the time unit corresponding to stage." Hollis Hedberg stated his agreement to Flint in a letter dated September 24, 1947.

In a long letter (copy undated; 1947?) John Rogers advised Moore "...the rock units, preeminently the formation, be defined solely as *lithologic* units..." but tempered this with "...the idea of a formation as a *unit*, a genetic unit..." And closing: "...I thought however you might be interested to know how one stratigrapher who is trying to use the formation as a lithologic or lithogenic unit is going about applying it in practice."

Wayne V. Jones addressed ACSN in a memorandum on the subject of subsurface units (copy undated; 1947?) noting:

Subsurface units have attained a stature more nearly equivalent to that of surface units during the past fifteen years...

and concluding

Revision of the code is needed in order to give adequate recognition to the increased importance of subsurface units and to set up a more up-to-date and detailed set of rules for their naming.

Hollis Hedberg provided the author with such correspondence and a number of other examples as copies from his extensive files. This material includes such remarkable items as a five-page handwritten response to Hedberg from G. G. Simpson and other thoughtful comments from prominent geologists of the day. Hedberg's massive correspondence was, evidently, in preparation for the second (1947) meeting of ACSN.

This and the literature mentioned below document (1) the receptivity of the geologic community to the forum provided by the new Commission and (2) the profound and intense debate on stratigraphic principles at the highest intellectual levels of the community. It is sometimes necessary to be reminded that our practices are the result of scholarly debate and conscious decisions.

A few selected titles of Reports and Notes from the early years of ACSN will assist in conveying the fundamental nature of debates conducted under its auspices. *Notes* are proposals and reports; *Reports* contain conclusions. Full citations appear in the appended "References" under "NACSN." Notes:

"Nature and Classes of Stratigraphic Units," Moore et al., No. 2, 1947b.

"Naming of Subsurface Stratigraphic Units," Jones and Moore, No. 4, 1948a.

"Definition and Adoption of the Terms Stage and Age," Flint and Moore, No. 5, 1948b.

"Division of Rocks and Time," Hedberg and Commission, No. 12, 1951.

"Unconformity-bounded Units in Stratigraphy," Wheeler, No. 24, 1959.

Reports:

"Declaration on Naming of Subsurface Units," Moore, No. 1, 1949b.

"Nature, Usage, and Nomenclature of Time-Stratigraphic and Geologic-Time Units," Hedberg, No. 2, 1952,

"Nature, Usage, and Nomenclature of Biostratigraphic Units," Hedberg/McKee, No. 5, 1957.

Key publications in addition to the Notes and Reports of the Commission include, and their titles record, the major stratigraphic questions generated following the 1933 Ashley Code that were presented to ACSN (full citations in References):

"Stage as a Stratigraphic Unit," Schenck, Hedberg, and Kleinpell 1936.

"Stratigraphic Terminology," Schenck and Muller 1941.

"Time-Stratigraphic Classification of Sedimentary Rocks," Hedberg 1948.

"Distribution of Mountain-Building in Geologic Time," Gilluly 1949.

"Mountain-Building Chronology and Nature of Geologic Time Scale," Spieker 1956.

Such titles, and there are many more, indicate the basic stratigraphic questions that called for the establishment of a stratigraphic commission and the basic tasks undertaken once ACSN was organized.

At this point it is appropriate to acknowledge the debt of the author and the geologic community to Stanley G. Wissler for meticulously collecting and preserving publications of ACSN and other discussions pertaining to the development of the 1961 Code. Wissler served four terms as Commissioner representing AAPG from 1963 to 1976. His records exemplify the diligence

with which Commissioners have conducted their voluntary assignments over the years.

CODE OF STRATIGRAPHIC NOMENCLATURE 1961-1970

The roots of the “Code of Stratigraphic Nomenclature” published in 1961 (“1961 Code”; cited as ACSN 1961a) lie deep in almost two decades of scholarly discussion. Early in the work of ACSN, it was recognized that major changes in stratigraphic procedures would be necessary. Notice (or warning) was given in the “Records...for 1947-1948,” Note 7 (ACSN 1949a, (Moore)):

Present judgment of the Commission is that attention should be directed to specific questions referred to it and to individual problems the commission itself may initiate for study. Within two or three years it may be advisable to undertake a general revision of the “code” (Ashley et al. 1933) and it is the sense of the Commission...that republication of the revised Code from time to time—say, at five- to seven-year intervals—is desirable, not only with the object of keeping it abreast with progress in stratigraphic science, but in having material published in the Code conveniently available for use of geologists generally (p. 1272).

