

CORRESPONDENCE

Limits of Growth

SIR,—As a member of the Club of Rome, I have been able to read a pre-publication copy of Dr Dennis L. Meadows's study *The Limits to Growth* which you castigated in an editorial (*Nature*, 236, 47; 1972) a month or more before it will become available to most of your readers. May I assure them that there is a good deal more to be said for it than your thunderings implied?

In the first place, Dr Meadows emphasizes several times that these studies should not be interpreted as predictions. What he is trying to do is to examine and illustrate the modes of behaviour of a complex system involving both positive and negative feed-backs when it is subjected to sudden alterations in inputs. Broadly speaking, he is investigating the transients which may occur on the way towards a new equilibrated pathway (or chreod, in my terminology). And when such transients could take the form of doublings or halvings of the world population in periods of a few decades, they are of more human concern than the word "transients" may at first suggest.

There are, of course, many real and important questions to be asked about this preliminary study. How robust are the demonstrated modes of behaviour against variations in the coefficients assigned to measure the strength of the various interactions involved? One would have wished Meadows to have provided more definite evidence on this point, but personally, having spent much of my life studying the highly "canalized" processes of biological development, I find fairly plausible his assurance that such variations (within reasonable limits) rarely alter the modes of behaviour and usually only produce minor alterations in the timing of them. Probably a more serious question is

one alluded to, in somewhat superior tones, by the editor of *Nature*, namely that this is a very "aggregated" study. It lumps together, not only nations and regions of very different characters into global totals of population, food production and so on, but also aggregates together various sorts of production, for example, housing and the infrastructures of urbanization with more ephemeral and less necessary consumer goods. Further distinctions within some of the broad categories employed by Meadows will certainly be very necessary. Indeed, I think he would be first to admit so; and further work, sponsored by the Club of Rome, is already attempting refinements of this sort. The results of these developments will be awaited with interest by all those, who I think will be many, who feel that Dr Meadows has taken an interesting first step in one of the few directions which seem to offer hope of a rational understanding of the complex world system.

Yours faithfully,

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Breast Cancer

SIR,—With great interest we read the editorial on the possible viral aetiology of human breast cancer (*Nature*, 235, 7; 1972). You mentioned a statement in which Spiegelman would advise women from breast cancer families not to nurse in case they had virus in their milk. As an objection to this thought you pointed out other possible routes of vertical transmission, referring to the work of the "Dutch school of RNA tumour virologists" on the murine counterpart of the human breast cancer virus. In our studies we emphasized the role

of the gametes in the transmission of various murine mammary tumour virus strains. However, we observed that if mice are prenatally infected with such a virus, additional milk borne infection has an accelerating effect on mammary tumour development. In addition, female mice which are heterozygous for spontaneous release of a gamete borne virus can infect their offspring either genetically or with their milk; that is, if a daughter does not carry the gene for virus release, she still may develop a mammary tumour because she was infected the other way.

These two observations may support those who want to abolish breast feeding by virus-carrying mothers. But one must also take into consideration that we only found transfer of the virus if large numbers of virus particles are present in the milk. As far as we know in most human milks the amount of virus is low. Often a hundred times more would be necessary to have effect in the murine situation. In our opinion the advice of Spiegelman could be moderated in that it might be given to those women who have a great deal of virus in their milk.

However, a further problem is that prolonged lactation has a protective effect on the mammary gland with regard to carcinogenesis. By not nursing, a mother may either save her child from getting breast cancer or at least delay it, but at the same time she promotes the chance that she will get the disease herself. Therefore, discussion of breast feeding seems rather academic, particularly in view of the many other aspects of breast feeding which are not related to the cancer problem.

Yours faithfully,

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Obituary

Professor G. Ya. Bei-Bienko

THE prominent Soviet biologist, Professor G. Ya. Bei-Bienko, died on November 2, 1971, after a short illness. He was President of the Entomological Society of the USSR Corresponding Member of the Academy of Sciences of the USSR and holder of several state awards. He was also President of the

last International Congress of Entomology, held in Moscow in 1968.

Professor Bei-Bienko was born on February 7, 1903, in the small Ukrainian town of Belopolie. His family, who were shoemakers, moved soon afterwards to Omsk in Siberia, and it was here that he went to school and later to the Omsk Agricultural Institute. After graduating he joined the staff of the Institute and later

became Lecturer in Applied Entomology there.

During his childhood Bei-Bienko accompanied his father on many of his business trips in Siberia and it was during these travels that he developed the love for nature—and particularly the interest in insects—that was to last for the rest of his life. While still a student he became interested in the orthoptera and, after making a list of

the acridoidea of the Omsk region, he went on to study their ecology. In later years he divided his interest between the taxonomy and ecology of orthopteroidean insects.

