Book Reviews

Conditional Optimism about the World Situation

Mankind at the Turning Point. The Second Report to the Club of Rome. MIHAJLO MESAROVIC and EDUARD PESTEL. Dutton, New York, and Reader's Digest Press, New York, 1974. xiv, 210 pp., illus. $12.95.

The first report to the Club of Rome, *The Limits to Growth* (D. H. Meadows *et al.*, Universe Books, 1972; reviewed by K. E. Boulding in *The New Republic*, 29 April 1972), had a remarkable resemblance to the Book of Jonah. Not only was a considerable part of it spewed out of the belly of the great fish of the computer, but its main message was that if Nineveh, that is, the great city of the developed world, did not repent it would be destroyed, though not so much by the wrath of an outraged God as by the sheer depletion of the resources on which it depended for its input and the depletion of sinks for its unwanted output of pollution. The Second Report to the Club of Rome is almost the Second Book of Jonah, no doubt lost in the Biblical version, in which the prophet gives Nineveh fairly detailed instructions about how to repent, which the first book did not specify.

The first report was criticized on the grounds that it took a far too holistic view of an extremely diverse and complex planet, though one could perhaps defend this as a very first approximation. The second report seems to answer this criticism by breaking the world down into ten regions—North America, Latin America, Western Europe, the Eastern Socialist bloc, China, Japan, India, the Arab world, tropical Africa, and the Southern Hemisphere rich countries of Australasia and South Africa. Each of these has a model of its own, somewhat more detailed than the models of the first report but essentially similar, involving in different parts of the world inputs, outputs, and accumulations or decumulations of people and things. In addition, there are included the trade, investments, and aid relationships among the various regions, especially of course from the rich countries to the poor.

Scenarios are run off on the computer involving various degrees in timing of population control and "aid," that is, gifts of economic goods from the rich countries to the poor. The general message of all these scenarios is "the earlier the better." If certain basic sets of decisions are made very soon the printouts give us some hope, but pretty soon it will be too late to avoid major catastrophes. As in all these computer models, there are assumptions of the constancy of certain parameters such as the efficiency of investment or aid or the success of population control, which are of course very risky assumptions. Nevertheless, provided we know what is going on and are not carried away by the esthetic delights of the "computer spaghetti," as it has been called, the plotting of these scenarios can be extremely useful, indicating at least the implications of the assumptions.

A particularly interesting scenario is one concerning the relations of the oil-rich countries to the food- and capital-rich countries, which turns out to be surprisingly optimistic, suggesting that a little monopoly squeeze in the oil market may not do the oil-importing rich countries very much harm and may end up doing the oil-rich countries a great deal of good by the time their oil is exhausted. One does worry, of course, about the cultural assumptions behind the parameters of these models. Again, however, one should be grateful for any gleam of hope.

In some ways, for all its modestly optimistic tone, this volume is even more depressing than the first report, perhaps because it is more specific. Its suggestions on what has to be done to repent (population control and large transfers *now*) are extremely plausible. Like Donne's great sonnet on the judgment, it points out that by the time the judgment has arrived it is too late to repent, and we have to repent now for repentance to do any good. What the report does not say is how we are to be persuaded to repent. If the only way to avoid catastrophe is immediate population control in the poor countries and an immediate vast outburst of generosity in the rich ones, the probability of catastrophe seems appallingly high. The failures of population control in India, for instance, are no accident, but are deeply involved with a social structure in the Indian village that seems fantastically hard to change. In many countries, also, where there is fear of "outbreeding," that is, differential population growth in different groups, or even between different nations, even the will to population control can easily be destroyed, as we have seen in Romania and Ceylon. On this score the population conference of last summer in Bucharest was by no means reassuring. Repentance is extraordinarily difficult as long as the general view prevails that anything that is wrong with anybody is always somebody else's fault, and that is the official ideology of a large part of the world.

The theory of grants economics, furthermore, suggests that generosity is a function of the image, especially in the mind of the donor, of the efficiency of grants. If by sacrificing a dollar I can benefit you ten dollars I am much more likely to do it than if I can only benefit you ten cents. The two items of repentance therefore feed back on each other. Without population control in the poor countries the rich countries can argue that anything that is done for the poor countries will not benefit them in the long run and indeed will only lead to a larger eventual catastrophe. This is the "lifeboat principle" as enunciated by Garrett Hardin. The poor countries can argue, on the other hand, that without generosity on the part of the rich countries there is no point in their controlling their population as there is going to be a catastrophe anyway and they might as well have whatever fun is available while it lasts. How one can possibly link these two items of repentance in a reinforcing union is something the report does not suggest, and I must confess also I have no answer. Perhaps we simply have to look beyond catastrophe and to ask how one prepares the ground for learning from catastrophe. There have indeed been catastrophes in history which produced very fundamental learning, like the Irish famine of the 1840's and the Japanese catastrophe of World War II. Since these catastrophes the Irish have controlled their population and the Japanese have controlled their aggressiveness. I understand that a third report is on the way. Perhaps this one will deal with the question how we repent in time, before catastrophe, or, failing that, how we prepare for catastrophe by preparing the ground for repentance after it.

Like the first report, the second report does not reveal all its technical details, and there will no doubt be criticism of these when they are revealed. There is real danger that computer modelers develop a "mystique" which makes the operation hard to criticize in detail. A dictionary of assumptions and parameters would be highly desirable. Nevertheless, the presentation is masterly. It consists of a general text interspersed with "briefs" which develop some, but not all, of the more technical details. It will be a rare person who is not moved as well as stimulated by this document. One hopes that these modern works will indeed have the same effect as Jonah's prophecies. It will be recalled that Nineveh did repent and was not destroyed even though this made Jonah furious. This is a slim thread on which to hang a hope for the future, but perhaps it is all the thread we have.

