

the talk in recent months of schemes in which students preparing for higher education would study three or four subjects as well as mathematics, and its own preference is for a mixture of science, social science and arts for everybody. So far, so good. The real problem is to know what should be done to bring about these changes.

The committee would have done a useful service if it had been more outspoken on this issue. Events in the last six months suggest that the time has come when several distinguished heads should be knocked forcibly together, and the Dainton Committee could have made a useful start. For one thing, it is important that the Schools Council, which has responsibility for the British school curriculum, should be dissuaded from its introspective preoccupation, the pressure of external examinations (and the need somehow to diminish it). Its own proposals are narrowing, not broadening, and have served so far chiefly to undermine confidence in the council's capacity to function sensibly. But it is also important that work should promptly be put in hand to design the kinds of curricula which the logic of the committee's proposals would imply, and on recent form there is very little to suggest that the Schools Council, which ought to be in charge, will be fit and able to do what is expected of it. But there are also problems concerning teachers' organizations—who, for example, is going to persuade the science teachers whose enthusiasm has been chiefly responsible for experiments in science teaching in recent years that the time has now come to have less, not more, formal teaching in the schools? One of the valuable discoveries which the Dainton Committee has to report is that students following science courses tend to be well looked after by well qualified teachers. The question now is who should tell these talented people that they must spend less time behaving as if they were teaching in universities. To be sure, it will be valuable to have Dr Dainton's support for the cause of more in-service training for teachers, more laboratory technicians in British schools and better means of persuading young people to take up science teaching. The trouble, unfortunately, is that these needs have also been obvious for some time. The most urgent need has become that of making them materialize.

It is, of course, a great absurdity that the British educational system has remained archaic for so long, but the prize will go to the one who can show how change can happen quickly.

What the committee has to say about the universities follows naturally enough—universities must be more flexible about their requirements for entry. By good fortune, it seems now very much as if the Standing Conference on University Entrance will be given advice in this direction in the months ahead. The article by Professor L. Rosenhead, a member of the Dainton Committee, on page 806, is one man's vision of how universities might quickly become better suited to the real needs of the schools. But here, too, it is all too likely that the formal processes of consultation and the traditional unwillingness of those concerned with British education to consider seriously any but the most moderate of changes will blunt the present tendency towards reform.

This, perhaps, is where the Government could help. As it has turned out, and as it should be, the Dainton Report is not a piece of special pleading on behalf of science teachers but yet another comment on the inadequacies of British education. It also stands out among public documents as a sensible statement of the part which should be played in education by science studies and of the reasons why some acquaintance with science should be considered important not merely for professional scientists but for everybody. The trouble, of course, is that in the present balance between British schools and British universities, there is no room for this kind of appraisal. On the whole, the schools are too preoccupied with specialist studies and the universities are forced as a result to be too preoccupied with the need for a broader education. It is hard to see how this pattern can be changed except by the simultaneous agreement of the host of interested parties, but it is also plain that the need for change is urgent. In the circumstances the Government could do worse than organize the kind of conference at which many interested parties could be persuaded to hammer out answers to the question which excessive modesty has persuaded Dr Dainton to leave alone.

## The Magic of Numbers

THE dead-pan send-up is a literary genre that seems now to be flourishing in the United States. A few weeks ago there was the *Report from the Iron Mountain*. Now there has appeared Professor D. J. de S. Price's *Research on Research* (Journeys in Science, University of New Mexico Press, 1967). It is true that Professor Price appears to be entirely serious in what he has to say, but many of his readers will be bound to suspect that he has devised a witty demonstration of the inadequacies of what is called the science of science.

That hindsight makes it seem as if scientific discovery points to a logical method of procedure has led some people to suppose that there must be an

analogous logic in the way in which science is carried on—a logic the investigation of which merits a new and distinct discipline of social enquiry. One approach of this "discipline" is to examine some numerical parameter assumed to be indicative of the forward march of science, such as the number of all papers published, and if possible to describe its variation in terms of some mathematical function. From this kind of exercise, scientists of science expect, some useful insight may eventually emerge. Among the principal difficulties of this argument is the assumption that the part of the individual in scientific discovery is either so predictable or so negligible that it can be altogether



ignored. The crude macroscopic indices considered by the scientist of science can be used to demonstrate that, so inexorably does the juggernaut of science roll forward, not even a genius can make a significant contribution to its momentum. But it is not easy to know whether Professor Price is mocking when he says that "Science is, so to speak, a much more regular thing in its behaviour than are people". This assumption, a necessary point of departure for the science of science as usually construed, is an absurdity which lies at the other extreme from the Cleopatra's Nose school of history. Can it seriously be supposed that if Archimedes, Newton and Einstein had never existed, the present state of science would be no different?

