

Missed opportunity in biology

The US National Academy of Science's study of opportunities in biology research is a thrilling tale and a lost opportunity. It says too little about research policy, and nothing about regulatory impediments to research.

Why does the US National Academy of Sciences repeatedly attempt to rewrite the late Vannevar Bush's great work *The Endless Frontier*? That is the question provoked by the appearance this week in Washington of the latest in the academy's monumental studies of research opportunities in a selected field of science, this time biology. The question is simply answered. *The Endless Frontier* was one of the decisive influences in persuading the US Congress that basic research should be supported generously, so is it not prudent to retell the tale lest the Congress should forget?

That seems to be the calculation, but the arithmetic is wearing thin. The Committee on Research Opportunities in Biology consists of 20 people. It was helped by 11 panels on special topics with at least half a dozen people each, by a hundred miscellaneous contributors and reviewers and a staff of six. It has spent five years compiling an account of the latest phase of the reductionist revolution that falls between three possible goals: a piece of popular science writing, a sales pitch at prospective graduate students and an attempt to secure the exemption of basic research in biology from the constraints of the Gramm-Rudman Deficit Reduction Act.

Peter H. Raven, director of the Missouri Botanical Garden and chairman of the committee, says that the book (which runs to 424 pages) has been written for "biologists; policymakers both (*sic*) in government, universities and in industry; and other scientists . . . who may interact with biologists", which is fair enough. The text is indeed well suited for setting a little knowledge, or a patchy knowledge, in a broader framework. But the absence of a list of references will frustrate many serious readers, especially because the tone of restrained excitement has been heightened by vignettes of discovery, in figure-legends and boxes, told in baby-talk often so arch that they will be mystifying without further reading.

The tale is, of course, every bit as exciting as the committee repeatedly proclaims. It is true that "all fields of biology are being revitalized" by the coincidence of the flowering of molecular biology with the arrival of other new techniques, from data-processing to NMR. It is true that biotechnology will "provide the basis for the accumulation of wealth at many levels" and may also yield means of treating conditions as different as AIDS and

some forms of cancer. Evidently a better understanding of the human nervous system will throw light on the causes of psychiatric diseases, and possibly on their treatment. Gene transplantation will yet transform animal and crop husbandry. And so on, and so on.

Nor has the excitement blunted the committee's judgement. Far from suggesting that all problems have now been solved, the committee is at pains to describe the questions that remain and the difficulties to be overcome. Protein folding, the initiation of cell division and the roles of learning and/or memory in animal behaviour remain basic puzzles. Similarly, understanding self-incompatibility in plants is an obstacle to the more deliberate application to agriculture, while the mechanism of diseases as apparently mundane as osteoarthritis must be determined before more deliberate therapies can be developed. But the outlook is encouraging.

The Raven committee might well have made more of the pace of technical innovation in molecular biology. It is too easily forgotten that even gel electrophoresis was still an awkward technique (chiefly for the analysis of proteins) a quarter of a century ago. Since then, discoveries in molecular biology important in themselves (restriction enzymes and reverse transcriptase, for example) have spawned their own technical revolutions (for determining the sequence of nucleotides in a nucleic acid molecule or for copying RNA into DNA respectively). Now it seems that there is a radical innovation of laboratory technology every few years. There will no doubt be many laboratories not equipped for the latest trick, called PCR, by which a single DNA molecule may be amplified indefinitely, before the next upheaval will be upon them. Is there any other field in which the pace of laboratory innovation has been as rapid?

Most of the other defects of the report are also omissions, but there is an irritating sin of commission — the repetition of declarations such as: "It is vital that the United States provide leadership in this [or that] area". One must suppose that the phrase is aimed primarily at members of the Congress and their staffs, but it is also echoed by a disconcerting argument tucked away in the insubstantial chapter on research policy at the end of the report.

Briefly, the committee notes that, in the international literature of biology in 1973, articles from the United States accounted

for 74 per cent of the 10 per cent of most frequently cited articles, but for only 70 per cent in 1980, while the proportion of frequently cited articles from Japan doubled in the same interval (to 6 per cent). The report muses on the question whether the explanation is more spending by the Japanese government, discovers comfort in the circumstance that in the field of biotechnology patents, "the United States is maintaining its leadership role" (presumably, "lead") and concludes that the United States should strengthen its continuing encouragement of international collaboration "as other countries increasingly emerge as valuable sources of quality research". The conclusion does not follow from the preceding argument, while the chauvinism is out of place.

The remaining policy recommendations are largely inoffensive but also disappointing. There may well be manpower shortages in the late 1990s, predoctoral and postdoctoral training positions are probably too few, it would be good if the numbers of women in biology more accurately represented the sex ratio (and if more academic women had tenure) and so on. There will be general agreement with the plea that something should be done the better to organize the data of biology, both information (sequences, for example) and material (the contents of museums and herbaria) but the Congress will hardly be set alight.

Circumstances change. In Vannevar Bush's time, the general view was that research is, almost by definition, a public good. Now, in genetics (the manipulation of genes and also their mere sequencing), embryology and the use of animals in research, researchers are hampered, rightly or wrongly, by regulation and public fuss. It would have been a public service, especially for the US Congress, if the Raven committee had provided a means by which legislators and their constituents might strike a better (because better understood) balance between legitimate public interests and the regulation of research. But regulation is hardly mentioned.

The committee will no doubt say that its terms of reference mentioned opportunities in, not impediments to, biology research, but that will be a cop-out. These days, the most telling account of the opportunities will not speak for itself, which is why the Raven report reads like an old-fashioned document and is a missed opportunity.

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