

the Trades Union Congress, TUC) are still disgruntled. One of the major issues they still consider unresolved is the question of comparisons between their salaries and those paid to poly-technic lecturers and heads of departments.

Straight comparisons between rewards in the two sectors of British higher education are notoriously difficult to make on account of different opportunities for promotion, the numbers of staff, on relative salary points and the balance in teachers' time between teaching and research. Yet they are made, and the AUT officially considers that many university people are comparatively underpaid.

In addition the bi-annual conference of the AUT last December showed that

the government's handling of negotiations on pay during the past year has left a legacy of bitterness. There is talk of "hatred" for the universities in the Department of Education and Science, discrimination in favour of the poly-technics, and—most disturbing—of a Civil Service plot to do down the universities.

The worst of these suspicions are likely to clear in the coming year, however. Mr Fred Mulley, the Secretary for Education, is a genial figure who attracts none of the opprobrium heaped on his predecessor, Mr Reg Prentice. Although the university teachers are likely to vote in favour of joining the TUC, it is unlikely that a moderate body like the AUT will do much to steel its arms for militant action on

the issue of salaries.

But action is promised on two fronts that could have important longer term effects on the structure of the profession. The AUT is planning to press for a revision of the ratios of senior to junior staff, on the grounds that there is a serious promotions log-jam, with a great build-up of those on the upper points of the lecturer and senior lecturer scales with little or no prospect of advancement. On another front the AUT is drawing up new salary claims to be presented to the government on the basis of comparison with the Civil Service. This marks an unwelcome development in the eyes of those who fear that the drawing of such analogies will speed the process of bringing universities into full state control. □

FORTY-EIGHT years ago I published the first of a series of papers on the exponential growth of colonies of duckweed and the circumstances under which exponential growth curves became sigmoid. I was following the fashion at that time. Raymond Pearl was doing elegant mathematical analyses of the growth rates of human populations, and Alfred Lotka's brilliant *Elements of Physical Biology* (surely one of the most seminal books on mathematical biology ever written) came into my hands when I was a third year student, just 50 years ago. It is a book which gave, as long ago as that, a masterly treatment of the conditions for equilibrium in biological systems.

So it is with a sensation of nostalgia that I have followed the publications sponsored by the Club of Rome and supervised by Dennis Meadows. It is touching to watch the rediscovery of exponentials, as though Pearl and Lotka had never lived, and ironical to note how much more credible those writers were, working with a slide rule and a little algebra, than Meadows and his colleagues are, armed with a computer. With these thoughts in mind I turned with hope rather than anticipation to the third volume of studies sponsored by the Club of Rome (*Dynamics of Growth in a Finite World*. Pp. 637; Wright Allen; Cambridge, Massachusetts, 1975). Have the authors, as I hoped, at last recognised the fundamental weakness of computer simulations in which the critical parameters—the adaptation of social values and norms to environmental change—have to be omitted because they cannot be quantified?

If this third volume does nothing else, it illustrates the phenomenon of exponential growth. The first volume weighs 170 g and cost \$2.75; the

second weighs 530 g and cost \$18; the third weighs about 900 g and costs (in sterling) the equivalent of \$37. If one makes the assumptions which are the theme of *The Limits to Growth*, the next volume, due in a couple of years,

## Exponentials again



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will weigh 1½ kg and cost about \$60, and the one after that 5 kg, perhaps.

Of course nobody in his senses makes such assumptions, but then neither does he make similar ones about the exponential increase of pollution in nations which have NEPA or the EEC Declaration on the Environment or the Control of Pollution Act; yet a section in chapter six of this book does make precisely this assumption, and the authors reach a conclusion which I think (without immodesty) I could have reached without a computer: "... as long as there is exponential growth in the generation of pollution, ameliorative measures ultimately do little to prevent the model from exhibiting unacceptable levels of pollution

damage" (page 477).

We owe a debt to Meadows and his colleagues for dispelling the utopian mirage: that material standards of living will continue to go up and up, until Indian peasants enjoy the comforts and amenities now enjoyed by the middle classes in Europe. But they do a disservice to their own cause when they imply that their computer simulations can be used as a guide to policy making. A glance at the present state of the world is enough to demonstrate that this naive approach (even though it does include an element of social feedback through the price mechanism) diverts attention from the much higher priorities in policy making. Long before we are starved of resources or smothered in excess population or choked by pollution we are in for a series of grave geopolitical confrontations, to be resolved either by war or by subjection for nations which need resources to conditions imposed by nations which own resources.

The world's future in the short run depends on how these confrontations are handled. The techniques for handling them are not in the hard sciences (though they will buy time) nor in econometrics (which has a dubious record of predictiveness). They are in social anthropology (to understand the nations which may inherit power), in ethology (to understand our own social behaviour under stress), in political science (to help us to devise political systems to match the complexity of post-industrial society). These are the fields which need massive support for research and development. I think sometimes that Britain suffers from a semantic anomaly: that *Wissenschaft* in Germany and *Nauk* in the USSR cover a much wider spectrum of disciplines than our word *Science*.