By 1958, Note 21, prepared by Frye for the Commission, stated:

The American Commission on Stratigraphic Nomenclature announces with the publication of this note that work has begun on a recommended code of stratigraphic classification and nomenclature (p. 1984)...This note calls attention of geologists to the preparation of a new Stratigraphic Code and solicits their assistance by comment and discussion (p. 1985).

Subcommittees of the Commission were established to debate and draft specific sections of a new code; *e. g.* geochronologic and chronostratigraphic units, Pleistocene units, and so on. A flurry of Notes in the period 1958-1961 records these activities.

According to Note 26 (ACSN 1961b, (Murray)), the 15th Annual Meeting of ACSN convened at 9 AM on November 2, 1960 at Denver, Colorado. “Chairman Lohman introduced the third draft of the proposed new stratigraphic code which had been prepared by the Coordinating Committee at a meeting in Washington, D. C., on September 29 and 30, 1960” (p. 672). Approval was moved by Moore and seconded by Gilluly. The record is brief. But the debate must have been extensive, and probably intensive. The Commission became a Committee of the Whole to facilitate debate. When it returned to Commission status, Gilluly moved and Frye seconded a motion “...that the Commission formally adopt the Code...Approval was unanimous” (p. 673). The 1959-1960 Commission adjourned at 10:40 P. M., and, in accordance with normal practice, the succeeding Commission was convened; the meeting finally recessed at 10:55 P. M.!

The new Code was published in the AAPG *Bulletin* in 1961. Its reception was immediate and strong. In the 17th Annual Meeting of ACSN, in addition to the run of the AAPG *Bulletin* itself, Chairman Bolton reported 4,800 copies had been distributed as reprints and AAPG had approved another 3,000 reprints. Forty-one organizations had adopted the Code at that early point, and others were identified during the meeting. Plans were made to translate it into Spanish.

It is perhaps noteworthy that at this same meeting it was reported, “...that the International Subcommittee on Strati-

graphic Terminology had accepted the American Commission on Stratigraphic Nomenclature as a member” (ACSN 1963, (Patton), p. 1990).

Challenges

As noted above, there is a fundamental conflict in classification in that it is both a method and a conclusion. A thread runs through the history of efforts to advance stratigraphy by organized approaches to understanding and conveying the characteristics of rocks in time (codes). An ideal classification requires complete knowledge of the subject in order to convey not only identification, but also information about origins and causes. However, measurement tools are necessary to the process of developing the required knowledge and some form of classification is inherent in that process. The results, at the extremes, may be “pigeon-hole” or “end-member” systems. (An example lies in the dual classification of plagioclase feldspars by names of species or proportion of anorthite.) Many differences of opinion about entities as complex as bodies of rock developed during the evolution of the 1961 Code. The differences are mitigated somewhat by the availability of both formal and informal nomenclature, but the value of the Stratigraphic Commission as an organized forum was tested and validated.

Almost immediately following publication of the 1961 Code, debates arose carried over from its genesis and also from new ideas stimulated by its appearance. The discussions are preserved in formal submissions and as letters to the Commissioners. Some selected examples may serve to demonstrate the dynamic nature of stratigraphic practice. Codes are not static; they reflect the science.

Note 27 (ACSN 1962a) by Frye and Williman addressed “Morphostratigraphic Units in Pleistocene Stratigraphy.” Comments by Richmond followed. Inherent in all this is the persistent idea that Pleistocene units are “different” and require their own stratigraphic specialization, morphostratigraphic and geologic-climate units, for example. By a convoluted route, this became one of the ways that allostratigraphy evolved during discussion preceding the 1983 Code.

The final test of “Pleistocene” units (climate, morphostratigraphic, ectostratigraphic, allostratigraphic, etc.) became whether they were sufficiently fundamental in concept to be useful throughout the geologic column. If not, among other difficulties, it would be necessary to predetermine the Pleistocene age of a unit in order to know whether a particular system of classification could be applied to it. As age determination is one of the final products of stratigraphic analysis, it should not have to be stated *a priori*. This can be considered an extension of the objective/subjective argument.

One geologist seriously and formally described a new unit’s upper contact with the “atmosphere” in an attempt to comply with his understanding of the application of the 1961 Code to surficial units.

“Elimination” of geologic-climate units was vigorously debated at the 1963 Annual Meeting (ACSN 1965a (Cohee)). Such units were eventually dropped from the 1983 Code. Scientific procedures (as well as ideas, principles, and laws) are tested by experience. Tests may require experiments, which take time, in this case 20 years, but the representative forum of NACSN assured due process.

