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 *instituti 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 polytechnics 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 CNAA 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. Elsden, G. A. D. Haslewood,

D. C. Phillips and R. M. S. Smellie, and Drs W. N. Aldridge and A. P. Mathias. The results of their deliberations have recently been published as a depressingly predictable little tract, *Biochemistry, 'Molecular Biology' and Biological Sciences* (The Biochemistry Society, London, 2*s* 6*d*). The members of the subcommittee, who take pains to stress that their report is not a formal statement of the British Biochemical Society but their own corporate opinions, support most of the recommendations of the Kendrew Report. They deplore the self defeating tendency of the over-ambitious school biology master who, in an attempt to be up to date, forces his pupils to learn by rote the biochemistry of DNA or the Krebs cycle when the pupil lacks the chemistry to give such feats of memory any meaning beyond examination marks. They hope the investigation of school biology sponsored by the Nuffield Foundation will result in a balanced curriculum.

At the undergraduate level, the subcommittee believes that biochemistry must increasingly be taught by experts to all first degree biologists and that a first degree in biochemistry will increasingly become the basic grounding for biologists. Supporting the Kendrew Report, the biochemists call for formal courses as a requirement for a PhD degree and go along with the idea that mobility at the change from undergraduate to postgraduate education is desirable, but not, however, if it has to be enforced by what the Kendrew Report euphemistically described as "administrative measures".

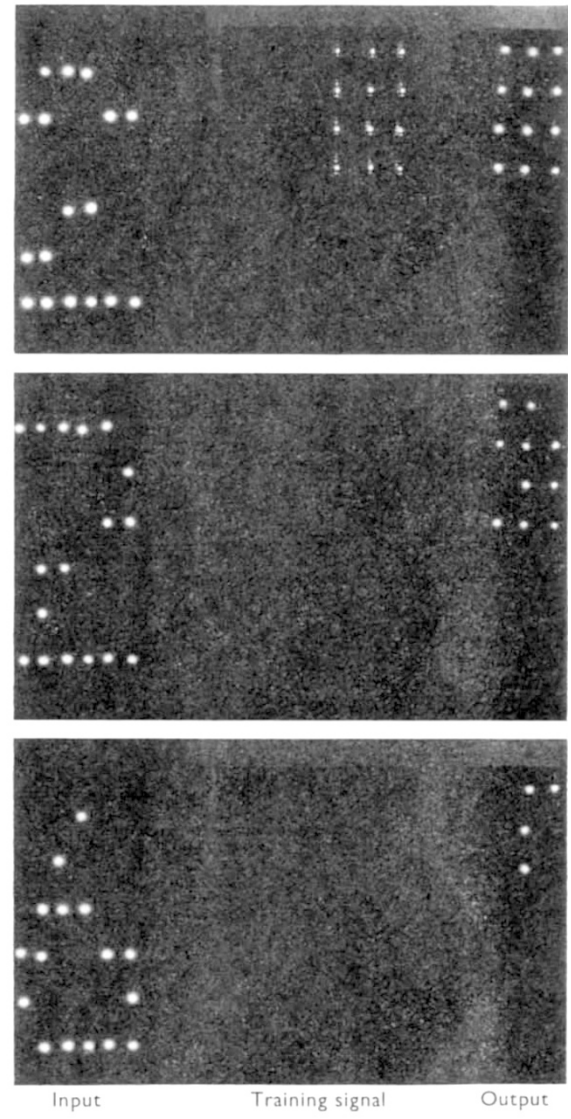
The subcommittee dismisses the idea that academic research is an unnecessary luxury, marshalling the history of electricity and examples of experience in the United States to prove the point, and says flatly that "a teaching institution without research does not deserve to be called a university". But the problem is maintaining standards of university research. The subcommittee's solution is to take the purse strings out of the hands of the universities, which lack the machinery or the will for assessing the value of an individual's research and pursue policies which "tend to be overridden by considerations of laissez-faire and assumed equality of competence of all scientists", and give them to the research councils. By strengthening the hand of the research councils, which currently administer only £3·8 million compared to the £6·1 million spent by the UGC on biological research in the universities, much second rate work could be starved out, and the universities might learn that all staff members are not equally good at teaching, research and administration.

Indeed, one of the chief criticisms levelled against the universities is the lack of subtlety in their administration. The gentlemanly assumption that all staff are equal makes for a quiet but a stagnant life. The real aim ought to be excellence even at the cost of treading on people's toes. But excellence should be within the universities, not in a few aristocratic centres of excellence largely divorced from the universities. The biochemists detect inconsistencies in the Kendrew Report when it discusses "focal centres", suggesting that its authors may not themselves have agreed on what they meant, and then go on to outline their own interpretation of the idea. It boils down to research council groups and units established in universities in much the same way, but on a larger scale than during the past thirty years. The subcommittee forgoes the opportunity of complaining about the gulf between the MRC's Laboratory of Molecular Biology at Cambridge and its local university.

ELECTRONICS

Microcircuit Learning Machine

A LEARNING machine which uses entirely digital circuitry has been built at the Electronics Laboratories of the University of Kent. The machine, known as Sophia, consists of twelve digital microcircuit learning cells, and it learns to recognize simple patterns beamed on to its photocell "eye". The only other learning machines built so far are based on a highly simplified model of the neuron and consist of large and expensive analogue electromechanical or electrochemical cells whose resistances are altered by learning. Because the model of the neuron has to be so crude—with only



In photograph *a*, Sophia is being taught to respond with all lamps on to a pattern representing a two. In *b* and *c*, the machine responds to a different two and a six, as shown, the response to the two being much stronger.