NEWS AND VIEWS

Politics as Applied Mathematics

THERE is very little chance that politics, variously known as the art of the possible and the art of the impossible, will become an entirely rational process, but it is important not merely for politicians and mathematicians but for ordinary electors that a great deal has been done to formulate in mathematical language some of the problems with which politicians are concerned. In the past year or so, mathematical models have been constructed for such things as the economic systems of nation states, the relationship between industrial activity and environmental pollution and the operation of hospital services.

Each of these devices is, potentially at least, of considerable importance to politicians and public administrators. Predicting what will happen to the level of unemployment from an increase of income tax can be a much more precise procedure than anybody would have guessed in the days when macroeconomics and differential equations were both considered by the world at large to be secret mysteries. It is sometimes hard to tell from the way in which governments actually behave, and from the air of injured innocence with which they greet predictable consequences of actions taken deliberately but blindly, that the lesson has been absorbed that much of the working of systems even as complicated as social systems is capable of objective analysis, but there has been some progress in this direction.

It may not be surprising that the most useful work has been done in defence, arms control and disarmament, for these are fields in which mathematicians have long been involved with those who are paid for making subjective judgments about imponderable issues. The article by Dr Ian Bellany on page 361 of this issue of *Nature* is yet another illustration of the way in which it is possible to describe mathematically what may be done to throw light on conflicts such as those which exist when opposing nations are asked to make reductions of military forces.

Dr Bellany's conclusions, are unlikely to bring the SALT talks to an immediate end when they are resumed in the new year, but they should help to show how straightforward can be some of the conclusions drawn by mathematicians about military situations. The starting point for Dr Bellany's argument is the assumption that the two sides are to begin with in a state of military balance which can be expressed by the numerical equality of two mathematical functions, each representing the way in which the military strength of each side is determined by parameters such as the size of its standing army, the number of tanks which it possesses and so on.

The argument is chiefly concerned with conventional weapons and with the possibility that there might in the next few years be a serious attempt to bring a balanced reduction of military forces in Central Europe. If the state of balance has been achieved because both sides have reached the point at which they have ceased to invest in new armaments, but are instead content merely to keep their armies up to strength and to replace equipment as it wears out, elementary calculus is enough to show that in any programme for disarmament there should be equal proportional reductions of arms on both sides. The point is important because its validity does not depend on the different ways in which the military strengths of the two sides may be differently determined by armaments of different kinds.

But if each side agrees, for example, to reduce its number of troops and of tanks to go with them by, say, 25 per cent, is there a danger that the outbreak of hostilities would then give one side a better chance of winning by causing damage to its opponent? Simply because defensive positions are frequently safer than offensive postures, it turns out that further conditions must be satisfied by the proportionate reduction of force. Problems like these, in the past few years, have been tackled successfully by means of geometrical multivariate models. This, for example, is the way in which it was shown in the 1950s that a balance of mutual deterrence with ballistic missiles is possible if and only if both sides have more than a certain minimum force—if one side has too few missiles, it can always legitimately fear that these will be destroyed by a pre-emptive strike by the other side. which would then be free to go on and hold the defeated country to ransom. The same argument has more recently been used to demonstrate that multiple independent re-entry vehicles would upset the strategic balance between the United States and the Soviet Union which has been expensively established during the past decade.

By now, there is a distinguished if small body of literature on these and related problems. The late Professor Lewis F. Richardson was one of the most stimulating of contributors, with books such as *Statistics of Deadly Quarrels* (Chicago, 1960). Richardson's chief contribution was to show that differential equations can in many circumstances accurately describe the ways in which an arms race between two close opponents may on some occasions be stable and on some occasions be unstable—in retrospect, for example, it is clear that the principal opponents in the First World War can be accurately described by Richardson's equations. But there are other problems to be considered, notably the economic constraints which increasingly determine the scale on which military forces can be developed in modern states and W. R. Caspary has made distinguished contributions to those aspects of these problems.

In the 1960s, the games theoreticians entered the scene and, in spite of the way in which the name of their craft seems continually to bring them into disrepute among ordinary people (not to mention politicians), nobody will deny that their influence has been stimulating and beneficial. The much maligned Mr Herman Kahn, once described as the "Herman Kahn of strategy", has helped enormously to demonstrate the intellectual interest and importance of mathematical models in military and political conflicts. Politicians who think otherwise should reflect on the value of abstract discussions of how to behave in the game of chicken—that teenage sport in which young people drive headlong towards each other to see which driver loses his nerve first—an unpleasantness for the loser—or whether neither loses his nerve—a greater unpleasantness for both.