In Note 28, Shaver (ACSN 1962) asked for the Indiana Geological Survey consideration of the possible formal recognition of "...useful beds, members, and formations even though such units also qualify as aquifers, oil sands, coal beds, and quarry layers" p.1935). Clarification did finally appear by amendment to Article 4, Remark (F) agreed at the 1983 Annual Meeting. Significantly, this foreshadowed consideration of "hydrostratigraphic units" in the 1990s and, perhaps, the complication of formal/informal nomenclature by increasing use of geologic names in legal proceedings relating to economic and environmental matters.

Code of Stratigraphic Nomenclature 2nd Edition, 1970

Publication of the Code in 1961 explained many basic elements of stratigraphy that had been decided by the Commission and provided guidance in procedure that was widely accepted. The Notes and Reports of ACSN show, however, that the concise Code document did require some explanatory elaboration and that some fundamental aspects were still debated. The Commission welcomed improvements and recognized that advances in science required adjustment of the Code. The formal process providing for application for amendment served well to ensure orderly reception, discussion, publication, and action on new proposals.

The Notes and Records contain examples of proposals and formal amendments dealing with such diverse aspects of stratigraphy as, for example: morphostratigraphic units; recognition of named aquifers, oil sands, coal beds, and quarry layers; capitalization; use of "stage"; hydrostratigraphic units; and erathem, substage, and chronozone. In 1968, Commissioner Cohee "Reported on printing a revised, up-to-date version of the 1961 Code..." (ACSN 1969, p. 2183 (Kottlowski)). The supply of reprints available at AAPG entered into the discussion of timing of a new publication in addition to the major concern for consolidating the accumulated amendments.

Publication was revisited in the 1969 meeting of ACSN as "Unfinished Business." Commissioner Patton moved "...that the Code of Stratigraphic Nomenclature as amended to date of printing, *i. e.* 1969 or 1970 be published in the *AAPG Bulletin*" (ACSN 1971, p. 1968 (Wilson)). The Commission approved unanimously. The "2nd Edition" was printed by AAPG as a leaflet or reprint, but not in the *Bulletin*.

Although it was resolved that the update of the 1961 Code should be printed in a manner similar to the original, this was not accomplished. The *AAPG Bulletin* was the intended outlet, but AAPG resisted devoting new pages to this purpose. This is indicative of a tension that has occurred occasionally between NACSN and AAPG's editors. The *AAPG Bulletin* is a desirable outlet because of its audience, wide distribution, and respected authority; however, some editors have questions NACSN's offerings as new science or as records of the petroleum industry. Nevertheless, all of NACSN's Notes and Reports, except one, have been published by AAPG, the exception appeared in the *GSA Bulletin* in order to resolve a temporary impasse. The Code itself appears in stratigraphy textbooks, and has, in its then current versions, been reprinted with permission.

Continuing Debate

During the effective time of the 1961 Code (1961-1970-1983), the rock/time-rock/time subject resurfaced, fueled in large part by the contrast between the 1961 ACSN Code and the developing Stratigraphic Code of the USSR (Zhamoida et al. 1977),

with some of the debate filtered through ISSC. This excerpt from the Record of the 21st (1966) Annual Meeting is illustrative:

Hollis D. Hedberg reported on activities of the International Commission...there was a strong feeling that work should go ahead on the preparation of an international code. A translation of the USSR Code has appeared. There is some objection to regarding lithostratigraphy as a part of stratigraphy in the USSR and there is a considerable body of opinion among U. S. stratigraphers against the differentiation of chronostratigraphy and biostratigraphy; many stratigraphers claim that time and time-stratigraphic units cannot be separated (ACSN 1967 (Harker), p. 1867).

As recorded in an addendum to the record of the 23rd (1968) Annual Meeting:

At the 1968 meeting of UNESCO, the International Geologic Correlation Program was accepted. George Cohee was appointed Liaison Commissioner for ACSN to work with Hollis Hedberg, UNESCO, and the International Union of Geological Sciences. Cohee will keep the Commission informed of all IGCP activities and decisions (ACSN 1969 (Kottlowski), p. 2186).

When considering the international exchanges of information and positions during the 1960s and 1970s, it is helpful to remember that the Cold War was in full progress. Disagreements in principle were easily characterized as being "American" or "Russian." "Dogma" sometimes surfaced as an accusatory term. Throughout, translations of the USSR Code and information about its implementation were eagerly sought, but sometimes difficult to obtain, in the West.

Correlation of Stratigraphic Units of North America

With the establishment of the project "Correlation of Stratigraphic Units of North America" (COSUNA) by AAPG in 1974, regular liaison with that large group, which had many shared appointments, was developed, largely through reports by Orlo Childs. COSUNA stimulated the organization of stratigraphic information much as had the "GSA Correlation Charts" several decades earlier.

