Meetings

Colston Symposium: Marine Geology and Geophysics

Colston Symposium on submarine geology and geophysics was held at Bristol University, Bristol, England, 5–9 April 1965. Headed by W. F. Whittard of the University, it was the 17th such conference sponsored by the Colston Research Society, a private philanthropic group of Bristol citizens. Seventy-five invited scientists, including 12 Americans, participated. In many respects the conference resembled a Gordon Conference; the scientists read their papers and were housed and fed at one location, Manor Hall. This arrangement permitted many hours of contact for personal discussions among the participants.

W. F. Whittard and his colleagues (Bristol University) offered two new papers in their continuing series covering the geology of the western approaches to Great Britain. Their aim is to extend classical mapping out to the margin of the continental shelf rather than the shoreline. The shelf is, of course, the logical limit to a geologic map. New techniques have made such mapping feasible (side-scanning, narrow-beam sonars, and other innovations). Also impetus has been added because of an interest in the natural gas prospects in the North Sea. Swept free of sediment by the strong tidal currents, the shelves around Great Britain are especially suited to geologic mapping.

Breakthroughs in the various branches of science usually follow closely the adoption of a new instrument or a new technique. One example is the recent development of sub-bottom, continuous, reflection profilers—arc-ers, thumpers, and so forth. Turbidites, for example, are now easy to identify by their finely layered structure; the sand beds are excellent acoustic reflectors. Single turbidite layers were shown to extend for remarkably long distances—up to 40 km in the Tyrrhenian Basin (J. B. Hersey, Woods Hole Oceanographic Institution) and up to 10 km in a Norwegian fjord (H. Holtedahl, Bergen University). Hersey's work has resolved as many as 17 turbidite sand layers injected episodically into the Tyrrhenian Basin. These layers accumulate at the rapid rate of about 1 m every 1000 years, or at about the same rate as in the basins off California. Hersey also has found in the eastern Mediterranean several diapiric structures which may possibly be salt domes similar to the Sigsbee Knolls in the deep center of the Gulf of Mexico.

The day has long since passed when F. P. Shepard (Scripps Institution of Oceanography) made submarine geology synonymous with the study of submarine canyons. However, one does not get that impression after hearing about his latest canyon investigations off La Jolla, California, and Cabo San Lucas, Baja California, with the Cousteau diving saucer. Shepard gave evidence supporting turbidity currents and other mass sediment transport in canyons. (His facts were documented by color movies.) Glacier-like action of the sediment fill has smoothed and undercut these canyon walls. H. Niino (Tokyo University Bureau of Fisheries) described a new Japanese deep-research submersible now operating off the shores of Japan. This craft, 14 m in length, can operate to 300 m at a speed of 4 knots and with an endurance of 6 hours. It carries 6 persons and is equipped with many instruments, such as a remotely-operated prehensile claw. Shepard and Niino emphasized the impact which observation from such deep-sea research vehicles is beginning to have on marine geology.

Using gravity and seismic data from many parts of the world, J. L. Worzel (Lamont Geological Observatory) discussed various possible models for the overall deep structure of continental margins and for mid-oceanic ridges. Worzel once more buried the concept of the tectogene or crustal root as an explanation for trenches. He suggested that a moderate expansion of the earth (2 to 3 percent) must have occurred. Such an expansion would explain his tensional interpretation of both mid-ocean rises and trenches. Worzel ruled out any extensive drifting of continents.

K. O. Emery (Woods Hole Oceanographic Institution) summarized the status of the U.S. Geological Survey-Woods Hole Oceanographic Institution 5-year program. Now in its third year, the program is devoted to the study of the continental shelf and slope off the eastern United States. These studies promise to revolutionize our understanding of this "prototype" continental terrace; its simple form is turning out to be much more complex than anticipated. One major finding, based on acoustic sub-bottom reflections to 1600 m, is that the continental rise uplaps the continental slope in the same manner that a growing alluvial fan uplaps the base of a mountain. The rise facies is thus fully detached from its time-equivalent, prograded shelf deposit. The continental slope would seem to be largely a realm of sediment by-passing rather than permanent deposition.

