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## **Another Whiff of Doomsday**

THE latest contribution to this rich season of sombre speculation about the future—or the danger that there will be no future—also happens to be the first pronouncement of the organization set up four years ago by Dr Aurelio Peccei to study "The Predicament of Mankind", and which has since become known as the Club of Rome. The introduction to this document, published this week in the United States (*The Limits to Growth*, Potomac Associates, \$2.75), says that the members of the club are united "by their overriding conviction that the major problems facing mankind are of such complexity and are so interrelated that traditional institutions and policies are no longer able to cope with them nor able to come to grips with their full content".

The text itself is not as original as might have been expected. Much of it is derived by simplification from Professor J. W. Forrester's World Dynamics (Cambridge, Mass., 1971), itself a somewhat dangerously over-simple document. Inevitably, however, The Limits to Growth is likely to spark off yet another wave of public anxiety about the decades which lie ahead, and indeed there is a good chance that the product of what is described as the "MIT team" will emerge as the most influential contribution so far to the literature of Doomsday. In the circumstances, it is proper to acknowledge in advance that the book will probably also become a focus for controversy, for there are the seeds of fierce arguments in its assumptions and its conclusions. On balance, in spite of its provenance, the book is at once over-simple and confusing.

Like Malthus and his recent disciples, Dr Paul Ehrlich for example, Dr Dennis L. Meadows and his co-authors begin with the simple truth that continued exponential growth of any numerical attribute of society is impossible. This, of course, is beyond dispute. If the population of the world appears to be increasing exponentially, or if its consumption of iron ore or its production of disposable bottles seems to be increasing exponentially, it requires no flair for prophecy but merely a simple understanding of the differential calculus to know that exponential growth will sooner or later be replaced by some other and more moderate law of growth. The interest of prophecy in matters like these lies in the extent to which it may be possible to guess how exponential growth will at some stage be attenuated.

In this sense, it will be observed, even the great Malthus (at least in the first edition of his *Essay*) was not so much a prophet as a commentator on the algebraic properties of exponential functions. He urged that if the population of Britain continued to grow "geometrically", the time would come when famine and pestilence would supervene. The alternative, he said, was that the British population should exercise "moral restraint" in reproduction. Malthus was, in other words, not so much a prophet as an admonitory figure, urging his compatriots to a change of habit that would help somehow to ensure survival.

In spite of the MIT connexions of Dr Meadows and his

team, and the impressive use of computer simulation of the course of future events with which the book is provided, the Club of Rome's first study is in this same evangelical mould. As the club's executive committee says in its endorsement of the study, "any deliberate attempt to reach a rational and enduring state of equilibrium by planned measures rather than by chance or catastrophe must ultimately be founded on a basic change of values and goals at individual, national and world levels". REPENT, OR THE END OF THE WORLD WILL COME. That, in its essentials, seems to be the message. How seriously must it be regarded? Are other formulations more accurate representations of the truth?

The apparent exponential growth of population is one of the most familiar illustrations of how the warning can be inappropriate. Dr Meadows and his colleagues, more sophisticated than Malthus, declare at the outset that exponential growth is always the product of a positive feed-back loop. And it is true that the greater the number of children born, the greater will be the number of potentially fecund adults a generation ahead. In this sense, of course, in any population in which the net reproduction rate (the number of girl children per woman per lifetime) is greater than 1.00, exponential growth will take place with a time-constant determined partly by the breeding excess and partly by the interval of time between generations. So much is self-evident.

So how does it come about that Malthus's predictions of disaster for the British population (which took the best part of a century to respond with a lower birth rate to his pleas for moral restraint) failed to come to pass? Dr Meadows and his colleagues would have had a more convincing tale to tell if they had been seen to be more aware of where their predecessors went astray. And the truth is, of course, that the British population, like the population of the rest of Western Europe and North America, has in the past century and a half (but only just) gone through a period of historic change in which a reduction of death rate, often but not always the mainspring of population increase, has been followed by a reduction of birth rate and by a demographic condition which, taking one decade with another, can only be called stability. In other words, the demographic history of the now prosperous societies of the world shows plainly enough that in the end it is not famine and pestilence but a kind of restraint (which would nevertheless have offended Malthus by its dependence on techniques of contraception) which resolves the dilemma of exponential growth.

In circumstances like these, it is of course pointless to set about calculations of how many people will be alive in the decades ahead, and to base calculations of the annual consumption of resources on these estimates. The interesting questions are, instead, to know when the demographic transition will set in in the parts of the world where population is now growing quickly—and even to know whether there are some parts of the world

in which there is reason to fear that the demographic transition will not happen. Dr Meadows and his colleagues do, as it happens, point to the historical connexion between prosperity and birth rate-richer communities have lower birth rates. There is also a graph which shows how uniform appears to be the correlation between birth rate and GNP per head. But for a study which is supposed to be an assessment of the prospects for the decades immediately ahead, it is odd that Dr Meadows and his colleagues fail to point out that there is now good evidence that the countries of south-east Asia and the Caribbean are now well launched on a demographic transition which appears to be essentially similar to but if anything more rapid than the social transformations which brought demographic stability to Europe half a century ago.

