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Caption of cover photograph. H.M.S. *Challenger* at Saint Paul's Rocks, equatorial Atlantic Ocean, in August 1873. Often considered the starting point of oceanography, the voyage of *Challenger* was only part of a new approach to the oceans evolving late in the 19th century. From *Report on the Scientific Results of the Voyage of H.M.S. Challenger, Narrative, Volume 1*, (1885).

THE HISTORY OF OCEANOGRAPHY: INTRODUCTION

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Earth scientists and historians of the earth sciences may be pardoned if the phrase "history of oceanography" draws a blank. What, after all, does "oceanography" denote? Is it the biology, or the chemistry, or the geology and geophysics, or the physics of the oceans, or perhaps a mix of some or all of the components? If we have trouble defining oceanography, how can there be a meaningful history of it? Is there anyone who could be called a historian of oceanography? And what are the historiographic approaches taken in this kind of history?

This special section of *Earth Sciences History* is devoted to the question of how and why one explores the history of a subject as chimerical as oceanography. It originated as a symposium during the XVIIIth International Congress of History of Science in Hamburg in August 1989. Not all the papers delivered at that symposium were prepared for publication, but the three printed here are of general interest because they review the literature of the history of oceanography, provide revisionist ideas of the origins of oceanography, and offer thought-provoking suggestions about how scientists and historians may approach the historiography of the marine sciences.

I would be the last to claim that oceanography is a single, well-defined and theoretically unified discipline, or that its history may be neatly circumscribed. Oceanography, clearly, may not be readily defined or schematized. As I stated in the second *History of oceanography newsletter* (1990, p. 2), "the history of oceanography investigates how and under what circumstances scientists have tried to understand processes in the ocean." That is suitably vague. Others have expressed better why oceanography is a problem, not a solution, and why it does not lend itself to neat formulations, scientific or historical. Elizabeth Noble Shor, the biographer of the Scripps Institution of Oceanography, in her book, *Scripps Institution of Oceanography: probing the oceans 1936 to 1976* (1978, p. 3), claimed that "oceanography is not so much a science as a state of mind". And Willard Bascom, in his autobiographical *The crest of the wave* (1988, p. xiii), said that "oceanography is not so much a science as a collection of scientists who find common cause in trying to understand the complex nature of the ocean".

States of mind and collections of scientists are social constructs or entities, not neat philosophical categories. It is here that some of the readers of this special issue may claim that we are expressing a sort of apostasy, suggesting that there has not been a neat, linear, logical development of oceanography as a science from the time of the 19th century voyages of *Challenger*,

Gazelle, *Valdivia* and the like to the present. Instead, we suggest a far more subtle (and more confusing) suite of social and scientific developments, a mosaic of change, centered around subjects as disparate as late 19th century British politics and the mathematical expression of how fluids like air and water circulate on a rotating earth. Margaret Deacon investigates the complicated background of British marine science after the time of *Challenger*, showing the variety of motives that led to the foundation of marine stations, and how difficult it was to do any work at all on the open ocean when state support was given so grudgingly to any science. And Mott Greene evokes a link between the evolution of oceanography and, on one hand, nineteenth century physical geography, on the other, the development of a practically-oriented mathematical physics of the atmosphere and the oceans, invoking what he calls "relocation of meaningful boundaries in science". Both essays are subversive of the view that the history of oceanography is mainly the history of expeditions and their results, a view that too many first chapters in elementary texts have propounded. Both suggest exciting new work that is unlikely to fall into established categories of the history of science.

Our aim in this issue is to convince historians of the earth sciences that it is worthwhile joining us to explore the historical development of a field as many-faceted and as problematic as oceanography. The historical and intellectual problems we outline here are real, significant, and, best of all, invigorating challenges to orthodox accounts. Solving them should contribute in an original way to the history of science, whether one views it as the history of disciplines, or as the development of science in societies.

The word "oceanography" had little meaning before the late decades of the 19th century; by the 1990's what it denotes may be fragmenting into disciplinary specialties centered around seawater, life in the oceans, or marine geology and geophysics. Yet the idea that a community of like-minded scientists, oceanographers, working in a field called oceanography, has developed is unlikely to die an easy death. Why this is so is partly a problem for the sociologist, but it also challenges the historian.

Investigating the historical roots of today's perceptions of oceanography, as well as the development of the scientific ideas in their own contexts, is likely to be more productive of original insights in the history of science than concentrating single-mindedly on the histories of biology, chemistry, physics, or geology alone. I hope that this will be shown convincingly in the papers that follow.

