Paying For The Privilege

Douglas Kell looks at ways in which British researchers could emulate the Japanese

Based on well-known cases too numerous to review (but including penicillin, hovercraft, and monoclonal antibodies), there is widespread acceptance of the idea that we in Britain are good at inventing or discovering things but poor at exploiting them commercially – a view coupled, in some circles, with the extraordinary claim that this is then the fault not of industry but of the hapless inventors. The view is equally widespread that in Japan the converse is true: although they may boast few Nobel laureates, they dominate the world economy in many high-technology areas.

Biosensors are devices which incorporate a biological element (such as microbial cells or enzymes) connected more or less directly to a conventional sensor capable of producing an electrical signal. By making use of the ability of cells or enzymes to recognise only a very limited range of substances, one can thus obtain with biosensors a much greater specificity, and hence accuracy, than was possible before. In consequence, the market for such devices is predicted to be both large and lucrative, especially in the area of health care; and several devices, some the products of research in British universities, are now commercially available.

I recently spent just over a week in Japan (as part of a Science and Engineering Research Council delegation), visiting counterparts in university and industrial laboratories working in the area of biosensors. Not least since intellectual progress in this area requires highly interdisciplinary skills (biology, chemistry and physics being almost equally important), it was obviously of interest to form a picture of the extent to which the supposed lack of creativity of our hosts, none the less coupled to an evident efficiency of technology transfer, was manifest.

Based on what I saw, I noted three particular differences in British and Japanese practice which may well reflect or account for the relative efficiency of the Japanese in getting products from (or even into) the research laboratories, through the development phase, and on to the market: I will summarise them under the terms creativity, technology transfer, and "short-termism".

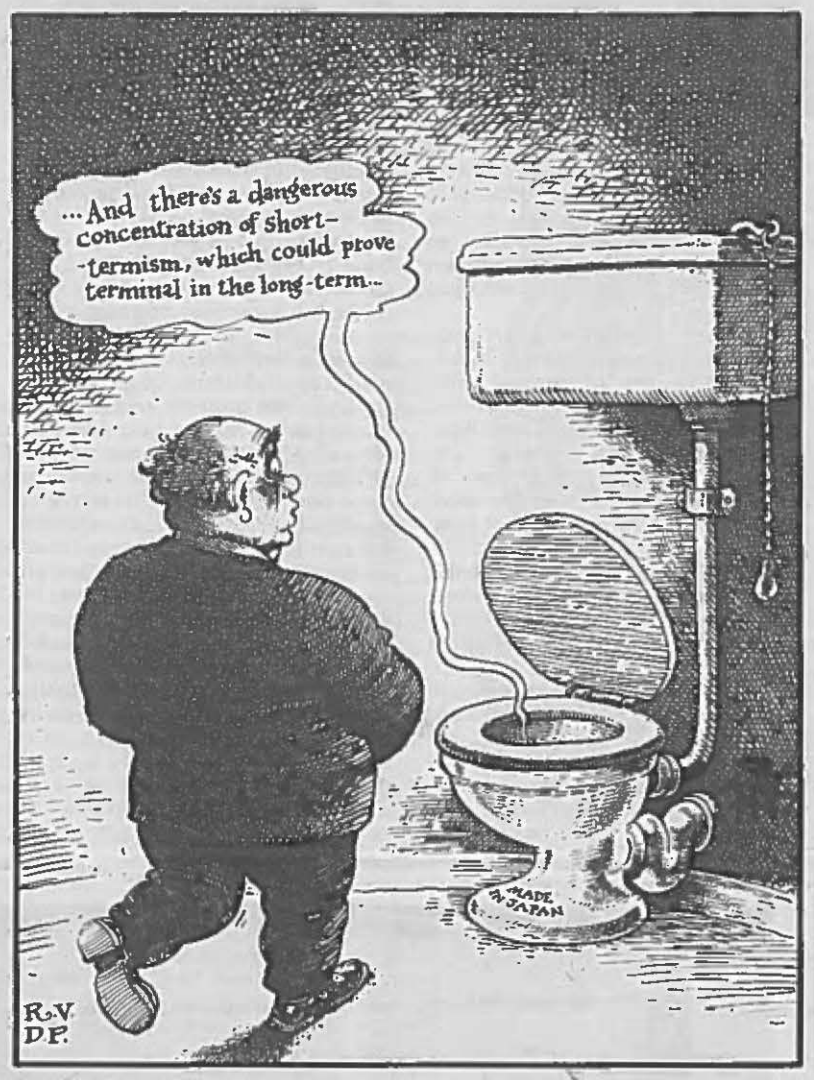
First, let us look at creativity. Go into a British laboratory, at least in a university, and you will find reprints everywhere: the electronic age has not yet replaced the journal article (and its xeroxed copies) as the main means of scientific communication and hence exogenous intellectual input. Of course this resource is not alone sufficient to ensure progress, but it is certainly necessary, since one cannot think about a problem and try to find an innovative solution to it if one does not even know that it exists or what the potential solution might be. Thus, some kind of input is necessary.