The truth, which those who manipulate exponential growth curves seem consistently to overlook, is that there is nothing in the history of the past century to suggest that developing countries are intrinsically less capable than were developed countries of striking a sensible demographic balance, that many developing communities seem to be within a generation of such a happy state but that it is in everybody's interest that the laggards should quickly follow suit. In short, the problem of world population is not a simple problem in the exponential calculus but a complicated aspect of the evolution of society. And there is practical experience to show that in the encouragement of lower birth rates in the developing world, utterances from the Club of Rome may be less effective than humane steps to reduce the prevalence of infant mortality. Like a good many other attempts to predict the future condition of society, the Club of Rome and its calculators had forgotten the complexity, the diversity and the richness of society as it is.

The same weakness attends the calculation of the effects of economic growth on the future condition of society-the other chief plank in Dr Meadows's platform. In its essentials, the calculations of Dr Meadows and his colleagues echo the conclusions which are the central part of Dr Barry Commoner's argument in The Closing Circle. For does not economic growth imply exponential growth of the GNP, is there not a correlation between GNP and the consumption of resources such as metal ores and is there not also a correlation between economic activity (which usually implies industrial activity) and the pollution of the environment? These are the starting points for several of the calculations which the Club of Rome has now endorsed. Here again, unhappily, the subtleties are overlooked. Like other calculations of this kind, for example, the Club of Rome's document does not set out to describe the negative feedback loop which can be constructed by making the reasonable (and demonstrable) assumption that more prosperous communities are more eager than less prosperous communities to devote resources to the purchase of amenity, which may often consist of cleaner air or water or freedom from some other kind of pollution. And although the calculations of Dr Meadows and his colleagues do take into account the way in which the scarcity of natural resources of various kinds will be reflected in increased costs of these materials, they do studiously refrain from using the assumption that national resources are frequently positively correlated with increasing prices. In the circumstances, it may not be surprising that

their forward projections of the present so often seem to lead to conditions of instability or "collapse", as the saying goes. What this implies is that, for all their modest protestations to the contrary, Dr Meadows and his colleagues are trying to read too much into their necessarily rudimentary model.

The global aspect of these arguments is especially misleading. Dr Meadows and the executive committee of the Club of Rome make it plain that they base their claim on public attention on the world-wide character of their study. Although there is an acknowledgment in the committee's endorsement that there has been polite disagreement about the validity of predictions of global catastrophe based on global calculations with a single set of parameters, neither the authors nor their sponsors give sufficient weight to the objections which have been raised in the past few years to the way in which Professor Forrester's model, in its original form and as it is now applied to the purposes of the Club of Rome, lumps the problems of all communities under the umbrella of a single set of parameters. In terms of the discipline of systems analysis, which is said to have informed the study, what this implies is that the number of degrees of freedom is drastically reduced, which should at the very least imply that the conclusions should be accompanied by a warning that predictions of instability are almost by definition likely to be over-gloomy estimates. But the study, in common with others of its kind, also makes the quite distinct over-simplifying assumption that the historical path of industrial and social development which has been followed in the past two centuries by the United States will in due course be the path which other developing nations follow. The assumption that the development of an admittedly exceptional community will be the paradigm for all-or, as many would say, the assumption that one community can never learn from the mistakes of others-does at least deserve to be acknowledged as such.

It goes without saying that this catalogue of weaknesses in the first report of the Club of Rome should not be taken as an assertion that the growth and evolution of society occasion no problems. On the contrary, the social problems of poverty, disease and injustice are as pressing as they have ever been. (To its credit, the Club of Rome makes a point of urging that in the stable society to which it looks forward, it will be necessary to arrange that inequalities between rich and poor nations are somehow ironed out.) The overriding question, raised by the latest study as by several of its less expert predecessors, is whether the present circumstances are so dangerous that steps must quickly be taken to bring about a radical revision of the way in which society is organized. This, of course, is the spirit in which people such as Dr Paul Ehrlich, who considers that population growth is the immediate threat, gravely weigh the advantages and disadvantages of social innovations such as compulsory sterilization. Not so long ago (see Nature, 235, 63; 1972) a group of British scientists lent their names to a document which urged a return to agriculture as the 'backbone" of society, the organization of small communities and the restriction of personal mobility, geographical and presumably social. Other more moderate prophets argue for a more prudent regard for the common ground between communal and personal interests and, by doing so, echo the old vague but self-congratulatory sentiments of the Puritans. Although the formal study by Dr

