Meetings

Deep-Sea Stratigraphy

Pleistocene stratigraphy of deep-sea sediments has aroused considerable interest since 1935, when W. Schott demonstrated that such sediments contain a record of world climate. Many research programs have evolved from this study, different in approach but with similar goals: definition of the Pleistocene series and of the glacial and interglacial units within it, and measurement of Pleistocene time. Approaches to such studies have included the evaluation of assemblages of planktonic Foraminifera, characteristics of nannoplankton, and geochemical analyses (including absolute-age determinations and paleotemperature measurements). Because of wide differences among the interpretations of results derived through these various means of study, a conference—supported by the National Science Foundation—on deep-sea stratigraphy was held in New York City and at the Lamont Geological Observatory of Columbia University, 22–23 January 1965. The primary aim of the conference was the exchange of information and ideas on (i) the position of the Pliocene-Pleistocene stratigraphic boundary, particularly in deep-sea sediments; (ii) the criteria used in estimating past temperature variations from the deep-sea sediment record; and (iii) the correlation of stratigraphic parameters in deep-sea sediments with continental events during the Pleistocene.

The participants were O. L. Bandy (USC), W. B. Benson (NSF), M. N. Bramlette (La Jolla), W. S. Broecker (Lamont), C. Emiliani (Miami), D. B. Ericson (Lamont), J. F. Evernden (Berkeley), M. Ewing (Lamont), R. F. Flint (Yale), J. D. Hays (Lamont), J. F Imbrie (Columbia), J. Jones (Miami), L. Lidz (Miami), T. Saito (Lamont), D. L. Thurber (Lamont), K. K. Turekian (Yale), and G. Wollin (Lamont). No formal papers were presented and no firm conclusions were reached, but an attempt was made to define significant areas for future research.

The initial discussion dealt with the classical Plio-Pleistocene sections and the criteria used to define them. It was noted that the Plio-Pleistocene boundary presently recognized by the International Geological Congresses of 1948 and 1952 is based on the first appearance of fossils with boreal affinities in marine sediments of the circum-Mediterranean region. However, in that region, paleotemperature and micropaleontological analysis by Emiliani, Mayeda, and Selli failed to reveal large temperature variations across the boundary. Thus no age determination is available. Subsequent discussion of seven sections scattered from England to New Zealand stressed the difficulty of correlation by fossils, the lack of absolute ages, and the uncertainty of paleoclimatic evidence.

The search for criteria for defining the Pliocene-Pleistocene boundary on a broader geographical basis led Ericson, Ewing, and Wollin to propose certain large micropaleontological changes noticed in eight cores from the Atlantic and Indian Oceans. They suggested a boundary at the position of the most recent change in coiling direction of the pelagic-foraminiferal species *Globorotalia menardii*. Paleotemperature analysis of two of the Atlantic cores by Emiliani revealed only insignificant temperature variations across the proposed boundary, suggesting (but not proving) sedimentary continuity. Bandy, using evidence from strata now above sea level in the Philippines and other western Pacific areas, stated the species such as *Globigerina nepenthes, Sphaeroidinella seminulina, S. subdehiscens, Globoquadrina altispira altispira*, and *G. altispira globosa* occur in significant numbers within the "Pliocene" of Ericson and are restricted to the Miocene throughout many areas of the world. This assemblage is typical of the upper Miocene. Also it underlies, in many parts of the world, a series of Pliocene assemblages that Bandy believed are missing in the cores studied by Ericson *et al.* because of hiatus that represents most of the 10 million years of Pliocene time.

The major climatic changes reflected in the "classical" European Pleistocene sequence were used by Ericson and associates as a basis for correlating the number of glacial and nonglacial units in deep-sea cores indicated by *Globorotalia menardii*, down to the horizon they called the Plio-Pleistocene boundary. It was agreed that the correlations among the several core segments used in the extrapolation are good in the top part of the sequence, but become less satisfactory below. The direction of correction, if any, would be to increase the length of the Pleistocene section.

Emiliani maintained that oxygen-isotope ratios, relative abundances of species of pelagic Foraminifera especially restricted to warm waters (*Sphaeroidinella dehiscens* and *Pulleniatina obliquiloculata*), ratios of these species to the temperate species *Globigerina inflata*, and weight percentage of the sediment fraction larger than 62 microns tend to produce mutually consistent temperature estimates in some cores. He held that temperature estimates by Ericson, based on relative abundance of *Globorotalia menardii*, are consistent with those obtained by other methods, only for the last 100,000 years. Emiliani concluded that inconsistencies are apparent below, and therefore believed that relative abundances of *G. menardii* cannot be used as a reliable temperature indicator and that the validity of the temperature reconstruction by Ericson and associates remains questionable.