A HANDLIST OF PRINTED SOURCES ON THE HISTORY OF OCEANOGRAPHY

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The reference books and monographs following have been selected to aid teachers and beginning students of the history of oceanography. The list is based on two principles, either that the publications are readily available in major libraries, or that they have not been superseded as sources of information. The periodical literature is not included except in Section 6, because of its extent. A good source of information on journal articles published between 1913 and 1975 is the *Isis cumulative bibliography* (ed. M. Whitrow and J. Neu); it is added to annually by the *Current bibliographies* accompanying the journal *Isis*.

1. Basic Texts

- DEACON, M. 1971. *Scientists and the sea 1650-1900. A study of marine science*. London: Academic Press. xvi + 445 pp.
- MCCONNELL, A. 1982. *No sea too deep. The history of oceanographic instruments*. Bristol: Adam Hilger. ix + 162 pp.
- MILLS, E. L. 1989. *Biological oceanography: an early history, 1870-1960*. Ithaca, N.Y.: Cornell Univ. Press. xvii + 378 pp.
- SCHLEE, S. 1973. *The edge of an unfamiliar world. A history of oceanography*. New York: E. P. Dutton. 398 pp.

2. Symposium and Congress Proceedings

1965. *Colloque internationale sur l'histoire de la biologie marine. Les grandes expéditions scientifiques et la création des laboratoires maritimes*. Vie et Milieu, supplement 19, 370 pp.
1968. *Premier Congrès International d'histoire de l'océanographie*, Monaco, 1966. Bull. Inst. Océanogr. Monaco. No. spec. 2,3 vols.
1972. *Second International Congress on the History of Oceanography. Challenger Expedition Centenary*. Proc. Roy. Soc. Edinburgh, 72, viii + 462 pp; 73, viii + 435 pp.
- SEARS, M. and D. MERRIMAN (eds.). 1980. *Oceanography. The past*. New York: Springer-Verlag. xx + 812 pp.

3. Source Books

- DEACON, G. E. R. and M. B. DEACON (eds.). 1982. *Modern concepts of oceanography*. Stroudsburg, Pa.: Hutchinson and Ross. xiii + 386 pp.
- DEACON, M. (ed.). 1978. *Oceanography, Concepts and History*. Stroudsburg, Pa.: Dowden, Hutchinson and Ross. xvii + 394 pp.

4. Ships and Expeditions

- DEACON, M. B. 1993. *The history of oceanography: an annotated bibliography*. New York: Garland Publishing Co.
- IDYLL, C. P. (ed.). 1969. *The science of the sea. A history of oceanography*. New York: Crowell. ix + 280 pp.
- KOFOID, C. A. 1910. *The biological stations of Europe*. U.S. Bureau of Education, Bulletin No. 4. Washington, D.C.: Government Printing Office. xiii + 360 pp.
- MCCONNELL, A. 1981. *Historical instruments in oceanography. Background to the oceanography collection at the Science Museum*. London: HMSO. i-iv, 1-52 (see also McConnell 1982 in Section 1).
- MCCONNELL, A. 1990. *Directory of source materials for the history of oceanography*. Unesco Technical Papers in Marine Science, Number 58, iii + 40 pp.
- MURRAY, J. 1895. *Historical introduction*. Rpt. Sci. Res. Voy. H.M.S. Challenger 1872-76. Summary Sci. Res., First Part, pp. 1-106E.
- MURRAY, J. 1912. *A brief historical review of oceanographical investigations*. Ch. 1, pp. 1-21 in Murray, J. and J. Hjort, *The depths of the ocean*. London: Macmillan.
- PAFFEN, K. and G. KORTUM. 1984. *Die Geographie des Meeres. Disziplingeschichtliche Entwicklung seit 1650 und heutiger methodischer Stand*. Kieler Geogr. Schr. 60, xiv + 293 pp.
- SCHOTT, W. 1987. *Early German oceanographic institutions, expeditions and oceanographers*. 4th International Congress on the History of Oceanography. Hamburg: Deutsches Hydrographisches Institut. 50pp.
- THOMASSON, E. M. (ed.). 1981. *Study of the sea. The development of marine research under the auspices of the International Council for the Exploration of the Sea*. Farnham, England: Fishing News Books. xix + 256 pp.
- VAUGHAN, T. W. 1937. *International aspects of oceanography. Oceanographic data and provisions for oceanographic research*. Washington, D.C.: National Academy of Sciences. xvii + 225 pp.
- ANONYMOUS. 1972. *Selected references to literature on marine expeditions 1700-1960*. Fisheries-Oceanography Library, University of Washington. Boston: G.K. Hall. iv + 517 pp.
- BUEN, R. DE. 1934. *Liste chronologique des croisières océanographiques*. Venezia: C. Ferrari. 73 pp. (Ma-