Meadows and his colleagues leans in this direction, the Club of Rome itself has only generalities to offer. It asks for "radical reform of institutions and political processes at all levels" without saying what kind of reforms it has in mind. It asks for international planning on an unprecedented scale without saving what arrangements there should be for making plans and agreeing on them. And it asks for what the old evangelists would have called a change of heart without itself displaying a sufficiently sensitive understanding of the way in which society functions to compel the allegiance of those outside the Club of Rome. Mr Peccei and his colleagues in the club should try to do better next time, and they should recognize that in present circumstances, as in the past, the prophecies most likely to be listened to are those which are accompanied by constructive suggestions about what to do. This, unhappily for them, requires more than mere computation.

## Which Ducks are Lame?

On the face of things at least, the British Government appears to be in rapid retreat from its declared policy that industry must learn to stand on its own feet. Mr John Davies, Secretary of State at the Department of Trade and Industry, let it be known soon after he came to office that industrial lame ducks could expect no help from him. His supporters are understandably chagrined that last week he agreed to provide £35 million as a subvention for the company which has been set up to try and make a success of the shipyards on the upper Clyde and that this week he has agreed to provide £100 million by way of subsidy for the National Coal Board as well as increasing its borrowing powers from the Treasury by another £50 million. The fact that the price of coal will also be increased by  $7\frac{1}{2}$  per cent is, of course, a simple consequence of the Wilberforce pay award (see Nature, 235, 409; 1972). On the face of things, all this appears to be a great defeat for the government's policies even if one of the pressures with which the Department of Trade and Industry has to contend is the fear that a further increase in unemployment would be politically intolerable. In one sense, at least, the new subventions for British industry are ways of providing jobs for men who would not otherwise be economically employed. The truth, of course, is that in the short run there may be virtue in such a course of action, inflationary though it may be. But a much more serious weakness in the government's policy is that it is doing very little to ensure that the jobs now being squeezed out of the British economy by competition from abroad are replaced by other ways of earning a living. On the long view, the most urgent need is for a constructive policy on industrial research and development.

What are the directions in which new opportunities should be sought? Where will jobs be found for all those who will be made redundant from the British coal mines in the years ahead, perhaps 50,000 people altogether? What will happen to those displaced from the shipyards when the subsidies have been expended? And what, in any case, is to be done to employ the million or so who are at present unemployed? Plainly, there is no sense in considering these questions in isolation from the prospects of Britain's entry to the European Community less than a year from now. It is not too soon to ask whether civil engineering is properly organized to be competitive on a European basis. Although West Germany has what would seem to be a commanding advantage in heavy mechanical engineering, there is also much that could be done to strengthen the British companies which are traditionally strong in the manufacture of machine tools, for example. But there are plainly great opportunities in nuclear power if only the British industry can be cast into a competitive pattern and if, by intelligent research and decisive development, it can be given tangible goals at which to aim. And then, of course, there is the whole field of telecommunications where Japanese companies in the past few years have demonstrated quite clearly that both market and job opportunities exist. In short, there is no lack of fields in which new prosperity might be found. The problem which only the government can solve is to make them accessible.

Ironically, the sums of money now being spent to help Mr Davies's lame ducks are very much larger than those needed to give the industries concerned a proper sense of enterprise. The most obvious gap in the government's present arrangements for sponsoring development in forward looking industries is that there is no machinery for channelling funds for research and development into potentially profitable paths. So does it not follow that the most constructive escape from the government's present dilemma in its economic policy is the setting up of larger and more effective organizations for supporting industrial research?

## **100 Years Ago**



DR. LIEBREICH, the eminent ophthalmist, of St. Thomas's Hospital, delivered a lecture at the Royal Institution on Friday evening last, on certain faults of vision, with special reference to Turner and Mulready. The later "aberrations" of Turner's style he attributed to a physical change in the refractive power of the eye, by which illuminated points were converted into illuminated lines. The change of manner in Mulready's later pictures he accounted for, in like manner, by increasing yellow degeneration of the crystalline lens. We hope in a future number to give a report of the lecture.

WE are very glad to be able to state that intelligence has just been received from Prof. Huxley that his health has already been greatly renovated by the pure air of Upper Egypt. He wrote from Thebes, and was then contemplating a visit to Assouan, from which he would probably have returned to Thebes before this.

WE understand that the Meteorological Committee have resolved to issue lithographed illustrative charts of the Daily Weather Report, which will be delivered in London, within a reasonable distance from the office of the printer in Lincoln's Inn Fields, between I and 2 P.M., or posted in time for the evening mails. Up to the 31st of March these charts will be supplied gratuitously.

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