Discussion of submarine units, subdivision of the Precambrian, nomenclatural hierarchy, magnetic-polarity classification, and igneous and high-grade metamorphic classification and more was brought to the Commission during this period. The need for and usefulness of the standing body envisioned by its founders was repeatedly validated.

NORTH AMERICAN STRATIGRAPHIC CODE OF 1983

The subject of "substantial amendment" or revision of the 1961/1970 Code begins to emerge in ACSN documents by 1976, Recognition of need for a revision gained momentum and, in 1977 it was decided to appoint a "Code Committee" which would, in turn appoint "...official subcommittees: Lithostratigraphic Units, Biostratigraphic Units, and Chronostratigraphic and Geochronologic Units..." and provide for additional advisory groups.

It may be recalled that this was a particularly productive and exciting period in geologic studies as the concepts of plate tectonics, bolide impacts, mass extinction, and expanded dating techniques were published and debated and petroleum exploration pushed into new frontiers on and off-shore with improving geophysical and drilling techniques. Seismic stratigraphy burst

onto the scene and quickly advanced toward sequence stratigraphy. New ideas of tectonics reinforced ideas about tectonostratigraphy and discontinuity-bounded units.

At the 33rd Annual Meeting at Toronto in 1978, Steven S. Oriel accepted chairmanship of the Code Committee and the Commission elected Malcolm P. Weiss Chairman and Robert R. Jordan Vice-Chairman-Secretary, an overall administration subsequently maintained as desirable to stability throughout the gestation of the 1983 Code (1978-1982). A basic decision was taken to develop a “new” Code, not to continue to amend the existing Code.

Forums and Writing conference

“Workshops to Revise the American Stratigraphic Code,” proposed on behalf of the Commission by William H. Hay of the Rosenstiel School of Marine and Atmospheric Science of the University of Miami in 1979, was funded by the National Science Foundation. The summary of the proposal stated:

Revision of the Code is needed for several reasons. The current Code (ACSN 1970) is but a slightly revised version of the Code written largely in 1960 and earlier (ACSN 1961), incorporating some minor amendments adopted by the Commission between 1962 and 1969. Although the present code has served the profession admirably for almost two decades and has been drawn upon heavily for codes prepared in other parts of the world, it reflects the state of the science at the time of its preparation. New tools and concepts developed during the past two decades have revolutionized the earth sciences. Seismostratigraphy and magnetostratigraphy, unrecognized then, are helping now to define the geometry and history (sic) of earth materials. Improved capability to drill at great water depths is helping to develop the framework of oceanic stratigraphy. The concept of subduction has led to recognition of both the complexity and significance of melanges. Yet the special needs of workers in these various fields are inadequately addressed by the current Code (Hay 1979, Exhibit II-8).

Partial support, largely for travel expenses, in the amount of \$40,000 was requested for open forums, advisory group, subcommittee, and Code Committee meetings during 1979, 1980, and 1981. A significant “writing conference” was also held at the end of the period of discussion in order to develop the final draft of the new Code by members of the advisory groups, Code Committee, and Commission.

The code-writing process produced several drafts of sections and of the complete document. In addition to the open sessions held at AAPG and GSA meetings and the several meetings of the Commission and its subcommittees and advisory groups, drafts were widely circulated for comments. Much of this material is now preserved in the Archives of NACSN and documents the openness and diligence of the process.

The rules of NACSN require that amendments of the Code (including, of course, writing the new Code) must be (1) formally proposed, (2) accepted for publication by the Commission, (3) stand for comment for one year as published, and only then (4) be adopted, rejected, or modified by formal action.

The draft Code was printed and widely distributed through the generosity of the Canadian Society of Petroleum Geologists (CSPG). Discussion at the point ranged widely, but the topics receiving most intense consideration were unconformity-bounded units and allostratigraphy. These subjects

would determine whether, after five years of work, the revision would be accepted.

Changing the name of the Commission to *North American Commission on Stratigraphic Nomenclature* (NACSN) was proposed and formally adopted in 1979. This name finally reflected accurately the international nature of the Commission and the substantial participation of Canadian and Mexican stratigraphers.

Development of the 1983 Code

The North American Stratigraphic Code was ultimately published in 1983 (NACSN 1983). It contains in “Part III: Addenda” important references to the literature involved in its generation, lists of memberships of the Code Committee, subcommittees, advisory groups and conferees. Also listed are Commissioners that served during the development period of the “revision.” A bibliography of the NACSN Reports (1-9) and Notes (1-52) is included. (Some inconsistencies may exist in numbering Notes in various lists of the publications.) As that version of the Code is widely available, it is possible to identify the principal contributors by this reference without diminishing their importance and burdening this paper with additional lists.

