

of, say, a new system of income tax? The immediate need is that governments should be forced to be more open on technological matters. The second is that the scientific community should help to guide informed and level-headed discussion. But it is significant that one of the most important influences on the direction of technological development is the old-fashioned interaction between supply and demand. Anybody who doubts that has only to ask how else than by popular acclaim has the automobile industry grown to its present size. And in this sense, of course, one of the causes of anxiety about the future of technology is that it is hard to predict just what will happen next. The uncertainty may seem more acute than it used to be, but it is not intrinsically novel. The problem is to live with it. Medawar and Hobbes should help.

#### RADIO ASTRONOMY

## More Telescopes Urged

from our Astronomy Correspondent

A CRITICAL need for new radio telescopes in the United States is urged by the National Science Foundation committee under the chairmanship of R. H. Dicke. In the committee's second report, issued last week, the Ad Hoc Advisory Panel for Large Radio Astronomy Facilities says that the momentum of radio astronomy in the United States will be lost unless a start is made immediately on new telescopes. The members of the panel are B. J. Bok (University of Arizona), S. A. Colgate (New Mexico Institute of Mining and Technology), R. Kompfner (Bell Telephone Laboratories), W. W. Morgan (Yerkes Observatory), E. N. Parker (University of Chicago) and G. Westerhout (University of Maryland). The chief cause for dismay seems to be that the complement of radio telescopes available to United States astronomers is the same as it was two years ago, when the panel last reported, and there are no firm plans for new instruments. What the panel would like to see is a resurfacing of the dish at Arecibo so that it can be used at wavelengths of 10 cm or less, an array of eight dishes of 130 foot diameter at the Owens Valley Observatory of the California Institute of Technology and a 440 foot steerable dish and a large array of twenty-seven antennae at locations not yet decided. The panel also recommends design studies on large steerable dishes to be used at wavelengths of 3 mm, a substantial improvement in the support for radio astronomy in the universities and at least half the observing time on large instruments to be available for visitors from elsewhere in the United States.

The report is published at a time when American ground-based astronomy is in the financial doldrums, with radio astronomy coming off if anything worse than optical astronomy. By the financial year 1970, federal backing for radio astronomy is expected to be down to \$5.45 million, from \$7 million in 1968. Support for optical astronomy is also to drop over the same period, but by 10 per cent compared with 22 per cent for radio astronomy. The National Science Foundation component is an unsuccessful attempt to slow the trend, caused as much as anything by a decrease of interest in pure astronomy by NASA and by the Department of Defense. In 1970, the National Science

Foundation expects to spend \$3 million on radio astronomy, an increase of nearly \$1 million on the \$2.14 million spending in 1968. But NSF support for optical astronomy is to drop from \$4.06 million to \$3.8 million during the same interval.

Against this background, the panel's recommendations seem a far cry from what United States radio astronomers are likely to get in the near future. Little confidence is generated by the reaction to the panel's 1967 report, in which a similar series of recommendations was put forward but no new telescopes were started. The latest report was commissioned to review the 1967 recommendations, and says that the needs for new telescopes which were urgent two years ago have now become critical. In particular, the panel records its disappointment that the resurfacing of Arecibo recommended in 1967 has not been carried out. The 1967 estimate of the cost was a modest \$3 million.

The 440 foot steerable dish and the large array of twenty-seven antennae which are recommended would both be built in the south-west United States. The steerable dish is based on a design study by the North-east Radio Observatory Corporation, and would be enclosed in a radome. In the opinion of the panel, a dish of this size is well within technical limits. By protecting the dish in a radome, a lighter and cheaper structure can be built, although radome losses mean that the instrument is equivalent to an unenclosed dish of 400 feet. In 1967 the cost would have been \$28 million spread over five years.

The large array is a proposal of the National Radio Astronomy Observatory, and would be built in sections with each section becoming operational while construction proceeded. According to the panel, it would produce up to three radio pictures per day with a resolution of 1" of arc—as good as optical photographs.

Both arrays of small antennae and individual large dishes are needed by radio astronomers. The arrays are used to produce high resolution radio pictures of particular objects—the large dishes complement them with low resolution sky surveys, line spectroscopy and observations at a range of wavelengths among other things.

#### EDUCATION

## Italian Policy Reviewed

THE system of secondary education in Italy has progressed a long way since the war towards meeting increasingly complex social and economic demands, but, according to a survey by the Organization for Economic Cooperation and Development, there are still a number of areas, particularly the supply of teachers and the structure of science teaching, in which reforms are urgently needed. The report (*Review of National Policies for Education—Italy*, HMSO, £2 6s) is part of the OECD's programme of helping member countries to evolve national science and education policies. It concentrates chiefly on secondary and particularly upper secondary education where the most rapid expansion is occurring and where the conflicting demands of general culture and specific job qualifications have to be resolved. It is based on a report by a group of examiners together with the

conclusions of a "confrontation" meeting between the examiners, a special delegation from Italy, and representatives from each of the other member countries.

