Book Reviews

Foundations of the Model of Doom

Dynamics of Growth in a Finite World. DENNIS L. MEADOWS, WILLIAM W. BEHRENS III, DONELLA H. MEADOWS, ROGER F. NAILL, JØRGEN RANDERS, and ERICH K. O. ZAHN. Wright-Allen, Cambridge, Mass., 1974. xii, 638 pp., illus. $35.

An earlier book by the Meadows team, *The Limits to Growth* (Universe, 1972)—also known informally as the Club of Rome report—caused a wide commotion when it was published a few years ago, even though it failed to convince all academic critics. The present thick volume presents the methodology behind the report, the details of a model called World3, complete with computer programs and flow diagrams. The authors were in the somewhat unusual position of writing up their methodology after having read the criticisms of their colleagues and of being able to justify themselves a posteriori. Although there is a chapter summarizing results, the value of the book resides in the explicit statement of the assumptions behind World3, "so they can be widely examined and discussed," for the same public of generalists to which *The Limits to Growth* was addressed. In expounding these assumptions the authors set standards for clear exposition and present an enticing philosophy for model builders and a guide to understanding complex systems through model building. Moreover, they achieve an almost impregnable intellectual position by issuing the challenge that advocates of other interpretations of the future of this planet and its economy should state their assumptions "as a formal model." The task of this reviewer is not easy, since he has not perfected such a model and does not want to be waved off testily as offering "vague criticisms about the lack of perfection" of the present formal model.

Much of the resistance to World3 and its implications for the future could well be a replay of Cassandra's curse. It has been termed "a model of doom," even though "World3 is a device for testing the implications of alternative assumptions, not a prediction of future events" (p. 22). But of course prediction is an acid test of any projection's usefulness, and World3 is an effective model because it almost invariably leads to the same outcome. "Doom" results from the model's structure, which reflects the structure of the world system itself as interpreted by the authors.

> A system that possesses these three characteristics—rapid growth, environmental limits, and feedback delays—is inherently unstable. Because the rapid growth persists while the feedback signals that oppose it are delayed, the physical system can temporarily expand well beyond its ultimately sustainable limits [p. 562].

Hence the dominant mode of the simulations: overshoot and decline. The mode will prevail under a wide range of assumptions. If exhaustion of raw materials has not occurred by the year 2100, food shortage or the collapse of industrial output per capita will get us anyway, and should we somehow avoid those, the world is due for intolerable levels of persistent pollution. However it occurs, the prognosis is that the death rate will soar and population numbers will plummet.

The authors are skeptical about the extent to which substituting other parameter values in their model would modify these conclusions. They are convinced that the structure of the model is more important than the numerical value of parameters. Even erroneous functions, even mistaken assumptions about the physical limits of the world system, should not affect the model's mode.

> Fortunately, given the inaccuracy of most social data, the behavior of complex feedback systems is not qualitatively sensitive to parameter values [p. 22].

The authors encourage anybody to substitute his own parameters, and themselves provide a large series of simulations using a wide range of values. Only through a radical switch in technological and social policies, requiring incredible virtue and foresight, starting right now, on the part of the human species can the overshoot and decline mode be averted—or at least postponed until after 2100, the end of the simulation runs. (The authors then assume, without demonstration, that "the rate of depletion of natural resources is slow enough to enable technology and industrial processes to adjust to changes in resource availability" [p. 545].)

The challenge, then, is either to refute the conclusions of World3 by substituting a model with a different logical structure that would permit "growth in a finite world" or to accept it and strive to mend the way of mankind. There is no logical third road—just the back alley of uninformed optimism, the "somehow-we-shall-muddle-through" approach, the blind confidence that some technical miracle will occur in time. Meadows *et al.* refuse to consider unimaginable future technologies. They do not deny that they may be invented ("that is one reason why no model can accurately predict the future" [p. 19]), but no model can incorporate miracles without undermining the strength of logical induction while jeopardizing the notion of miracle at the same time.

Short of constructing an alternative model, I shall state here some reservations about World3, make suggestions about how it could be improved, and consider whether these changes could alter the model's mode. My emphasis will be on the population sector of the World3, because of a professional bias. I shall specially be concerned with the enormous loss of population that is part of the "overshoot and decline" mode. (In the reference run of the World3 simulations, population peaks at about 7 billion in 2030 and has declined to 4 billion by 2100, because of a drastic increase in mortality, and despite a surprising rise of fertility.)

An obvious improvement—so the authors grant—would have been to disaggregate the simulation into at least two different submodels representing the industrialized and nonindustrialized regions of the world. This was not done, and one of the explanations reads as follows:

> The physical system connecting population with the environmental carrying capacity is structurally the same in any geographic subregion [p. 13].

This seems to mean that an isolated collapse of the industrial output of the developed nations should have the same impact on the world's overall mortality level as a decline of similar effect on the world's output that would be more equitably distributed among rich and poor nations. If so, the statement is clearly in contradiction with the model's own mortality functions. At the levels of per capita income prevailing in industrialized nations today, the level of expenditures on health services is very loosely, if at all, related to mortality level. A considerable reduction of the industrial base of the United States would cause almost no decline in life expectancy in a disaggregated model, whereas aggregation locates the relationship between output per capita and mortality at a level

of the curves which maximizes the projected loss of life.