It is, however, desirable to especially record the Code Committee: Steven S. Oriel, Chairman, Hubert Galbrielse, William H. Hay, Frank E. Kottowski, and John B. Patton, and the chairmen of the related bodies:

Lithostratigraphic Subcommittee	James D. Aiken
Biostratigraphic Subcommittee	Allison R. Palmer
Chronostratigraphic Subcommittee	Zell E. Peterman
Plutonic-metamorphic Advisory Group	Jack E. Harrison
Magnetostratigraphic Advisory Group	Roger W. Macqueen
Volcanic Advisory Group	Richard V. Fisher
Tectonostratigraphic Advisory Group	Darrel S. Cowan
Quaternary Advisory Group	Norman P. Lasca

Debate, Involvement, Result

The “Preamble” of the 1983 Code notes that from the forums alone, comments were received from more than 150 geologists. More than 50 responses to the published draft were also received. The particular contributions of Hollis Hedberg and Amos Salvador as chairmen of ISSC were acknowledged. The 1983 Code represented itself as a product of the entire North American geologic community, and the records verify that claim. In contrast, a representative committee developed the 1933 Code. The 1961 Code resulted from action of a formal Commission working primarily through publication and mail correspondence. The “2nd edition (or revision) of 1970 was a compilation of accumulated amendments approved within the commission. The 1983 Code benefited from support for open forums, wider representation, and more general communication than had ever occurred previously for such an effort.

David S. Fullerton, who served as a Commissioner for USGS during the development of the 1983 Code is among those who most carefully preserved drafts and correspondence; he has shared several kilograms of such paper with the author. The length and depth of the comments from many sources (as well as the strength of some of their language) testify to the involvement of the geologic community in this project. Fullerton’s papers, together with the author’s, and those of other participants will be placed in the NACSN Archives (see below) where, it may be hoped, they will be consulted by future stratigraphers

for authoritative evidence of the state of the science around 1980.

At the 37th Annual Meeting of NACSN, held October 19, 1982 at New Orleans (NACSN 1986 (Jordan)), Chairman Weiss "...advised that the Code was to be considered as a unit, noting that it had been under consideration for 4 1/2 years and that the commission should determine whether the product was acceptable" (p. 100). The request was not received without considerable debate. Interestingly, a motion to delete allostratigraphy, which may be considered to have anticipated or even subsumed unconformity-bounded units, sequences, and other such discontinuity-defined units, was defeated by one vote (p. 100). Finally, "...Chairman Weiss called for a vote on the motion to adopt the Code as submitted. The motion was approved with one vote opposed" (p. 100).

Subsequent motions provided for the effective date of the new Code, vacating previous codes, editorial corrections, submission to AAPG for printing, and discharge of the Code and related committees with gratitude. The Code formally appeared in the AAPG *Bulletin* for May 1983 (NACSN 1983) and was made widely available as a reprint by AAPG.

Robert L. Bates captured the sense of reaction by much of the geologic community. Although acknowledging some negative comment, he wrote:

Well, I've taken the trouble to consult the new code, in the May AAPG *Bulletin*, and I must say I don't think it's all that bad. As an effort to classify the unclassifiable, name the unnamable, and pin down the unpinnable, it's a nice job—and, more to the point here, even readable if you're a true seeker after the stratigraphic word (Bates 1983, p. 38).

Records and Documentation

NACSN recognized that the events and, especially, the discussions recorded in minutes, correspondence, and publications might be of interest, even of value, to future geologists and historians of science. It should be remembered that the minutes of each NACSN meeting are more extensive and detailed records than the published Notes. The Commission has respected the need to honor brevity in publication, particularly in its publishing partnership with AAPG, while also leaving a full accounting of its work for the scrutiny of the community it serves.

Commissioner Norman P. Lasca led the establishment of a formal archive for NACSN materials at the Golda Meir Library of the University of Wisconsin-Milwaukee. The Archives may be addressed at www.uwm.edu/Library/archives/findaids/ags001.htm

The formal citation for the NACSN Archives appears in the References.

Relationship to the Guide and to Other Codes.

Interaction with the International Subcommittee on Stratigraphic Classification (ISSC) runs through the records of NACSN. ISSC Presidents (Chairmen) Hedberg and Salvador regularly participated in NACSN meetings. A strong indication of the close relationship of the two international bodies can be seen in the title alone of Note 32: "American Commission on Stratigraphic Nomenclature Definition of Geologic Systems, International Subcommittee on Stratigraphic Classification" (ACSN 1965b (Hedberg)).

