

ness to provide different kinds of courses with an insistence that there should be more money for post-graduate education as a whole.

British universities will also, no doubt, be downcast by what the Swann committee has to say about the status of the PhD degree as a kind of social symbol. The committee considers that many people may be seduced away from useful occupations in industry by the wish to acquire what has become the easiest acknowledgment of academic standing in the sciences—not to mention the deference of British greengrocers at the same time. In the belief—which may not be entirely well founded—that it is too late for people to call doctors “mister”, the committee would undermine the snobbishness which is sometimes associated with academic titles by making it possible for the engineering institutions and the universities to dub working engineers “doctor”. This is an ingenious solution, but not a particularly courageous one. If the committee really wished to make the forms and ceremonies of British academic life less seductive to bright people, it would have to start much farther back. The laying-on of hands which often determines the transference of power and authority would have to go. So would many of the trappings of academic life—the ermine trimmings and the like. It is hard to think that a thorough programme of anti-snobbery would leave even the Royal Family untouched and, even though there may be a good case for a study of this social problem, it is probably outside the terms of reference of the Swann committee.

The committee's proposals on the recruitment of science teachers are entirely sensible, and here the only doubt is whether even the most enlightened and vigorous proposals can be entirely successful. It is, however, obvious that the recruitment of experienced people into science teaching should be urgently encouraged. There should be a particular welcome for the committee's suggestion that Government departments and other organizations should be ready to pay pensions early to people willing to go into teaching. As things stand, there is no doubt that a great many people in middle life who find themselves in scientific laboratories would welcome a chance to change jobs if they could do this without risking penury. With luck and a little ingenuity from the actuaries, it should be possible to work out a career structure for many scientists in which teaching would be an opportunity to share with young people some full experience of what the real world is like. It is a continuing shame that the Government has steadfastly ignored the advice of dozens of committees in the past few years, and has so far neglected to act on the transferability of pensions, even within its own payroll. But even if devices like these can substantially increase the number and quality of science teachers, the chances are that British schools will have to learn to live with chronic shortages. In the long run, the only remedy is to teach less science in the schools, which would not be a tragedy but the opposite if this were done by creating a less specialized pattern in the sixth forms. The

Swann committee could have made more of that objective.

On the character of undergraduate education in science and technology, however, there is no doubt that the Swann committee's heart is in the right place. Indeed, the committee has done a great service in directing attention to a part of the educational system which has been for too long neglected by university teachers. Yet it would, of course, have been a great surprise if the pattern of university courses evolved in British universities during the period between the two world wars would have been suited to the needs of the present university population, at once much larger and more diverse. Few will be able to quarrel with the committee's view that undergraduate education should be made much more general—the article by Professor A. B. Pippard on page 1307 of this issue is powerful demonstration of the need and feasibility of more general courses. Yet there are bound to be many dragging feet. Not merely will it be necessary to work out new curricula, but close attention will also have to be paid to the departmental structure which at present determines the pattern of teaching at many universities. Luckily, some (though not all) of the younger universities have broken new ground in recent years. The problem now is to make the others move, and quickly. Can the universities respond as quickly as they should?

SCIENCE POLICY

Making Way for Innovation

Two reports issued within a few months of each other from either side of the Atlantic have reached strikingly similar conclusions about the structural weaknesses in British industry. *Technological Innovation in Britain*, the first report of the Central Advisory Council for Science and Technology, under Sir Solly Zuckerman, was published last week (HMSO, 3s. 6d.). Like the report of the Brookings Institution, it argues that British engineers are not only too thin on the ground but also deployed in the wrong way, both within companies and industries. The scarcity of engineers can be alleviated by switching people and resources from pure to applied science—this remedy is proposed by the Brookings report in particular—and the cost effectiveness of engineers would be improved by transferring them from industries such as aircraft, where there are proportionately too many, to those such as machine tools where there are too few.

The Central Advisory Council points out that, over the past 20 years, nearly two-thirds of the successful innovations have been made by American firms. Although Britain spends a higher percentage of the gross national product (GNP) on research and development than any other country except the United States, there have been proportionately fewer engineers in almost every sphere of advanced scientific enterprise. This contrasts with the policy of Japan, which is to tailor industrial effort to the prospective demand of markets overseas. The council argues that this unselective approach has allowed engineers to be concentrated in some industries to the detriment of others.