Imbrie suggested that multivariate analysis might show quantitatively which species, species ratios, or other parameters are most convenient for estimating temperature and other environmental factors. Saito, speaking for A. W. H. Bé, questioned the use of *Sphaeroidinella dehiscens* as a warm-water indicator because this "species" may result from further deposition of shell material on shells of *Globigerinoides sacculifera* at considerable depth, and therefore at relatively low temperature. Bandy, on the other hand, questioned Bé's conclusion that *S. dehiscens* develops from *G. sacculifera* on the basis that the adult specimens of both species reach similar sizes. The restriction of *S. dehiscens* to low latitudes was in any case recog-

nized, together with the possibility of using this species as a "pragmatic" warm-water indicator. Ericson stated that *Globorotalia menardii* was used as a climatic indicator because of its abundance in the upper portions of the cores, and because this criterion can be easily utilized to process the large number of cores at Lamont.

Other criteria for temperature estimates may be available. Bandy stated that in southern California *Globigerina pachyderma* is right-coiling in the interval back to 11,000 years before the present; it is left-coiling in Pleistocene segments, right-coiling in the upper Pliocene, left-coiling in the middle Pliocene, and right-coiling in the lower Pliocene. In modern seas, polar populations of *G. pachyderma* are predominantly left-coiling, whereas warm-temperature populations are right-coiling. Therefore in boundary areas between these populations, such as in the Pacific northwest, variations in currents from time to time may result in changes in coiling populations of *G. pachyderma*, reflecting significant changes in water temperature. *Globorotalia truncatulinoides*, on the other hand, is dextrally coiled in tropic, subtropic, and eastern temperate and subpolar waters of the North Atlantic. However, sinistral coiling prevails in western temperate and subpolar zones. Apparently coiling is independent of temperature and is useful for intercore correlation.

The participants agreed that forthcoming programs directed at coring deep-sea sediments in continuity, from drilling vessels, will provide cores for the solution of some problems discussed.

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Forthcoming Events

August

17–27. **Infrared Spectroscopy**, 16th annual inst., Fisk Univ., Nashville, Tenn. (Director, Fisk Infrared Inst., Fisk Univ., Nashville 8)

18–20. American **Astronautical** Soc., natl. meeting, San Francisco, Calif. (J. N. Nielsen, P.O. Box 642, Los Altos, Calif.)

18–25. Upper **Atmosphere Chemistry** Circulation and Aerosols, symp., Intern. Assoc. of Meteorology and Atmospheric Physics, Visby, Sweden. (The Association, Commission of Atmospheric Chemistry and Radioactivity, c/o Natl. Center for Atmospheric Research, Boulder, Colo.)

20–21. American Inst. of **Ultrasonics in Medicine**, 1st Pan American meeting, Lima, Peru. (C. Bustamante Ruiz, Dept. of Physical Medicine and Rehabilitation, Hospital Obrero, Lima)

21. American Assoc. of **Electromyography and Electrodiagnosis**, annual, Philadelphia, Pa. (M. K. Newman, 16861 Wyoming Ave., Detroit, Mich. 48221)

21. **Spectroscopy**, 5th, Intern. Union of Pure and Applied Physics commission, Copenhagen, Denmark. (W. Price, Dept. of Physics, Kings College, Univ. of London, London, W.C.2, England)

21–25. **Insect Endocrinology**, symp., Prague, Czechoslovakia. (F. Hrabal, Foreign Relations Dept., Czechoslovak Acad. of Sciences, Narodni tr. 3, Prague 1)

22–25. **Soil Conservation** Soc. of America, Philadelphia, Pa. (H. W. Pritchard, 7515 Ankeny Rd., Ankeny, Iowa)

22–27. **Medical Electronics and Biomedical Engineering**, Tokyo, Japan. (K. Suhara, Japan Soc. of Medical Electronics and Biological Engineering, Old Toden Bldg., 1-1 Shiba-tamura-cho, Minato-ku, Tokyo)

22–27. **Microchemical Techniques**, intern. symp., Pennsylvania State Univ., University Park. (H. Francis, Jr., Pennsalt Chemicals Corp., 900 First Ave., King of Prussia, Pa.)

22–27. American Acad. of **Physical Medicine and Rehabilitation**, Philadelphia, Pa. (M. K. Newman, 16861 Wyoming Ave., Detroit, Mich. 48221)

22–28. Physiology of Giant **Algal Cell**, conf., Australian Acad. of Science, Canberra, Australia. (The Academy, Gordon St., Canberra)

22–28. **Industrial Research**, 16th annual conf., Tuxedo, N.Y. (R. T. Livingston, School of Engineering and Applied Science, Columbia Univ., New York, N.Y.)