Granted that the individual is insignificant, Professor Price shows how several intriguing "laws" may be set up. The "First Law of Research on Research" is that the "size" of science increases exponentially, whether judged by the number of scientists, scientific journals or scientific papers. It follows that "87½ per cent of all the scientists who have ever been are alive now". This is an impressive figure indeed and doubtless deserves its place in the *Guinness Book of Records*, along, perhaps, with a note that a similar figure would probably have been valid in 450 B.C. But what does it show? Professor Price offers this, that "science runs so much faster than people, so much more rapidly than civilization". This would seem to cast the man at the bench in the position of the Red Queen, which may be Professor Price's way of saying that the size of science bears no relation to such wholly immeasurable aspects as its quality or rate of progress at any given time. Alas that the latter aspects, which alone are of significant interest, fall outside the crude scope of the science of science.

No first law is complete without a second, and Professor Price announces the Second Law of Research on Research which states that the distribution of quality among scientific institutions, men or journals follows the approximately inverse square law typical of the Pareto law of distribution of income. "For men as for institutions", Professor Price explains, "the chance of doubling the size of achievement is uniformly about one in four, no matter what the size already achieved." From this follows the premise implicit in the foundation of the argument, that in science (though not, apparently, in art) the individual counts for nothing. "If Beethoven had not existed, other men would have written quite different symphonies; Beethoven's private property is unmistakable. If Planck, however, had not made his particular discovery, somebody else would have to have made it and . . . rather quickly."

As the culmination of his essay, Professor Price produces statistics to show that the size of each country's research effort is proportional to its gross national product. Size is measured by the percentage of papers of each national origin indexed in *Physics Abstracts* and *Chemical Abstracts*. (He calls these "National Brownie Points", which is another reason for believing that he may not be entirely serious.) From this analysis it emerges that the Soviet

Union, whose share of the world's GNP is 15.6 per cent, contributed 15.6 per cent of physics papers, while the equivalent figures for the United States are 32.8 and 31.6, respectively. This is a remarkable concurrence, but is it significant? Concurrences in historical and social phenomena have an unfortunate habit of being less meaningful than their counterparts in scientific experiments. George I, II, III and IV all died on a Saturday, but this does not by itself serve to establish the existence of a baneful influence between the Sabbath day and the House of Hanover. The science of science has far to go before it attains respectability. Only Professor Price can know whether his ingenious essay was written to help it on its way or as another obstacle in its path.

## Mr R. Brightman

THE death of Mr R. Brightman at his home in Cheshire last week-end is a particularly sad blow for *Nature*, for he played an important part in its production for the whole of forty years. He was a chemist by trade, and served for many years in the Dyestuffs Division of ICI Ltd. He had a passion for books and for the scientific literature, which is why no doubt he spent much of his professional energy on the management of the literature. But he also had a great affection for his work for *Nature*, which began with book reviewing and quickly graduated to other tasks. In the years since the Second World War, when many men of his age would have settled back in their retirement, he found himself writing a great proportion of the leading articles which appeared in *Nature*. More recently, he took on the job of working through *Hansard* each week in search of parliamentary news, and he was at the same time hard at work on a volume intended to celebrate the centenary of *Nature* next year. He would have wished no better monument.

## Gloomy Post Office

THE prospects of the General Post Office for its final year before being established as a public corporation are described in a Government White Paper, just published (HMSO, 1s. 9d.), and presented to Parliament last week by the Postmaster-General. A Bill for the establishment of the corporation will appear later in the year. For the past five years a financial target of 8 per cent was set for the Post Office as a whole, but this has not been achieved. The overall return is expected to be nearer 7.6 per cent, the return from telecommunications, which reached the target, compensating for comparative failures of the postal services. Under the current reorganization these two sections will be managed separately and, because of the different nature of their activities, will aim for different targets. A net return target of 8.5 per cent for telecommunications (after historic depreciation but before interest and supplementary depreciation) has been set, but for the postal service, which is less highly capitalized, a margin of 2 per cent on total expenditure is being attempted. At present prices, it is unlikely that these targets will be reached. In fact, the postal service expects to make a loss, and, faced with capital