What was striking, however, was that in several of the Japanese university laboratories I visited there was not a reprint to be seen. It is not possible to put this down simply to linguistic problems. In these groups, experimenters were simply told what experiments to do, based on what the group leader had heard at the latest conference. By the time the work had been reproduced, the scientific horizon would have moved, and truly innovative work was highly unlikely. By contrast, getting into a new market with established technology might be speeded up.

But the supposed general lack of creativity of our hosts I found no less mythical than that here; as anywhere, there is a spectrum of scientific activity ranging from a smaller amount that is very innovative to a majority that is more or less derivative ("the Kuhnian view of scientific progress"); and in the former groups one did indeed see the "normal" (British) complement of reprints. So the first conclusion is that if we want to keep our people creative, we should make them read as widely as possible.

My second point involves looking at technology transfers. If the research director of a British company wishes to move into a new area, and to try to make something commercial out of a novel scientific advance, one conventional way is to look to see which academic laboratories are doing good work in the area and hire one of their postgraduate students or postdocs. It is presumably supposed that by some mystical process the requisite scientific and technological knowledge will then be transferred to the industrial laboratory. This is a very haphazard way of effecting technology transfer, to say the least.

Notwithstanding the relative lack of postdoctoral positions in their universities, what I found particularly noteworthy about the Japanese system was that if a company wished to get into a particular area of science it actually sent one of its own employees to work in the university laboratory for a year (and paid for the privilege). He (or much less commonly she) would then begin his work in a state mindful of the type of device (say) that the company wished to develop, and would then emerge with the knowledge necessary to proceed, tailored exactly to the problem at hand. At least in the biological sciences this way of going about things in Britain simply does not take place to any extent worth quantifying.



I would add, too, that the Japanese companies in question were generally ones that had no obvious background in the biosensors area: in one laboratory, a motor manufacturer was there to find out how to make sensors which would establish (by measuring appropriate compounds in sweat) when drivers got tired (and thus could send a signal to the engine to slow down); a printing company was there to find out how to make biosensing inks for the subsequent mass production of sensors; even a toilet manufacturer was there, to make "smart" toilets which would make measurements in urine and tell their captive audience of impending clinical problems. It is not easy to imagine such proactive behaviour from the corresponding British companies.

Discussion of this problem of technology transfer usually highlights the so-called "not-invented-here" problem; and it is certainly striking that the very poor take-up of monies allocated under the LINK schemes, at a time of very straitened academic circumstances, hardly reflects a lack of desire of academics to be funded. So my second conclusion is that if a company wishes efficiently to transfer technology from a university, it should put its employees into the university laboratory.

Finally, there is "short-termism". That this is something of a catch-all word, used to describe shortcomings in all areas of the British infrastructure, does not decrease its fundamental importance. If the City expects a "return on investment" of 10–15 per cent but the real economy is growing by only 0.5 per cent then it must be obvious that the only way to balance the books is to devalue the currency (to have inflation), neatly cancelling the supposed benefits of the high profit margin. Top Japanese companies have a bottom-line profit of "only" some one per cent of turnover. It is not because they are just scraping by: it is because the other nine to 14 per cent has been invested in research in, and more especially the development of, new products for the future. As is well known, it is investment in the stages between development and production which is the most costly.

Yet some of the products I saw were self-evidently just being held back until the present market had been saturated and the time considered right for the public to be exposed to the next generation of consumer products (which will certainly fall into the category of "not invented here"). Of course, they will then pay handsome returns on the very large investments necessary for their development and manufacture, an investment that had started long ago. There was no obsession with "this year's profits and the future will look after itself": until we rid ourselves of our short-term vision we shall never establish significant technological leads. So my third conclusion is that big future profits require big investments now, and a payback time that is certainly longer than the term, let alone the event horizon, of a British government.