Perhaps coincidentally, but nevertheless interestingly, NACSN and ISSC have alternated in producing "codes" and "guides" at roughly 20-year intervals. Jordan (2004) found a tendency for 20-year periodic reviews of stratigraphic procedures over a 200-year span. Attempts at coordination of mutually stimulating international activities have continued into the 21st Century.

CONSOLIDATION AND INTRUSION

Although the process by which the 1983 Code was developed sought involvement of all interested geologists, the published result did require some explanation. A few internal contradictions in the compact but complex document were corrected, clarification was added to a few points that proved less clear to the community than the Commissioners, and, of course, a few disappointed practitioners were heard. The theme for several years was to enhance acceptance and application of a Code considered to be fundamentally sound. NACSN has consistently recognized that usefulness is the test of its judgments. The new Code was announced (Jordan 1983), explained (Owen 1987), and defended (Easton, et al. 1993).

As the science advanced, concepts were discovered or rediscovered and brought forward for consideration. This process may have been in part stimulated (not satisfied) by the demonstration that a stratigraphic code could indeed be modified, amended, revised, and rewritten.

Within this period of consolidating the advances of the 1983 Code simmered a long-term, and continuing question involving the possibility of formalizing (codifying) procedures and nomenclature for sequence stratigraphy. For many this became a crosscutting intrusion into all other aspects of stratigraphy.

Accumulations

In 1997, NACSN became a "Member Society" of the American Geological Institute (AGI). This action reflected the Commission's broad and varied relationships with the general geologic community, which indeed it represents. The step was graciously endorsed by Canadian and Mexican Commissioners.

Ever since establishment of the International Subcommittee on Stratigraphic Classification (ISSC) in 1952, NACSN encouraged communication and, where deemed appropriate, coordination. From the beginnings Hollis Hedberg and Amos Salvador were prominent in both organizations. In 1998, NACSN became officially represented on ISSC (other commissioners had been and are "Individual" members), with Norman P. Lasca designated as Representative and Bruce C. Wardlaw Alternate.

Electronic communication and publication received increasing attention by the Commission during the decade of the '90s. USGS and others digitized the Code and effort was devoted to incorporating amendments and assuring uniformity of products. The NACSN web page was established in the AGI server in 2001 primarily through the work of Commissioner Randall C. Orndorff. The "North American Stratigraphic Code Revised June 2003" (Preliminary) became available on CD in that year primarily through Orndorff's work. This was followed under date of October 30, 2003 by the Spanish language version "*Código Estratigráfico Norteamericano*" prepared by Commissioner Ismael Ferrusquia-Villafraña.

The possibility of incorporating hydrostratigraphic units in the Code was given consideration over a period of several years. Paul R. Seaber and Keros Cartwright proposed the subject and

worked with the Commission to formulate recognition of units based on hydraulic properties. The journey of this proposal illustrated the thorough nature of NACSN's amendment procedure. Publication of the proposal in this case required a detailed explanation. Although assisted by Commissioners, notably Robert H. Fakundiny, the process proved laborious. Although directed to water, questions arose about potential application to other fluids such as oil and gas sands and sources and traps. Aquifers (and oil and gas sands) have a long history of informal names and may or may not benefit from formalization. Ultimately, the proposal was formally withdrawn by its authors at the 55th Annual Meeting in 2000.

The record reflects the efforts of the Commission to continue to refine the 1983 Code and respond to questions and suggestions of practitioners. Productive work of this type is illustrated by approval of amendments in 2002 accepting electronic publication of stratigraphic names, refinement of the definition of allostratigraphic units, and clarification of biostratigraphic units in Notes 63 and 64 (NACSN, 2001a (Ferrusquia-Villafranca); 2001b (Lenz)).

At NACSN in 2005, Commissioner Orndorff reported the 2005 edition of the Code was published in the AAPG *Bulletin* (NACSN, 2005) and that free download from the NACSN website was planned. This was the culmination of several years of work by Orndorff to incorporate amendments and "corrections" within the digitized Code and also to accomplish print publication by AAPG.

At the same 2005 meeting, John Van Couvering proposed the journal *Stratigraphy* be adopted as the journal of record for NACSN. The diligent, albeit sometimes reluctant, contribution of AAPG in publishing all but one (NACSN 1980 (Harrison and Peterman)) of NACSN's Notes and Reports over 60 years was appreciatively noted. *Stratigraphy* was, however, approved as the NACSN journal of record.

