
General Discussion

F. W. Hayes

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General discussion

F. W. HAYES (37, *Sussex Square, London W2 2SP, U.K.*). ‘New horizons’, as we have used them in the context of these discussions on ‘industrial microbiology’, refer neither to west nor east, but to our ability to see beyond the immediate foreground. I am astonished at some of the negative thinking behind the gloomy forecasts of the practicability of schemes for growing agricultural crops to provide us with our energy needs in the future.

It is true that, in the U.K., we have neither the land nor the climate to grow vast quantities of sugar cane for fermentation. But we do not grow all our own food now and, before the advent of North Sea oil, we were quite resigned (if not happy) to buy fossil products of million-year-old photosynthesis, ejected from holes in the ground in Saudi Arabia, Alaska or wherever. Why should we, therefore, be disinterested in the production of massive quantities of fermentable material in overseas countries that have the land and the sunshine? Is not ethanol from Brazil, Australia, South Africa or Kenya as good a proposition as methanol from New Zealand, N.W. Australia or other countries with unutilized methane?

As regards our assets and our abilities, our discussions at this conference show that we have advanced ideas, technology and high design and engineering skills. In the context of *fuel ethanol*, these abilities are just what is needed now. We can sell these skills and plant designs. The countries with the space and the sunshine are short on both scientific progression and design experience. This is where we should be in business.

Poor plant delivery times have been mentioned by one author, plus our sufferings under engineering industry disputes, but these are not peculiar to the fermentation industry. In many of the countries that could be our technology customers, the maximum supply of home-fabricated plant and equipment will be mandatory, but the advanced technology is sought after eagerly.

Coupled with this is the need for financing the supply of the equipment and the construction of the plants. Our British international chemical engineering contracting companies have a good track record in this field and, to me, the potential large-scale fermentation industry for fuel ethanol opens up a very exciting vista.

It was stated that in the U.K. there was a shortage of ‘risk capital’ for the development of new ideas in industrial technology, fermentation in particular. This is quite incorrect. Industrialists are eager for promising and well presented development projects.

Personally, I have many new ideas in fermentation technology. I have obtained backing from a large U.K.-based group with wide overseas interests and we are forming a new development company, which will have as its main objectives the development and progression of new fermentation techniques, so that the required chemical engineering work may be carried out to complete the process flowsheets, to do the design and engineering work, and then to offer the process for licensing, or the complete package, to an appropriate market. One of our initial projects will be fuel ethanol, with pilot plant work to be carried out in a cane-growing country. The financing of this development company is by private capital and *not* by Government; the latter being put forward so frequently in these discussions as the only possible course.

Yes, I think our conference should end on a high and hopeful note of immediate developments in industrial microbiology being the instrument for us to sell British skills.

PANEL DISCUSSION

The discussion began with the Chairman (Dr Langley, I.C.I.) inviting comments as to what impediments exist to industrial application of the new advances in industrial microbiology. Dr J. D. Coombes (Hoechst U.K.) pointed out that, as money for research and development comes from profits, a healthy economic climate with the availability of money and confidence is essential for innovation. Furthermore, innovation necessarily involves taking risks and, as society has moved more and more to avoid taking risks (e.g. G.M.A.G., producer liability, Health and Safety Executive), these limitations provide many hindrances. However, without taking risks there will be no innovation and, ultimately, with no innovation, there will be a loss of jobs. Dr Coombes also drew attention to the need to ensure adequate government support for universities, as universities provide the source of talent for industry. Academic-industrial contact is inhibited by various factors, such as the impossibility of giving consultancy salaries to many academics on research council support and the necessity of university patents going through N.R.D.C.; the introduction of a system whereby academic researchers could actually profit through patents on their work would be a great incentive. Dr Gould (B.P.) claimed that in the areas of research with which he is involved, which are largely chemical, B.P. enjoys good relations with many university departments. It was suggested that academic-industrial contacts were much better in chemistry and engineering than in biology. Dr Carrington (Beechams) also pointed out that productive collaboration had taken place between his company and University College, London, in the use of immobilized enzymes, and suggested that further applications of immobilized enzyme systems could usefully be examined.

Dr Coombes suggested that the Government should introduce legislation to allow patenting of industrial microorganisms and should also take a positive attitude to the E.E.C. proposals in biotechnology. However, Dr M. H. Nielsen (Novo), while strongly supporting the E.E.C., felt that the E.E.C. proposals for biotechnology were far too bureaucratic and that the U.K. should have a biotechnology programme of its own, using and expanding its own research facilities, which are of high quality but undersupported. Reliance on the E.E.C. would introduce a ridiculous delay. Dr Nielsen felt that the E.M.B.O. Laboratory at Heidelberg could provide a centre for the training of research workers in fields needed for the development of industrial microbiology.

