

discoveries in bacterial genetics are more than fascinating; they are also perhaps rather disturbing, particularly in the light of the changes reported (J. Benoit, P. Leroy, R. Vendrely and C. Vendrely) to have been induced in White Pekin ducks simply by injecting into their peritoneal cavities soon after birth samples of deoxyribonucleic acid prepared from Khaki Campbell ducks. We can dimly see approaching a day when not merely bacteria but also higher animals and even human beings may have their transmissible characters moulded synthetically—a most alarming thought in some ways.

More dimly still, but now not nearly so as it appeared only a short while ago, a day can be envisaged when we may be able, in a process analogous with infection by a bacteriophage, or with any fertilization, to add a synthetic polynucleotide to a collection of synthetic substrates and thereby set going a little hive of 'synthetic life'.

There is something seriously wrong with dreams such as this, of course. Systems of proteins and nucleic acids and accessory molecules with nothing else can scarcely keep on thinking and asking questions about themselves and experimenting on themselves until they have at last succeeded in making themselves. Reason apart, the halt will surely be called by an ultimate indeterminacy principle which says that it is impossible to place the required components in their correct places all at the same time.

W. T. ASTBURY

## EDUCATION FOR A TECHNOLOGICAL AGE

**D**ELIVERING the ninth Hinchley Memorial Lecture to the Institution of Chemical Engineers on November 5, under the title "An Education for Our Times", Dr. R. P. Linstead, rector of the Imperial College of Science and Technology, London, said that the proportion of scientifically qualified men to the total employed in British industry as a whole is 0.8 per cent. The proportion varies, however, in the principal scientific industries from 10.9 per cent in nuclear power, 5.2 per cent in oil refining, to 2.7 per cent in chemical industry and 1.9 per cent in the aircraft industry. This vocational demand is likely to increase, but Dr. Linstead insisted first that science is an intellectual discipline of the first rank in its own right, and secondly that when the current very large requirement for scientists and engineers has been met by the necessary adjustments in our pattern of education, man will still have to meet his ultimate problems of virtue, civilized behaviour and the wise conduct of affairs. He argued that the study of pure and applied science provides an education peculiarly suitable to our times, and, limiting himself essentially to the higher education of boys from fifteen years upwards at school and university during the next decade, explored four questions.

The answer to the first, whether we have enough qualified engineers and scientists, is no, and Dr. Linstead said that in the next few years an increasing proportion of science specialists in the schools should be diverted from science to engineering when they reach the universities, and university departments of technology must be provided with the necessary facilities. In considering the second question, when their education should become specialized, he sug-

gested that specialization in science and mathematics should not be pushed to the extent that a boy loses touch with the world of human studies and values, and he would like to see more flexibility in the general educational pattern, with some lightening of the requirements in factual scientific knowledge and, above all, search for intelligence. In discussing the third question, namely, whether the first-degree course should be longer, Dr. Linstead pointed out that this would involve additional capital expenditure of £15 million to £30 million, a large increase in recurrent expenditure and a hiatus in output for one year of at least 7,000 men. Rejecting this as impracticable, he urged that a real contribution could be made at the university-level by postgraduate instruction in the new types of scientific technology, where there is a real intellectual discipline to be mastered and not just a technique to be acquired.

In answer to his last question, whether scientists and engineers should be taught non-scientific subjects at the university, Dr. Linstead argued that any good system of education would provide a good product out of good material, against a good social background. In considering how far assistance can be given to students of science and technology to acquire a broader education and the attributes of leadership during their university career, Dr. Linstead suggested that, in general, compulsory and examinable non-scientific subjects should not be introduced into a three-year first-degree course. The college or university should, however, make a continuous and organized effort to provide facilities whereby a student can broaden his outlook, interests and experiences. In addition, certain types of non-scientific studies arise directly and, as it were, functionally out of a man's vocational interests and should very properly be studied in an organized way as part of them or side by side with them; for example, languages, some aspects of economics, and the history of science and technology. Finally, Dr. Linstead urged that the benefits of organized and compulsory classes in cultural subjects are limited, and in the last resort it is more important for a technological university to provide the facilities for a full life in human surroundings.

## MANAGEMENT, GROUP CONFLICT AND THE SCIENCES

**A** PENETRATING analysis of management attitudes towards group conflicts in industry has been made by the Earl of Halsbury, managing director of the National Research Development Corporation (*Impact of Science on Society*, 8, No. 3). Management is an act which occurs in opposition to some form of resistance, and to treat it as a problem in communications is inadequate. No mere verbal exposition of what a man does not want to do will make him want to do it. The fact that someone else wants it will not make him want it either. In some way the individual has to identify his wishes and hopes with those of others, with whose wishes and hopes his own were originally in conflict.

According to text-book expositions, change occurs because 'loyalty to the firm' binds management and workers together, and what is in the interest of the whole will ultimately seem to be in each individual's own interest, and will thus produce co-operation.