Sequence Stratigraphy

The long history and enormously successful use of sequence stratigraphy and its antecedents in the petroleum industry is reflected in 20 years of NACSN minutes. Although the subject does not specifically appear in the Code to the date of this account (except as "innovative approaches to regional stratigraphic studies"), the subject was absolutely not neglected and in fact occupied much of the Commission's attention. NACSN designated Commissioner Donald C. Owen and others to develop and further encourage liaison with practitioners in the petroleum industry. With the blessing of NACSN, Commissioner Ernest A. Mancini organized an AAPG Hedberg Conference "Sequence Stratigraphic and Allostratigraphic Principles and Concepts" with Commissioners Edwards, Jordan, Mancini, and Owen together with Amos Salvador serving as the Program Committee. The scope is suggested by the list of "conference Hosts": AAPG, ISSC, NACSN, and PTTC (Petroleum Technology Transfer Council). Commissioner Mancini reported the success of the Hedberg Conference to the 56th Annual Meeting in 2001, emphasizing conclusions that formalizing sequence units in the Code was undesirable and should be revisited in 10 years, but that the importance of its informal status should be noted by the Code. Further, allostratigraphy should not be abandoned, and should include volcanics. In addition, reconciliation of allostratigraphic units (Code) with "unconformity-bounded units (ISSC Guide) was encouraged (Mancini, 2001; NACSN Minutes, 2001).

Relationships with scientists and organizations beyond North America intensified with the approach of the International Geological Congress (IGC) of 2004, propelled in part by interest in sequence stratigraphy. ISSC Chair Maria Bianca Cita attended the 58th (2003) Annual Meeting of NACSN and discussed "revitalization" of ISSC and its work on cyclostratigraphy and sequence stratigraphy. Commissioner Ashton Embry elaborated on the inconclusive efforts of ISSC's Sequence Stratigraphic Working Group of 1995-2001. Significant additional cooperative steps developed with plans for the 32nd IGC at Florence, Italy in 2004. ISSC sponsored one symposium on stratigraphy and Gian Battista Vai and Commissioners Edwards and Jordan organized another. The activities of the subsequent IGC "workshops" "Unconformity/Disconformity Bounded Units" and "Post-Hedberg Developments in Stratigraphic Classification" were reported to NACSN at the 59th (2004) Annual Meeting. For historians of science, the exquisite volume compiled and largely written by Gian Battista Vai in connection with the 32nd IGC is of fundamental interest. The roots of the discipline of stratigraphy from Steno through the transfer of European concepts to North America in the mid-19th Century and on to current considerations are eloquently presented (Vai and Cavazza, 2003).

The 61st Annual Meeting of NACSN in 2006 included important discussion and debate on aspects of sequence stratigraphy crystallized by Commissioner Octavian Catuneanu's development of an "International Working Group on Sequence Stratigraphy" independent of NACSN, but including three Commissioners and intended to inform the Commission of an up-to-date consensus. Ashton Embry presented somewhat contrasting continuing efforts by ISSC. NACSN called for reports from both units for its next meeting.

Accommodation Space

A fundamental procedural question was raised at the 2006 meeting by a proposal that SEPM (Society for Sedimentary Geology) be included as a member organization with Commissioners formally assigned to NACSN. Robert Dalrymple, Howard Harper, and Vitor Abreu represented SEPM and eloquently argued its case. The matter was basic because of NACSN's conception as a representative body with membership limited to the broadest constituencies so as to be capable of achieving authoritative consensus by a group of manageable size with, of course, the ability to call for assistance when needed from the general geologic community. For 60 years expansion of membership had been limited to avoid redundancy and unwieldy numbers. The SEPM delegation, however, were persuasive and NACSN welcomed the enthusiasm of new members and invited SEPM to appoint two Commissioners as it moved to modify the Bylaws to include SEPM as a member organization. Similarly, the Bylaws were modified to include the Servicio Geologico Mexicano, which was formed from the former Consejo de Recursos Minerales (Mineral Resources Counsel).

CORRELATION

It is hoped that readers will join in concluding that NACSN has steered a prudent and constructive path through the years of extraordinary development of the science of the Earth and that by so doing has contributed positively, as intended, to the enterprise. The Commission itself has not been static, but has deliberately reflected and encouraged expanding knowledge. The present account is offered as a tribute to the Commissioners and

their associates who have given so generously of their wisdom, their influence, and their good will.

Perhaps recalling the historical debates about concepts and the development of the web of interdisciplinary and international relations will help future Commissioners and practitioners avoid repetition and to move ahead. Even though the participants must necessarily change over generations, continuity and consistency in procedure can be beneficial.