As regards training people suitable for research in industrial microbiology, it was generally agreed that it was necessary to bring together individuals trained in a variety of disciplines. It was felt that biotechnology was not yet a sufficiently developed or defined subject to constitute an undergraduate degree course. However, the merits of M.Sc. courses in biotechnology were discussed and Dr Dunnill (University College, London) pointed out that, in response to a clear need, they had developed, at his college, an undergraduate course in biochemical engineering and that this had proved a success.

Both Dr Meers (Sturge) and Dr Nielsen argued that it was necessary to distinguish the various areas of industrial application of microbiology. There are grounds for considerable optimism in the field of biologically active compounds, e.g. pharmaceutical products, food flavouring, etc. With the growing world population, production of foodstuffs would also prove an important area. In this context, Dr Nielsen pointed out that his company felt that, due to the energy shortage, there was more future in developing plant proteins, rather than single cell protein. Dr Solomons (Rank, Hovis, McDougall) pointed out the attraction of using algal photosynthetic

CO₂ fixation to provide foodstuffs, and drew attention to the fact that many industrial fermentations produce as much CO₂ as final desired product. He reiterated the feeling that the E.E.C. biotechnology policy hindered research, and illustrated this by quoting a figure of 10⁷ t of excess soft wheat per annum that the E.E.C. stored and then gave away to Eastern Europe. This biomass, he argued, could profitably have been used as an industrial feed source.

There was much discussion on the use of microbial processes in providing industrial energy sources. It was widely felt that, due to the coming world food shortage, starch and sugar would not be available for fermentation to ethanol for use as an energy source. Furthermore, E.E.C. pricing policies made it an uneconomic process, even at present. Dr Righelato (Tate & Lyle) emphasized that, as he hoped that he had made clear in his talk, the ethanol fermentation was only economically attractive, at present, in a few developing countries, but that further developments in technology and shifts in political climate were likely to change this position. In the longer term, carbohydrates might be used directly to construct new types of fibre rather than fermenting them to ethanol to replace petrochemical feedstock for a plastics industry. Dr Gould (B.P.) pointed out that petroleum stocks would not be exhausted for a good few years yet and drew attention to the large amounts of coal deposits. He reiterated the need to examine photosynthesis as an energy source. Dr Nielsen pointed out that developing means of using cellulose as an energy source would constitute a considerable break-through, since E.E.C. straw production last year topped 3 × 10⁹ t. Mr Wynne Hayes pointed out that there were subtle errors in most assessments of the economics of the ethanol fermentation (see general discussion).

The comments that Professor K. Murray had made on the limited availability of venture capital in the U.K. stimulated much discussion. Several members of the panel claimed that sufficient capital would be available for proposals that would prove commercially attractive. The only problem might prove that, with the Minimum Lending Rate at 14 %, there might be a shortage of 'patient money'. Dr Cuthbertson (Glaxo) drew attention to the need for academics to approach the right company for the implementation of their ideas and Mr Wynne Hayes stressed the need for clear presentation of the attractions of a particular innovation. Dr Meers suggested that one of the major differences between the U.K. and U.S.A. in this area was the lack of enterprise shown by U.K. inventors in their failure to start their own companies.

Professor Hartley (Imperial College) suggested that the present British Government looked to industry to bring down from the mountain the tablets of stone that were to transform our economy. The discussion panel represented a formidable collection of industrial expertise in biotechnology, and he was rather disappointed at the shortage of positive suggestions made so far. University scientists had been patted on the head for producing a few useful ideas and asked to turn out more brilliant Ph.D. graduates with suitable training for the coming biotechnology revolution. But Government has squeezed out almost all of the fat from universities and is now cutting into lean muscle. For example, S.R.C. awards only two research studentships to his Department to be allocated among 20 academic staff, and funds will not allow replacement for staff who have moved into industry.

Therefore, if industrial companies really believe that British universities have something to offer them, they will themselves have to step in with support to prevent the drying up of the pool of young talent on which they eventually rely. This could turn out more to their interest than encouraging the taxpayer to foot the bill, since they could call the tune more convincingly if they were a little more generous to the piper.

There was considerable support from the audience for Professor Hartley's polemic.

The discussion ended on a note of cautious optimism, with the hope that some of the recent successes that had been presented during the meeting would encourage more support for research into industrial microbiology.