In 1927 Bei-Bienko moved to Leningrad, where he was to spend the rest of his life, and began work in the Zoological Museum of the Academy of Sciences of the USSR. Although always retaining a close connexion with this museum, he moved in 1929 to the Plant Protection Institute of the USSR and in 1938 to the Leningrad Agricultural Institute, where he held the chair of general entomology until his illness last year. While working in Leningrad Bei-Bienko published several major works on the systematics of the dictyoptera, dermaptera, tettigonioida and acridoidea of the USSR, and at the same time produced many papers on the applied entomology and ecology of these groups. He took part in many expeditions, both within the USSR and to other Asiatic countries, and this resulted in the publication of a number of faunistic studies.

During the siege of Leningrad in the Second World War, Bei-Bienko took an active part in defending the city, and it was only when he became completely exhausted that he was evacuated to Perm, where he remained until the end of the war.

Professor Bei-Bienko will be remembered not only for his substantial contributions to science, but also for the warmth and good humour of his personality. He was a man of remarkable energy and remained fully active in his scientific work until the year of his death.

Mr Michael Graham



MICHAEL GRAHAM, a former Director of Fishery Research in the Ministry of Agriculture, Fisheries and Food, died on January 1, aged 73.

He will be remembered firstly as a distinguished marine scientist who was largely responsible for the development

of British fishery research after the Second World War to a position of world renown, and secondly, as a man who appreciated the importance of ecological studies and the need for conservation of natural resources many years before such ideas attained their present importance and, what is more, took practical steps to translate his ideas into action. But to those who worked with him he will also be remembered as a man of deep sympathy and understanding. This is clear from his books and it dominated his personal relations. Never could there have been a better mentor to lead the young biologist through the intricacies of fisheries research and its applications.

After service in the Royal Navy during the First World War Michael Graham went to Cambridge to read Natural History and joined the staff of the Fisheries Laboratory, Lowestoft, in 1920. At first he worked mainly on the biology of the North Sea cod, and in particular studied its life history and fluctuations in the size of the stock.

Between 1927 and 1928 these studies were interrupted by a period of work in East Africa to carry out fishing survey of Victoria Nyanza. This was concerned with the study of the distribution of the important food fish, *Tilapia esculenta*, and the danger of its being over-fished, and it resulted in the formulation of a series of recommendations to the appropriate governments. This was a period of fruitful collaboration with E. B. Worthington and the expedition started a movement whereby fishery science, which had been developed in the seas, became applied to large lakes, especially those in the tropics. The study of Victoria Nyanza stimulated other surveys and from them has emerged, over the years, a large and flourishing fishing industry as well as much research which has revealed some of the fundamental processes of biological production.

In both his North Sea and Victoria Nyanza studies Graham had been concerned with the problem of rational fishing, and in the 1930s he became concerned with the general problem of the dynamics of exploited fish populations. In this he followed the lead given by his director, E. S. Russell. He assumed that the growth of a fish population took the form of the logistic curve observed for other populations and from this concluded that the most effective level of fishing is that which maintains the population at an abundance equal to about one half that of the virgin stock. Outside the laboratory he found time during this period to study, experiment in and write about soil and grassland management.

After service in the RAF during the Second World War Michael Graham was appointed Director of Fishery

Research and was responsible for the Ministry's fishery research programme until he retired in 1958. This period was particularly noteworthy for the impetus which he gave to the mathematical studies of fish populations by recruiting to the Lowestoft laboratory and encouraging the work of men like Beverton, Holt and Gulland. He also played a prominent part in obtaining intergovernmental agreement concerning fish conservation in the North Sea and elsewhere. Other milestones during his directorship were the establishment of the Ministry's fisheries radiobiological laboratory at Lowestoft and its shellfish research laboratory at Burnham-on-Crouch, and the development of a comprehensive research programme in distant waters, especially the Barents Sea, based on cruises carried out in all seasons of the year by the research vessel Ernest Holt.

After retirement he carried out highly successful pioneer work on the reclamation of slag heaps in Lancashire and his experiments showed that they could be "greened over" at very little cost. He also became a special lecturer in biology at Salford University from 1966 to 1971 and delighted in expressing in lecture and book form the importance of ecology and in illustrating his theme with practical examples culled from various parts of his own career.

Announcements

University News

Professor E. J. H. Corner, University of Cambridge, has been appointed Royal Society Leverhulme visiting professor to the **National Biological Institute**, Bogor, Indonesia, for a period of 7 months.

Dr V. Dubowitz, University of Sheffield, has been appointed to the chair of paediatrics at the Institute of Child Health, attached to the Royal Postgraduate Medical School, **University of London**.

Dr C. J. Stairmand has been appointed to an industrial chair in the Department of Chemical Engineering, **Loughborough University of Technology**.

Appointments

Professor R. E. O. Williams has been appointed director of the **Public Health Laboratory Service** in succession to **Sir James Howie**, who will retire in September 1973.

Miscellaneous

The **Institution of Mechanical Engineers** will award annually a senior James Clayton fellowship, for project or study programmes in specific areas of mechanical