It was evident that the theory of turbidity currents has been accepted, at least among the marine geologists. The few papers on the subject triggered no heated discussions and were concerned with the nuances and details of turbidity current processes. Ph. H. Kuenen (Groningen University), known alternately as the "father of turbidity currents" or "the first of the muddy river boys," described circular flume experiments bearing upon the development of graded bedding, a hallmark of turbidite deposits. He has been able to show, for example, that pulsating flow is not a requirement for laying down graded beds. Such beds may form during the steady flow expectable when a turbidity current injects sediment into a deep marine basin.

Continental drift and "drifty" strike-slip solutions to sea floor tectonics enjoyed favorable treatment. Quite clearly, the drift theory is favored and seems to be endorsed by at least a vociferous minority. British geologists especially seem to have opted to drift. A. S. Laughton (National Institute of Oceanography) presented a rather convincing interpretation, from evidence collected in the Gulf of Aden, that Arabia has been translated about 125 km and rotated 8 degrees relative to Africa since early Miocene time. J. Schoeffler, a French oil geologist, gave evidence for a thick fill of Eocene and younger marine sediments in a triangular section of southern France, north of the Pyrenees. To the drifters present this seemed to add support to their belief that, before the mid-Mesozoic, the northern continental slope of Spain

fitted against the continental slope off Brittany and southern England. Accordingly, the Bay of Biscay would have been opened up by a late Mesozoic rotation of Spain and the coast of France would be defined for the first time. H. H. Hess (Princeton University) reviewed his many thoughts about active movement of the ocean floor and continental drift. Some geophysicists have recently considered drift untenable because they find the mantle under continents to be different from that under the ocean. Hess finds this objection not pertinent, for, by his mechanism, the mantle moves along with the continents.

Following Menard's lead in the Pacific several years ago, sea floor fracture zones are now being found all around the world. D. C. Krause (University of Rhode Island) described a possible fracture zone clear across the North Atlantic from Gibraltar to the northeastern United States through the Azores and the Kelvin Seamount Chain. Krause seems to be one of the new breed of marine geologists who is not constrained by the limitations of traditional land geology. Bolder solutions are being offered for seafloor tectonics of the virtually exposed (?) earth's mantle in contrast to the rather passive (?) sialic crust of the continents.

J. Wiseman (British Museum) described the petrology of St. Paul Rocks, a small ultrabasic exposure of the Mid-Atlantic Ridge. He believes the structures to be an outcropping of the earth's upper mantle and possibly the only nonallochthonous outcrop of the mantle known, thus making it of special interest to Moholers. He recognized four types of peridotites, which were formed in a 500° to 1000°C environment. The limits were based on the lack of serpentine and the presence of hornblende. Excepting a high K-content rock type, these ultrabasics seem to be tholeiite of the deep-sea type, that is, those which have undergone essentially no differentiation. Their partial melting would produce 1 part of tholeiitic basalt (pure mantle "broth") and 9 parts of dunite residue.

We were kept in the dark regarding B. C. Heezen's (Lamont Geological Observatory) "to be announced" paper, the last on the program. But the title, *Tephra and Thera*, would not have helped much anyway. From studying ash layers in deep sea cores in the eastern Mediterranean and by C^{14} dating, Heezen described a great eruption of the volcano Santorini (the ancient Greek name of which is *Thera*) about 1400 B.C. which might explain the demise of the Minoan civilization on Crete. A 10-cm blanket of ash (tephra) supposedly would have fallen in amounts sufficient enough to poison the land. Crops could not have been grown for several years, thus forcing the Minoans to emigrate. Heezen also discussed the stagnation of the Mediterranean deep water 6000 to 8000 years ago.

A visit was paid R.R.S. *Discovery II*. This 3000-ton vessel of the National Institute of Oceanography replaced in 1963 R.R.S. *Discovery*, which had been decommissioned after 33 years of service. The new *Discovery* is a modern research vessel in all respects; she was designed especially for oceanographic work rather than being a conversion. A rather unusual facility is her central well into which sonars can be fitted and changed at sea without necessity of drydocking. Canada's fine new oceanographic research vessel, *Hudson*, was also available for inspection.

Marine geology and geophysics seem to remain peculiarly American disciplines. Our total effort must at least match that of the rest of the world combined. In this field at least, the countries which have done little work in the past (for example, the Mediterranean countries) show little sign of increasing their effort. The scientific gap in this case seems to be opening rather than closing. Heartening, however, is the surge of new interest displayed by the Canadians.