At present the non-university educational system in Italy is made up of three successive cycles—primary school, middle school and an upper secondary school divided into several branches. The development of the middle school, which provides unstreamed compulsory schooling for all children up to the age of 14, was one of the radical changes introduced in the 1960s, the other being the conversion of the former technical institutes into upper secondary schools which qualify students for entry to university. As a result of this encouragement of technical and also vocational training, which the review describes as unparalleled in most other countries, more than half the pupils completing middle school enrol for further technical or vocational education. Secondary education is also given in three other types of school, the classical lycée, the scientific lycée and the teacher training colleges. The Italian authorities are planning a reorganization of the upper secondary cycle in which there will be five types of lycée offering five year courses: the old classical and scientific lycées and a new linguistic lycée, the former teacher training colleges, with their course increased from four to five years, and the arts lycées. Vocational training in groups of related occupations will still be given in the *istituti professionali*. The new linguistic lycée will concentrate on "the languages, literature, civilization and social organization of other nations". The idea is that the five year period should be divided into a two year general cycle during which students can switch from one type of lycée to another, and a more specialized cycle of three years. At the meeting the OECD examiners expressed their doubts about the length of the upper secondary cycle, and the rigid division between the classical and scientific lycées.

The problem with science teaching is that there is not enough time for it with the present curricula. Even in the scientific lycées and technical institutes, science teaching takes only between 12 and 15 per cent of the total time, and practically no experimental work is done. As a short term measure, the Italians introduced pilot classes in which new OECD syllabuses and textbooks in mathematics, physics and chemistry are being tried out and they hope soon to introduce pilot lycées in which all subjects will be taught in this way. On the basis of these experiments, it should be possible to plan a national system of science education.

As a long term measure, the examiners strongly recommend that there should be a research and planning service, within the Ministry of Education, responsible for formulating and putting into action an overall educational policy and that it should be staffed by qualified economists and sociologists rather than by civil servants trained in the law or humanities.

## HIGHER EDUCATION

### More Polytechnics

RESHAPING an area of higher education is a slow and laborious process. Three years have now elapsed since the issue of a white paper outlining proposals for establishing and developing the polytechnic system, and while the announcement this week that polytech-

nic have been formally designated at Bristol, Newcastle, Portsmouth and Wolverhampton is at least an outward manifestation that these plans are being put into practice, it will be several years before these institutions will operate fully along the lines laid down in the white paper.

The basic aim of the polytechnics is to provide a comprehensive range of courses for full-time, part-time and sandwich students, complementary to the universities and colleges of education. It is also hoped that amalgamating several existing colleges into one polytechnic will result in less duplication of courses and in the ability to offer new and more progressive courses, thereby utilizing existing resources more efficiently. The problems involved in amalgamating several colleges are among the causes of the delay in getting the system fully under way, and evidence of this can be seen clearly at Bristol.

The Bristol Polytechnic will be formed from three colleges—the Bristol Technical College, the Bristol College of Commerce and the West of England College of Art—which are on opposite sides of the city. Physical problems of travel between the constituent colleges will present difficulties in communication and will almost certainly result in a lack of coordination and corporate spirit, at least until the completion of central buildings in the late 1970s. The Bristol Polytechnic is probably not typical in several respects, however, since the constituent colleges do not offer any courses leading to CNAAs degrees at the moment, and it will also have a strong regional bias, illustrated by close links with the British Aircraft Corporation and other nearby industries.

At the other extreme, the Portsmouth Polytechnic will be made up mainly of students at the Portsmouth College of Technology together with about 90 students from the Portsmouth College of Art and Design. The pattern of education is already fairly comprehensive, since external London degree courses are offered together with HNC, part-time and sandwich courses, so the transfer to a polytechnic will not result in any very radical changes. New courses which will be offered are predominantly in the field of business studies, which reflects one of the main objectives of the polytechnic system: to form closer links between education establishments and industry.

The designation of these four polytechnics brings the total number to eight, out of a proposed total of thirty, and there are already some doubts about the practicability of establishing courses of widely differing types in one institution. But perhaps a more fundamental criticism is that it is impossible to coordinate several widely spaced colleges under one governing body. The problem of how the polytechnics and the universities will co-exist is less tractable if more distant.

## MOLECULAR BIOLOGY

### Dog Wags Tail

THE Kendrew Report on the state of molecular biology in Britain, which was published last year (*Nature*, 219, 107; 1969), prompted the Biochemical Society to set up a subcommittee. The members of the subcommittee, under the chairmanship of Sir Hans Krebs, were Professors K. S. Dodgson, S. R. Elsdon, G. A. D. Haslewood,