Geologists might also agree that the organization of the materials and events of the history of Earth is a basic scientific exercise with essential economic benefits and, further, that the ability to unambiguously communicate results of such organization of diverse entities is highly useful. Imagination and creativity are valued in formulating hypotheses appropriate to exploration of the deep past represented by only fragmental evidence. The ability to constructively organize a methodology within the vast and varied field of geology is rare. Stratigraphy has benefited from the cooperative efforts of its practitioners; successors should be encouraged to continue the quest. The Foreword and Preamble of the 1983 Code are recommended to all geologists, but especially to those who seek to contribute to the future goals of NACSN. From the Foreword:

Take this Code, use it, but do not condemn it because it contains something new or not of direct interest to you. Innovations that prove unacceptable will expire without damage to other concepts and procedures...Any code necessarily represents but a stage in the evolution of scientific communication (NACSN 1983, p. 841).

Even broader perspective on the worthy efforts of the commissioners, past, present, and future, may be found in Boorstin's "The Discoverers," coincidentally of the same date as the Code—1983:

The first grand discovery was time, the landscape of experience. Only by marking off months, weeks, and years, days, hours, minutes and seconds, would mankind be liberated from the cyclical monotony of nature. The flow of shadows, sand, and water, and time itself translated into the clock's staccato, became a useful measure of man's movements across the planet. The discoveries of time and space would become one continuous dimension. Communities of time would bring the first communities of knowledge, ways to share discovery, a common frontier on the unknown (p. 1).

Deposition on the scale of the continent of North American will, of course, be continuous; however, a gap in this record must develop at this point. It may be interesting, or at least amusing, to learn whether in the future this will be considered a discontinuity, hiatus, lacuna, or some sort of surface or unconformity.

ACKNOWLEDGMENTS

Hollis D. Hedberg encouraged the author and generously and graciously provided copies of correspondence from his personal library. Such materials will be placed in the NACSN Archives. In the original plan for this paper Dr. Hedberg would have covered the first 30 years of so of the Commission and the present author the last half of the story. If Dr. Hedberg had lived beyond 1988, this account would have been more complete, elegant, and prompt.

Commissioners Lucy E. Edwards, David S. Fullerton, and Randall C. Orndorff of the USGS all kindly provided informa-

tion and comment on several of the drafts. Commissioner Walter L. Manger tried heroically to salvage an electronically mangled draft and offered helpful editorial comment. Commissioner John A. Van Couvering completed the electronic rescue. Commissioner Norman P. Lasca provided both archival information and editorial correction.

Dorothy C. Windish maintained the "lists" of Commissioners and meetings distributed to NACSN by the author for about 25 years.

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APPENDICES

An objective of this account is to acknowledge geologists who have contributed to NACSN and science by serving as Commissioners. The complete records of members, officers, and meetings since 1946, originally prepared as Appendices II to V of this paper, have been placed on the official NASCN website at <<http://www.agiweb.org/nacsn>> as the basis of what is intended to be a regularly updated or "living" archive, freely available to the public. These records are appropriately accompanied by the works of the Commission, in the form of the current version of the Stratigraphic Code, and eventually with copies of the Commission publications (see References, Part I).

The names of individual Commissioners should be noted because their distinguished reputations impart authority to the actions of NACSN. It is also important that those who learn and use the Code understand that it is the work of colleagues with whom they can participate and may aspire to join.

Appendix 1

Organizational meeting of "ACSN," December 1941.

Following an exchange of correspondence, a conference to establish a commission on stratigraphic nomenclature was arranged to be held during the meeting of the Geological Society of America in Boston, December 29 and 30, 1941 (Hake and Moore 1942). The attack on Pearl Harbor just three weeks earlier, and the war effort that followed, delayed implementation of the plans that were agreed at this meeting until 1946.

The geologists who were delegated to represent the several organizations conferred at the Hotel Statler, Boston, during both days of the meeting. Those present included: for the American Association of Petroleum Geologists, B. F. Hake; for the American Association of State Geologists (sic), G. H. Ashley, P. H. Price, and A. C. Trowbridge; for the Geological Society of America, C. O. Dunbar, G. Marshall Key, and W. H. Twenhofel; for the Geological Survey of Canada, G. S. Hume and G. A. H. Norman; and for the United States Geological Survey, W. W. Rubey and L. W. Stephenson; R. C. Moore, at large. Appointed representatives who were unable to be present included: for the American Association of Petroleum Geologists, M. G. Cheney and E. H. Sellards; for the Geological Survey of Canada, W. H. Bell; and for the United States Geological Survey, J. B. Reeside, Jr.