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- ESTOK, R. AND R. E. BOYKIN. 1976. *A union list of oceanographic expeditions including results of some major cruise reports*. College Station, Texas: Texas A & M Univ. Libraries. iii + 138 pp.
- FERRANTE, E. 1985. *Crociere e relazioni di viaggio dei marinai italiani nell'ottocento (1861-1900)*. Rivista Marittima 6, Suppl., 95 pp.
- GUBERLET, M. 1964. *Explorers of the sea. Famous oceanographic expeditions*. New York: Ronald Press. 226 pp.
- KREBS, B. N. 1961. *Expedition reports and related publications in the library of the New Zealand Oceanographic Institute, DSIR Wellington*. New Zealand Oceanographic Institute Miscellaneous Publication 10, 87 pp.
- MACIVER, E. J. 1979. *Expedition reports and related publications in the library of the New Zealand Oceanographic Institute Library*. DSIR, Wellington: New Zealand Oceanographic Institute, Miscellaneous Publication 87, 73 pp. (see also Hurley 1974 in Section 5).
- NELSON, S. B. 1971. *Oceanographic ships fore and aft*. Washington, D.C.: Office of the Oceanographer of the Navy. xvii + 240 pp.
- REINKE-KUNZE, C. 1986. *Den Meeren auf der Spur. Geschichte und Aufgaben der deutschen Forschungsschiffe*. Herford, F.R.G.: Koehlers Verlags-gesellschaft MBH. 169 pp.
- RICE, A. L. 1967. *British oceanographic vessels 1800-1950*. London: Ray Society. 193 pp.
- SCHLEE, S. 1978. *On almost any wind. The saga of the oceanographic research vessel Atlantis*. Ithaca, N.Y.: Cornell University Press, 301 pp.
- TREADWELL, T. K., D. S. GORSLINE AND R. WEST. 1988. *History of the U.S. academic research fleet and the sources of research ships*. UNOLS Fleet Improvement Committee Report. College Station, Texas: UNOLS Fleet Improvement Office, Texas A & M University. v + 55 pp.
- WOLFF, J. 1967. *Danish expeditions on the seven seas*. Copenhagen: Rhodos. 336 pp.
- WÜST, G. 1964. The major deep-sea expeditions and research vessels 1873-1960. A contribution to the history of oceanography. *Progress in Oceanography* 2: 1-52.
5. *Biography and Bibliography*
- BRUSH, S. G. AND H. E. LANDSBERG (eds.). 1984. *The history of geophysics and meteorology: an annotated bibliography*. New York: Garland Publishing. xvi + 450 pp.
- CARPINE-LANCRE, J. 1968. Les expéditions océanographiques et la publication de leurs résultats (étude bibliographique). *Bull. Inst. océanogr. Monaco*, No. spécial 2 [Congr. int. Hist. of Oceanogr. 1] pp. 651-664.
- CHARTON, B. 1988. *The Facts on File dictionary of marine science*. New York: Facts on File.
- DEACON, M. B. (compiler). 1993. *The history of oceanography: an annotated bibliography*. (See Section 2).
- DUNBAR, G. S. (compiler). 1990. *The history of modern geography: an annotated bibliography of selected works*. New York: Garland Publishing. xvi + 386 pp.
- HERDMAN, W. A. 1923. *Founders of oceanography and their work*. London: Edward Arnold. xii + 340 pp.
- HURLEY, D. E. 1974. *Titles of selected scientific periodicals and expedition reports dealing with marine sciences. New Zealand and the Antarctic*. Wellington, New Zealand Oceanographic Institute. Miscellaneous Publication 58, 45 pp.
- LAUDAN, R. (compiler). 1990. *Histories of science and mathematics, 1700-1912: an annotated bibliography*. New York: Garland Publishing.
- OVERMIER, J. A. (compiler). 1989. *The history of biology: a selected, annotated bibliography*. New York: Garland Publishing. xvii + 157 pp.
- PORTER, R. S. (compiler). 1983. *The earth sciences: an annotated bibliography*. New York: Garland Publishing. vii + 192 pp.
- SARJEANT, W. 1980. *Geologists and the history of geology: an international bibliography from the origins to 1978*. London: Macmillan. 5 vols. + supplement.
- SEARS, M. (compiler). 1972. *Oceanographic index. Subject compilation 1946-1971*. Vols. 1-4 and Supplement. Boston, Mass.: G.K. Hall & Co.
- WATERMANN, B. AND O. J. WREZINSKI. 1989. *Bibliographie zur Geschichte der deutschen Meeresforschung. Chronologische Titelaufzählung (1557-1989). Second extended edition*. Hamburg: Deutsche Gesellschaft für Meeresforschung. xiii + 248 pp. See also Schott 1987 (Section 2) for biographies.
6. *Institutions*
- BRANDT, K. 1921. Die zoologischen Arbeiten der Kieler Kommission 1870-1920. pp. 76-194 in *Festschrift der Preussischen Kommission zur Wissenschaftliche Untersuchungen der Deutschen Meer zu Kiel aus Anlass ihres 50 jährigen Bestehens*. Kiel and Keipzig: Lipsius and Tischer.
- BRATTSTRÖM, H. 1967. The biological stations of the Bergens Museum and the University of Bergen 1892-1967. *Sarsia* 29: 7-80.
- BURSTYN, H. L. 1980. Reviving American oceanography: Frank Lillie, Wickliffe Rose, and the founding of Woods Hole Oceanographic Institution. pp. 57-66 in M. Sears and D. Merriman (ed.). (See Section 2).
- DICK, S. J., AND L. E. DOGGETT (eds.). 1983. *Sky with ocean joined. Proceedings of the sesquicentennial symposium of the U.S. Naval Observatory, December 5 and 8, 1980*. Washington, D.C.: U.S. Naval Observatory. viii + 190 pp.