All aspects of the meeting were well organized. A single criticism might be the great variety of subject matter presented; this occurred because participants were given unrestricted freedom of choice of topics. Some of the papers seemed to go beyond the scope of marine geology and geophysics, even in its broadest sense. However, the principal objective of the meeting was certainly achieved—to bring together active researchers from many countries to discuss recent advances in the field. Most of us were pleased with the French scientists' continued acceptance of English as the lingua franca of science in spite of recent official pressure for the increased use of French.

The papers read, together with the ensuing discussions, will be published as volume 17 of the *Colston Papers* in the fall of this year.

ROBERT S. DIETZ
U.S. Coast and Geodetic Survey, Rockville, Maryland 20852

Forthcoming Events

July

12–14. **Biological Sciences** Symp., 16th annual, Univ. of Michigan, Ann Arbor. (L. B. Mellett, Dept. of Pharmacology, Univ. of Michigan Medical School, Ann Arbor)

12–14. Physiology and Biochemistry of **Muscle as a Food**, symp., University of Wisconsin, Madison. (E. J. Briskey, College of Agriculture, Univ. of Wisconsin, Madison 53706)

12–15. Japan Soc. of **Constitutional and Diathetic Medicine**, congr., Kyoto, Japan. (The Society, Dept. of Pathology, Kyoto Univ., Kyoto)

12–15. **Nuclear and Space Radiation Effects**, annual conf., Univ. of Michigan, Ann Arbor. (S. C. Rogers, Radiation Effects Dept., 5312, Sandia Corp., Albuquerque, N.M.)

12–17. **Spectroscopy**, 12th intern. colloquium, University of Exeter, Exeter, England. (C. E. Arregger, 1 Lowther Gardens, Prince Consort Rd., London, S.W.7, England)

12–18. **Pure and Applied Chemistry**, 20th intern. congr., Moscow, U.S.S.R. (N. A. Kleimenov, Inst. of Chemical Physics, Acad. of Sciences, Vorobyevskoye chaussee 2-b, Moscow)

13–15. **Aerospace Vehicle Flight Control**, Soc. of Automotive Engineers/NASA conf., Los Angeles, Calif. (SAE, 485 Lexington Ave., New York 10017)

13–16. Royal **Medico-Psychological** Assoc., annual, Glasgow, Scotland. (RMPA, 11 Chandos St., London W.1, England)

14–15. **Reinforced Plastics**, regional conf., Soc. of Plastics Engineers, Seattle, Wash. (J. B. Meyer, RETEC Registration, c/o J. B. Meyer Co., P.O.B. 6664, Seattle)

15–16. **Water Quality Management** in River and Reservoir Systems, seminar, Vanderbilt Univ., Nashville, Tenn. (W. H. Wisely, American Soc. of Civil Engineers, 345 East 47 St., New York 17)

15–18. Properties and Applications of **Low Temperature Plasma**, symp., Moscow, U.S.S.R. (E. S. Starkman, College of Engineering, Univ. of California, Berkeley)

15–21. **Education of Professional Physicists**, intern. conf., London, England. (Miss P. N. Boston, Inst. of Physics and the Physical Soc., 47 Belgrave Sq., London, S.W.1)

18–24. **Dental**, 2nd intern. congr., Rio de Janeiro, Brazil. (P. F. Reis Filho, Associacao Brasileira de Odontologia, Rua da Baia 570, 5.º Andar, C. Postal 2357, Minas Gerais, Brazil)

18–24. International **Ophthalmic-Optical** Congr., Dublin, Ireland. [E. Pemberton, Assoc. of Ophthalmic Opticians (Ireland), 11 Harrington St., Dublin]

19–21. **Surgery of the Hand,** 1st intern. congr., Rio de Janeiro, Brazil. (Sociedade Brazileira de Mäo, Rio de Janeiro)

19–21. **Swine in Biomedical Research**, intern. symp., Richland, Wash. (L. K. Bustad, Biology Dept., Battelle-Northwest, P.O. Box 999, Richland 99352)

19–22. Association of **Food and Drug Officials** of the U.S., 69th annual, New York, N.Y. (The Association, P.O. Box 9095, Austin, Tex.)