But it is the myopia of British managements as much as the shortage of supply that has prevented qualified scientists and engineers (QSEs) from permeating the functions of production and, above all, marketing, where their presence—if the American example is anything to go by—is essential to innovation. Basic research is but one part of the process of innovation, and is often the least significant financially, yet British industry seems to use only half as many professionally qualified people in production and marketing as does Germany. A recent survey showed that in large British companies (over £5 million capital value) only 8.5 per cent of directors have scientific or technical qualifications. There is, however, evidence to show that the profitability is correlated with the proportion of QSEs among the executives.

The Central Advisory Council makes a number of specific recommendations for redressing the imbalance of QSEs and promoting effective technological innovation. First, newly qualified scientists and engineers should be encouraged into production and marketing, as opposed to merely research and development. "This could be done partly through the negative measure of reducing the number of research grants made by Government institutions to new graduates, and by concentrating the support for work in Government establishments on projects which are related to foreseeable production." Second, Government establishments whose original purpose no longer justifies their present scale of effort should be further run down unless they can provide services for industry. "Any measure," the report explains, "which will help to get the pattern of our scientific, technological and manufacturing efforts into balance will pay in the long term." Government research establishments could also help by acting on a commercial basis as agencies for private industry, both in research and development and in the later stage of the innovation chain. The report also recommends that, where appropriate, royalty rights should be purchased from overseas in order to release scarce scientific manpower for production and marketing.

The Brookings report (see *Nature*, 219, 105; 1968) arrived at a similar diagnosis from a different approach. In the section on science and technology, Merton J. Peck of Yale University observes that Britain has traditionally operated the economy with proportionately fewer engineers than the United States. The shortage of engineers has to some extent been remedied by the substitution of scientists and non-professional technicians, which is one reason why the demand for engineers, as expressed in the salary structure, is less than would be expected.

BRITISH SCHOOLS

Yet Another Examination

THE debate on ways of improving the sixth form course continued this week with a working paper from the Schools Council on sixth form examination methods and a view from the Headmasters' Conference of the sixth form of the future. The Schools Council has also announced the names of the thirteen people who will make up the working party on sixth form work for those not seeking higher education. First announced in March (see *Nature*, 217, 1199), the working party

will safeguard the interests of the not-so-academic sixth formers and will work in conjunction with the joint working party of the council and the Standing Conference on University Entrance which is looking into proposals for broadening the curriculum. The new working party, which has appointed Dr E. W. Briault, deputy education officer for the Inner London Education Authority, as chairman, will shortly begin to hear evidence from interested parties such as prospective employers.

The collected opinions of headmasters are easily accessible, in that *The Sixth Form of the Future* (Headmasters Association, 5s.) covers both the field Dr Briault and his colleagues will be studying and the overall pattern of sixth form courses. Although it does not claim to submit firm recommendations, the headmasters' report sets out the historical development of the present highly specialized sixth form and, bearing in mind the likely composition of future sixth forms and proposals already made, goes on to produce its "preferred solution"—yet another GCE examination.

Called the "Intermediate Level", this examination would come between O-level and A-level, and is conceived of as differing from A-level in the amount of ground covered rather than in the academic standard. The headmasters believe this new examination will allow for the inevitable development of additional curricula patterns and will provide a final examination for the increasing number of students who would not otherwise reach A-level. This very proposal was rejected by the Secondary Schools Examination Council ten years ago, but the headmasters' report suggests that circumstances have changed sufficiently for it to be reconsidered. Although the fine detail of the proposal has not been worked out—and this is admitted to be beyond the scope of the headmasters' resources—the headmasters want to add to the GCE examinations, with the proviso that new examining techniques would be an improvement. The Schools Council *Working Paper 20* (HMSO, 3s. 6d.) discusses the various possible reforms and includes a firm denunciation of existing methods from the Welsh Committee of the Schools Council. This is then appraised by the individual subject committees of the council and capped by an equally firm statement of faith in existing examination methods from two secretaries of GCE boards. The Welsh Committee seeks an alternative to the present external examinations, which lead to pointless cramming, hasty regurgitation of predigested answers and the resulting narrowing of the sixth form studies. More assessment by teachers is at the centre of the Welsh Committee's proposals, with oral tests in most subjects. The problem of external moderation in examinations for university selection would be assisted by aptitude tests if these were found to be acceptable by the vice-chancellors' investigation now in progress. The *Abitur*, an internal school examination in Germany, is held up by the Welsh Committee as an example of the way in which a pupil's ability to think can be tested, but the subject committees are more sceptical of its qualities. On the other proposals, the views of the subject committees vary, with scientists and mathematicians seeing no need for oral tests. The suggestions for more examination aids (such as books) and more time for answering the papers had a mixed reception from the subject committees. The craft, applied science and technology committee of the