- GALTISOFF, P. S. 1962. *The story of the Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, Massachusetts*. U.S. Dept. of the Interior, Fish and Wildlife Service. Bureau of Commercial Fisheries Circular 145, 121 pp.
- JOHNSTONE, K. 1972. *The aquatic explorers. A history of the Fisheries Research Board of Canada*. Toronto: University of Toronto Press. xv + 342 pp.
- KOFOID, C. A. 1910. (See Section 3).
- KORTUM, G. 1987. Berlins Bedeutung für die Entwicklung der geographischen Meereskunde. Das Vermächtnis der Geographenstrasse. *Berliner geographische Studien* 25: 133–156.
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- LUCAS, C. E. 1956. The Scottish Home Department's laboratory in Aberdeen. *Proc. Roy. Soc. Edinburgh*, B 66: 222–234.
- MANNING, T. G. 1988. *U.S. Coast Survey vs. Naval Hydrographic Office. A nineteenth century rivalry in science and politics*. Tuscaloosa: University of Alabama Press. xii + 202 pp.
- MARSHALL, S. M. 1987. *An account of the marine station at Millport* (ed. J. A. Allen). University Marine Biological Station, Millport, Isle of Cumbrae. Occasional Publication No. 4, v + 133 pp.
- MAWSON, V., D. J. TRANTER AND A. F. PEARCE (eds.). 1988. *CSIRO at sea. 50 years of marine science*. Hobart, Tasmania: Commonwealth Scientific and Industrial Research Organization. 216 pp.
- METZ, C. B. (ed.). 1985. The Naples Zoological Station and the Marine Biological Laboratory: one hundred years of biology. *Biological Bulletin* 168 (supplement): 1–207.
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- PINSELL, M. I. 1981. *150 years of service on the seas. A pictorial history of the U.S. Naval Oceanographic Office from 1830 to 1980. Volume 1. (1830–1946)*. Washington, D.C., Dept. of the Navy, Oceanographic Office. x + 233 pp.
- POULSEN, E. M. 1952. Kommissionen for Danmarks Fiskeri-og Havundersøgelser 1902–1952. Skrifter udgivne af Kommissionen for Danmarks Fiskeri-og Havundersøgelser No. 14, 77 pp.
- RAITT, H. AND B. MOULTON. 1967. *Scripps Institution of Oceanography. First fifty years*. San Diego, California: Ward Ritchie Press. xix + 217 pp.
- REVELLE, R. 1980. The Oceanographic and how it grew. pp. 10–24 in Sears and Merriman (Section 2).
- ROLL, H. U. 1979. *A focus for ocean research. Intergovernmental Oceanographic Commission. History, functions, and achievements*. UNESCO, Paris. Intergovernmental Oceanographic Commission Technical Series 20, 64 pp.
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- SHOR, E. N. 1978. *Scripps Institution of Oceanography. Probing the oceans 1936 to 1976*. San Diego, California: Tofua Press. x + 502 pp.
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- THOMASSON, E. M. 1981. (see Section 5).
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