Today, the relationship between economic level and mortality has largely disappeared. Countries at vastly different levels of development, such as the United States and Taiwan, have similar levels of life expectancy at birth. The impact of an economic collapse in terms of human life cannot easily be assessed, but it is certainly a mistake to believe that processes and relationships are reversible. Despite attempts to introduce lags and impact delays in World3, the model remains essentially ahistorical, and assumes the reversibility of its functions. In the model it makes no difference whether a dependent variable is affected by an independent variable on its way up while the system is growing or on its way down while it is collapsing. But the process of building up is conceptually very different from that of deteriorating. Whereas there is a historical correlation between industrialization and other processes such as the demographic transition, a decline of industrial output per capita would not bring fertility and mortality all the way back to where it had been brought from by the equivalent rise of that output. Many things that took time in the learning cannot be unlearned: the germ theory of disease, vaccination, and the technology of contraception, for example, could continue to be used by a population with a much reduced access to resources and to capital. A throwback to the per capita food production and industrial output of the 18th century would probably not bring preindustrial demography back to England. With its knowledge of nutrition and the organizational ability to ensure equitable distribution through rationing, an industrial economy could probably withstand severe reduction of food supply without suffering major loss of life.

On the whole, then, a great reduction of world population is not an ineluctable part of the World3 model. The rise of fertility that appears in the decline phase of the simulations, as a mechanical result of the rise of family size norm when industrial output declines, also seems to be based on an unwarranted belief in the reversibility of historical experience. As far as the population sector of World3 is concerned, the overshoot and decline mode is not the only conceivable one, nor, perhaps, the most likely. It is likely that other sectors of the model would similarly be able to incorporate other functions that would significantly alter its conclusions.

But the value of this contribution, fortunately, does not hinge on the guidelines it gives for the future or on the accuracy of its insights about the world as a system. A model is a tool for investigating relationships and deriving unknown values. Much can be learned from its failure and its failings; and it points to areas of ignorance and research needs. When a model has reached the formal perfection of World3, and when so much effort and talent have gone into presenting its methodology in intelligible detail, its conclusions cannot be dismissed without resorting to similar methods and raising new questions to be answered by new models. In the authors' words (p. 25):

> World3 was developed through an exercise in assembling information from many sources, summarizing it explicitly, exploring its implications, and generalizing from the process a little understanding about the future of the complex human socio-economic system. This type of exercise can be valuable, even though the information it yields is incomplete. For example, it may bring about a critical reexamination of the underlying assumptions of current mental models and a more open discussion of the bases of social decision making. It may stimulate further attempts to improve the process of model making and the theories of social systems upon which all models depend .... It is both a demonstration of what can be done and a challenge to do better.

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Intelligence and Ideology

The Science and Politics of I.Q. LEON J. KAMIN. Erlbaum, Potomac, Md., 1974 (distributor, Halsted [Wiley], New York). viii, 184 pp. $10.95. Complex Human Behavior.

The author of this book steps squarely into the controversy over the heritability of IQ, motivated at least as much by the political implications of the question as by its scientific interest. His position is that those who interpret the evidence as indicating that individual differences in IQ are largely inherited are "fundamentally incorrect." Secondarily, he wishes to counteract the effects of hereditarians upon policy makers, largely by impugning the evidence upon which their case rests.

But before launching his attack upon the evidence, Kamin seeks to document his view that the science and the politics of IQ testing are inseparable. He contends that the IQ test has been fostered by those committed to the view that genetic inferiority is the cause of poverty, that the trappings of science have been used politically to oppress the poor by carrying tidings that they are not only stupid but immutably and ineducably so. He supports this contention by tracing the role of certain of the early leaders in intelligence testing who expressed worries about the supposed degeneration of the American population as a result of multiplication of the feebleminded and insisted on the importance of "curtailing the increasing spawn of degeneracy." He documents the use of World War I U.S. Army intelligence test data by psychologists testifying before the Congress for restriction of the immigration of those European "races" that were thought to have lower heritable IQ scores. While recognizing that there is probably no living psychologist who views the World War I data as relevant to resolving this issue, he draws a parallel between the historical misuse of inadequate data and present-day attempts to draw social and political implications from data bearing on the heritability of IQ. He does this with a certain degree of affect. Although otherwise showing restraint in avoiding explicit ad hominem characterizations in an area where they are not unknown, he does remark, "Patriotism, we have been told, is the last refuge for scoundrels. Psychologists and biologists might consider the possibility that heritability is the first" (p. 3).

How well does the author document his assertion that the IQ test has been fostered by men with a particular social view? How valid is his at least implicit suggestion that all those who interpret the evidence as favoring the heritability of intelligence are cut from the same political cloth? It should be recognized that the author's collection of historical quotations by no means represents a random sample of the views of psychologists of the past or of today. In every decade since the introduction of intelligence testing there has been vigorous debate regarding the relative influence of nurture and nature. Granted that some unwarranted conclusions have been drawn from inadequate data in an effort to support social action consistent with a large role of genetic factors in IQ. An equally strong and equally misleading case could be made by assembling from the historical literature the intemperate interpretations and conclusions of extreme environmentalists. Neither side has been notable for restraint in drawing social implications from insufficient data.

It does not follow that because some historical advocates of the heritability of IQ have espoused illiberal views and policies all have such views. Traditionally, advocates of standardized testing have argued that its application permits the identification of meritorious individuals regardless of background. Even psychologists and human geneticists who specifically disavow any interest in comparing races or nationalities have nevertheless learned to expect to be harassed and called "racists" and "fascists" by the radical left. Kamin does not use these terms, but the impression he