specific polymerisation. It was because universities concentrated on the scientific problem of describing and explaining the mechanisms involved and the structure of the polymers produced whilst industry concentrated on obtaining manufacturing processes and improving properties such as light resistance. From a common origin, the discovery of stereospecific polymerisation, academics and industrialists have moved in different directions.

The relationship between university research and industry may well be a function of the degree of development of the area concerned. Once a new area has been established, the aim of science is to understand; the aim of technology is to make it work, and industry has been very successful at making things work without too much reliance on understanding.

Industry makes use of the trained manpower supplied by universities. It also uses new techniques such as chromatography, developed in universities. But the new products and processes of industry seem to depend on a combination of existing technological concepts, economic pressures and empirical research with scientific understanding not being very relevant.

This does not mean that university research is a waste of money; the situa-

tion may be changing. Concern about such matters as resource depletion, ecology, pollution, fire risk, health hazards and quality of working life coupled with the increasing scale of industrial operations may mean that industry will have to pay more attention to understanding what it is doing.

In the study of 84 innovations mentioned earlier, the only example of theoretical work in a British university assisting British industry was in the area of steel frames for building construction. A concern for human safety together with a shortage of steel led to the use of Baker's theory of plastic flow to design buildings which are safe but use less steel.

It could be that in the future, many sections of industry are going to require an increasing reliance upon theoretical research aimed at understanding, as the empirical approach, which has been so successful, joins the quest for economic growth as a thing of the past.

It would seem, therefore, that there are both macro and micro effects leading to changes in the relationship between science and technology.

At the micro level, the relevance of a particular part of science has depended on its degree of development. At the macro level, the relationship

seems to move in cycles, with the first half of the nineteenth century involving little reliance upon scientific theory (although the scientific technique of methodical observation was made use of) the second half of the nineteenth century being characterised by a series of inputs from research concerned with exploring scientific problems, the first half of the present century being a triumph of industrial methodical empiricism and the future requiring an increasing dependence on understanding.

I thank the Department of Education and Science and the Programmes Analysis Unit for funding parts of this research and Trevor Parkinson for his considerable ingenuity in tracking down the institutional origins of some of the more obscure references.

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² Schmookler, J., *Invention and Economic Growth* (Harvard University Press, 1966).

³ Langrish, J., Gibbons, M., Evans, W. G., and Jevons, F. R., *Wealth from Knowledge* (Macmillan, London, 1972).

⁴ Langrish, J., *Chemistry in Britain*, 8, 330 (1972).

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international news

A WORKING party under the chairmanship of Lord Ashby, Master of Clare College, Cambridge is being set up by the Advisory Board for the Research Councils to "make an authoritative assessment of the potential benefits and potential hazards of techniques which allow the experimental manipulation of the genetic composition of microorganisms".

At the same time the Medical Research Council (MRC) has made public the fact that they have asked their staff members not to embark on experiments in bacterial manipulation vetoed in the recent National Academy of Sciences (NAS) statement.

The letter circulated to directors of those MRC units which have the capacity to carry out work in this field asked that no experiments of type I and II in the NAS statement be undertaken in the near future until the working party has reported. This covers work on recombinant drug resistance plasmids that do not occur

Improper plasmids?

by Eleanor Lawrence

naturally, and the linking of animal virus DNA to plasmid DNA and its subsequent introduction and replication in a bacterial cell.

Directors were also asked not to initiate research on linking animal DNA to plasmid or bacterial DNA, which, according to the NAS statement, "should not be undertaken lightly." Experiments of this kind have already been carried out in the United States.

According to a spokesman for the MRC, the council supports no programmes actually involving research of the kind mentioned by the NAS, although the separate techniques are being studied in various laboratories.

He estimated that about 50 laboratories in Britain have the capacity to carry out genetic manipulation of the sort vetoed by NAS, but that until now there had been a self-imposed holding back from this type of experiment, which has been technically possible for some time.

The establishment of a working party to clarify the issue is generally welcomed, as the part of the NAS statement referring to drug resistance plasmids is felt by some to be ambiguous; it could, for example, be interpreted as banning experiments necessary for important public health work. Other workers also feel that the ban on introducing animal genes into bacterial cells could hold up work on new ways of producing important substances such as insulin.

The working party will consist of "high-level scientists" and the Advisory Board for the Research Councils hopes to be able to announce the membership within the next two weeks. □