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Oceans of the Geological Past

Studies in Paleo-Oceanography. Papers from a symposium, Houston, Texas, Mar. 1971. WILLIAM W. HAY, Ed. Society of Economic Paleontologists and Mineralogists, Tulsa, Okla., 1974. iv, 218 pp., illus. $11; to members, $9. SEPM Special Publication No. 20.

As the first book to use "paleo-oceanography" in its title, this volume extends to ancient oceans the broad acceptance by chemists, geologists, biologists, and physicists that the study of the marine realm is more than the sum of the individual parts. The emphasis on ancient oceans per se is, in addition, in sharp contrast to the time-honored geologic interest in rocks and indicates yet another change in the traditional topics of geology departments.

Two types of results are being published for these ancient bodies of water: descriptive statements of the sequence of events as oceans appeared, disappeared, and reappeared, in which the particulars of special history are of prime importance; and causal analysis of ocean behavior (using the averaging effects of geological time), in which stochastic processes within narrow equilibrium limits are the chief guiding principles. Paleooceanography (a form preferable to the tentative-looking "paleo-oceanography" and in accordance with the usage of Kay [1945] and von Arx [1959]) is in the growth phase of descriptive work, as the appearance of 27 volumes from the JOIDES Deep Sea Drilling Project in only five years makes very clear. Simultaneously, models are being developed which are independent of time and place and which look at events in ecologic (or laboratory) time and apply the results over evolutionary (geologic) time.

One can divide paleooceanography into seven major topics, each one of which is covered to some extent in the ten chapters of this book. None of the seven is given even, thorough coverage, however, and in truth the book is chiefly notable for its chapters on chemical aspects of sediments and oceans, past and present.

Concerning the *paleogeography* of ocean basins, Berggren and Hollister use paleogeographic reconstructions on a Lambert equal-area projection centered at 30°N,20°W, as prepared by Phillips and Forsyth (*Bulletin of the Geological Society of America* **83**, 1579 [1972]) for the North and South Atlantic since the breakup of Pangea in the Mesozoic. Ramsay presents Atlantic physiography for the Eocene, Oligocene, and Miocene but uses the reconstructions and modified Mercator projection of Francheteau (unpublished). *Paleobathymetry*, for which there is a voluminous literature, is barely touched upon. However, if one follows Worsley, a previously suggested criterion, the carbonate compensation depth, has migrated from depths of 5 to 6 kilometers to the surface, and then back, in the 20-million-year period from the Late Cretaceous to the Late Paleocene.

In *water studies*, Berggren and Hollister present inferred circulation patterns through the history of the Atlantic, and show the origin of Atlantic Ocean currents. Data on *paleotemperature* are also summarized for Mesozoic and younger oceans by Berggren and Hollister, who emphasize the conclusion of Emiliani that deep water of the world oceans cooled from about 14°C in the Cretaceous to its present 2°C, as a result of chilling of source waters at high latitudes. Ramsay presents a summary curve of temperatures of surface waters in temperate latitudes for the world ocean since the Jurassic.

Paleochemistry of oceanic sediments is the chief subject of the book. With characteristic lucidity, Berner discusses the solubility of calcium carbonate in seawater, using data from both descriptive chemical oceanography and laboratory experiments. He contrasts the expected effects of special historical factors, namely crossing of boundaries between water masses, with results obtained by equilibrium chemical approaches involving dissolution kinetics and surface chemistry, and considers the equilibrium approach of main importance. The origin of the compensation level on the western flank of the East Pacific Rise is treated by Broecker and Broecker, who find the kinetic and historical factors inextricably interwoven at this locality. Ramsay, in discussing the distribution of calcium carbonate in deep-sea sediments, attributes the chief causal influence to ocean productivity, which, in turn, is believed to be regulated by temperature changes in surface waters. He also presents postulated distributions of red clay, pure siliceous ooze, and carbonate ooze for the Atlantic during the Eocene, Oligocene, and Miocene. Heath, in a very wide-ranging and excellent paper, presents all aspects of the silica cycle and emphasizes regulation by plants. He concludes that deposition of silica by inorganic precipitation appears "virtually impossible since the late Mesozoic and unlikely since the Precambrian."

In the present ocean, perhaps 1500 pre-Quaternary sediment cores have now been obtained, and Saito, Burckle, and Hays show the position, depth, and age of 900 of these which are housed at the Lamont-Doherty Geological Observatory (see also the listing by Funnell of 500 cores obtained before August 1967 in *The Micropalaeontology of Oceans*, B. M. Funnell and W. R. Riedel, Eds., Cambridge University Press, 1971, pp. 507–534). Saito *et al.* conclude that over much of the Pacific the accumulation rates are less than 1.2 centimeters per thousand years for the Pleistocene, with the narrower Atlantic Ocean having rates two to four times higher.

Three chapters treat ocean chemistry through geologic time. Chemical considerations allow one to predict phases that would precipitate if the ocean varied widely from its present chemical composition. Holland examines these limitations on ocean chemistry and draws specific conclusions about ranges permissible in present and past seawater (the topic is further developed by him in *Geochimica et Cosmochimica Acta* **36**, 637 [1972]). Mackenzie and co-workers (Garrels in one case, Lafon