Of course, these are not the only differences between the two countries: one can hardly fail to mention the correlation between the current economic strength of countries such as Germany and Japan and both their investment in civil science and their lack of diversion of scientific resources into so-called defence research. Similarly, the success of manufactured products from these countries is certainly attributable in part to the obsessive implementation of detailed quality control procedures. Neither would I claim that the three themes I have highlighted constitute anything approaching a cure-all for a variety of historical mistakes. But if we wish to emulate the apparent (and real) success of the Japanese in getting advanced technology to the marketplace, a good place to start is by emulating some of their better practices.

Douglas Kell is a reader in microbiology, University College of Wales, Aberystwyth.

Complementary Assets

Helen Lawton Smith and Erik Swyngedouw report on European trends

In October 1990, we began a two-year project involving the comparative analysis of technology transfer in Britain, France and Belgium with reference to two base industries: flow measurement and electronic components. These industries were chosen because of their importance in affecting the competitive positions of companies in other industries. Supported by the joint committee of the Economic and Social Research Council and the Science and Engineering Research Council, the project aims to determine the critical factors in shaping how firms in the two sectors overcome problems of achieving continuous technological change in order to remain competitive by appropriating technology developed in public-sector research institutions (PSRIs) such as universities and national laboratories; and to analyse how these links and their outcomes are organised territorially.

The increasing interaction between industry and PSRIs itself is part of a wider process of collaboration which encompasses inter-firm collaboration between competing and non-competing firms, and operates in a variety of different forms ranging from informal to highly structured and institutionalised linkages. By supplementing in-house effort with technology generated outside the firm, firms are externalising part of their research and development effort, and gaining access to "complementary assets". In so doing, they are gaining access to technology produced at a lower cost than if they were able to undertake the research in-house.

However, the process of externalisation changes the nature of the ownership of intellectual property. On the one hand intellectual property is shared, but on the other there is an increasing commodification of information as industry monopolises, through payment, research undertaken in PSRIs. These changes raise important issues. For example, it appears that the role of universities and national laboratories as creators of public goods is being reassessed as higher education and industry become increasingly interdependent. The changes in emphasis on research activities which this involves might not necessarily serve longer-term interests.

The growing scope and scale of industry and academic relationships, recorded in studies of the United States, Japan and countries in western Europe, is linked to major upheavals in industrial organisation at national and international scales which became pervasive in the 1970s and 1980s and which are continuing into the 1990s. Governments in advanced industrial countries have responded to these upheavals by becoming increasingly interventionist in the way innovation is organised, recognising the importance of industrial innovation to economic growth and competitiveness.

The role of the state in shaping the operating environment through the organisation of the science base, and through technology policy towards industry, is a central theme of the research. However, we are aware that supra-national forces such as the European Commission and multinational companies interact with and may transcend local and national influences. The first stage of the research, just completed, has shown that although the intent is the same, for historical factors, the pattern of governmental intervention is different in each of the three countries.

In Britain, one solution to the problem of increasing international competition, is to increase contact between industry and universities. This policy is expressed in the DTI White Paper of January 1988. The government will: "encourage collaboration between higher education institutes (HEIs) and companies (at the pre-competitive stage) and "give greater emphasis to encouraging and facilitating many different aspects of technology transfer".

Schemes operating within the LINK and Eureka frameworks and other collaborative research programmes are designed to foster links between industry and universities. The support for innovation schemes administered by the DTI such as the (Joint) Instrumentation and Measurement Scheme (JIMS) are of importance in the operating environment of some, but not all, of the firms in the two sectors being studied.

France and Belgium have also responded to the need to integrate research activities in the centres of research and industry, by in part changing the location of scientific research, and by encouraging technology transfer. In France, national (CNRS) laboratories and not universities have traditionally provided the main facilities for university researchers, but this is changing as the government is moving to strengthen research in universities. Moreover, there are considerable barriers to interaction to be overcome in France; the report by the Organisation for Economic Co-operation and Development *Innovation in France* (1986) estimated that two-thirds of CNRS laboratories have no ties with industry and that only 1,000 out of 80,000 firms have links with CNRS laboratories.

Belgian research and development expenditures as a percentage of gross domestic product are lower than in Britain and France, but there is a general intention to increase the level of public and private-sector research and development spending. However, universities have been under financial pressure to maintain links with indus-

continued on page VII