22–28. **Lunar Geology**, intern. field conf., Bend, Ore. (L. Staples, Dept. of Geology, Univ. of Oregon, Eugene)

23–25. **Cryogenic Engineering**, conf., Houston, Tex. (K. D. Timmerhaus, Engineering Research Center, Univ. of Colorado, Boulder 80304)

23–25. American Soc. of **Human Genetics**, Seattle, Wash. (J. B. Graham, Dept. of Pathology, Univ. of North Carolina, Chapel Hill)

23–25. **Plant Phenolics** Group of North America, annual, Albany, Calif. (V. C. Runeckles, Imperial Tobacco Co. of Canada, P.O. Box 6500, Montreal, Quebec)

23–26. **Clay Minerals** Soc., 2nd annual, Univ. of California, Berkeley. (J. A. Pask, Dept. of Mineral Technology, Univ. of California, Berkeley 94720)

23–26. **Quantum Chemistry**, Physical Chemistry Div., Chemical Inst. of Canada, Edmonton, Alta. (The Institute, 48 Rideau St., Ottawa 2, Ont.)

23–27. Control Procedures in **Drug Production**, seminar, Univ. of Wisconsin, Madison. (W. Blockstein, Extension Services in Pharmacy, Univ. of Wisconsin, Madison)

23–27. **Neurological Surgery**, 3rd intern. congr., Copenhagen, Denmark. (DIS Congress Service, Sankt Peders Straide 19, Copenhagen K)

23–27. American **Ornithologists** Union, Ohio State Univ., Columbus. (R. Mewaldt, San Jose State Teachers College, San Jose, Calif.)

23–27. **Space**, 5th annual conf., Virginia Polytechnic Inst., Blacksburg. (M. L. Collier, Jr., Virginia Polytechnic Inst., Blacksburg)

23–28. American **Physiological** Soc., Univ. of California, Los Angeles. (R. G. Daggs, 9650 Wisconsin Ave., Washington, D.C. 20014)

23–29. European Soc. of **Haematology**, 10th congr., Strasbourg, France. (R. Waitz, Faculté de Médecine, Inst. d'Hématologie, 1, Pl. de l'Hôpital, Strasbourg, Bas-Rhin, France)

23–29. **Logopaedics and Phoniatrics**, 13th intern. congr., Vienna, Austria. (Mrs. A. M. Jorg, Vienna Acad. of Medicine, Alserstr. 4, Vienna 9)

23–30. **Limnology**, 16th intern. congr., Warsaw, Poland. (G. E. Hutchinson, Yale Univ., New Haven, Conn.)

24–26. Association for **Computing Machinery**, 20th natl. conf., Cleveland, Ohio. (G. J. Moshos, Post Office Box 4741, Cleveland)

24–26/28–29. **History of Science**, 11th intern. congr., Warsaw and Krakow, Poland. (W. Voisé, Inst. of the History of Science and Technology, Polish Acad. of Sciences, Nowy Swiat 72, Room 19, Warsaw 1)

24–27. Western **Electronic** Conv. (WESCON), San Francisco, Calif. (E. L. Rogers, Wescon, Suite 203, 780 Welch Rd., Palo Alto, Calif.)

24–27. **Pharmaceutical Sciences**, 25th intern. congr., Prague, Czechoslovakia. (Pharmaceutical Section, Czechoslovak Medical Soc., J. E. Purknye, U Elektry 8, Prague)

24–28. **Electron Microscope** Soc., 23rd annual, New York, N.Y. (L. Ross, Anatomy Dept., Cornell Univ. Medical College, 1300 York Ave., New York)

25–27. **Gas Dynamics**, 6th biennial conf., Evanston, Ill. (A. B. Cambel, Gas Dynamics Symp., Northwestern Univ., Evanston 60201)

25–27. **Thymus**, Ciba Foundation symp., Melbourne, Australia. (Ciba, 41, Portland Place, London, W.1, England)

25–27. **X-Ray Analysis**, 14th annual conf., Denver, Colo. (Metallurgy Div., Denver Research Inst., Univ. of Denver, Denver 80210)

25–28. Systems Engineering for **Control System Design**, Tokyo, Japan. (H. M. Paynter, Mechanical Engineering Dept., Massachusetts Inst. of Technology, Cambridge 39)

25–28. **Photochemistry**, intern. conf., Tokyo, Japan. (I. Tanada, Laboratory of Physical Chemistry, Tokyo Inst. of Technology, Ookayama, Meguro-ku, Tokyo)

25–28. International **Phycological** Soc., Halifax, N.S., Canada. (E. G. Young, Natl. Research Council of Canada, Halifax)

25–28. **Seaweed**, 5th intern. symp., Halifax, N.S., Canada. (E. G. Young, Natl. Research Council of Canada, Halifax)

26–28. **Helium Superfluidity**, symp., St. Andrews, Scotland. (J. F. Allen, St. Andrews Univ., St. Andrews)

26–28. **Neurovirulence**, symp., Munich, Germany. (Permanent Section of Microbiological Standardization, Intern. Assoc. of Microbiological Societies, Inst. d'Hygiène, Geneva, Switzerland)

26–28. National Council of **Teachers of Mathematics**, Vancouver, B.C., Canada.