

take legal control the genetic parents would need to adopt the child. *In vitro* fertilisation also offers the chance of determining the sex of a child, once methods for separating male and female sperm are developed. Although this could conceivably lead to an imbalance of the sexes in the population it could also prove beneficial in circumventing the appearance of sex-linked defects in cases where there is no reliable test to detect them *in utero* sufficiently early in pregnancy for abortion to be feasible.

Plans for extending the use of *in vitro* fertilisation in this way must also take into account that it is at present an extremely expensive and specialised procedure, and it is not yet clear that it will ever become routine. The development of better methods for screening fetuses for defects early enough for them to be aborted, if necessary, may in many cases be a more rational use of resources.

An incidental effect of the recent success may be to give the UK Medical Research Council pause to review its policy on funding research in this field. Several years ago it decided not to support work on *in vitro* human fertilisation until sufficient animal work has been done to show that the procedure was safe. This policy was apparently formulated after Edwards and Steptoe applied for a grant, and were

refused, and it still stands although much more animal work has now been done. The lack of applications to do human work has meant that no reappraisal has yet been necessary. Perhaps the MRC will now reconsider its position.

To venture into what some people would still regard as science fiction, the recent success is also a step on the way to much more fundamental manipulation of human beings. Rapid progress in a variety of disparate fields has brought the much-discussed possibility of correcting defective genes by replacing them with a normal copy a little nearer.

Once this sort of intervention is possible the social and political implications could be enormous. On the one hand there may be public pressure to meddle in matters that might be better left alone—in determining the sex of the offspring, for example. And on the other, there is a danger of an emotional response to such meddling that would backfire on the whole of biomedical research. The experience of the nuclear industry, which attempted to forge ahead without taking public opinion with it, has its lessons for biology. The biotechnologists who will surely emerge from our rapidly increasing understanding of molecular biology must take public opinion into careful account. It is not too soon to take these matters seriously. □

Science for the people, or by the people?

Professor Alvin M. Weinberg, Director of the US Institute for Energy Analysis, defends the 'Republic of Science'.

I FIRST encountered Science for the People at a meeting of the American Association for the Advancement of Science in Chicago about eight years ago. The meetings were picketed, and packed, by unruly young people who insisted that they be heard. The Establishment's Science was not responsive to the needs of the people: a revolution in science policy was needed, a revolution that would give to the People a greater voice in determining the course of Science.

Those were stirring times, campus revolutions, Vietnam, and then Watergate; still, Science for the People was regarded by establishment scientists and scientific administrators as a deviation that would go away.

The campus unrest and Vietnam and Watergate have gone away: but Science for the People is widening its influence. As good an example as any is the current excitement over the nutritional etiology of cancer. That nutrition is the most important etiological factor in cancer is regarded as likely by some, but not all, cancer epidemiologists. The question, as far as I can judge, is moot—just as was the viral etiology of cancer about ten years ago. It is a matter that I think deserves careful examination; but this examination must be based on the best judgment of those cancer specialists who have studied the matter. It cannot be settled by popular demand: despite Barry Commoner's recent finding of mutagens in fried (not broiled) hamburgers, it is much too early to conclude that cancer is caused primarily by what we eat.

I could therefore hardly believe my eyes when I saw on national television Senator Robert Dole (the Republican candidate for Vice-President) tax Dr Arthur Upton, director of the National Cancer Institute, for spending too little on the nutritional etiology of cancer. The NCI's annual budget is around \$800m; of this, about 20 per cent goes for environmental etiology of cancer, but only a small fraction of that goes specifically for nutrition and cancer. Senator Dole, fresh from hearings on the subject, proposed that \$200m ought to be spent on the relation between what we eat and cancer.

Dr Upton remained calm and poised despite the Senator's needling—as well he should. After all, the whole war on cancer was itself an example of Science for the People. It was good politics to launch a war on cancer; and as Robert Marston pointed out in his *Nature* review of Rettig's *Cancer Crusade: The Story of the National Cancer Act of 1971*, the war was launched in no small measure because Ann Landers, adviser of the lovelorn, had urged one million of her readers to write to Washington about cancer.

In a democracy the directions of scientific research must in some degree respond to the will of the People. The scientists, who, after all, spend public money, cannot fairly object to the public setting the *ends* of scientific research. If the public deems a cure for cancer, or solar energy, or the environment, to be important, then that public has a right to support scientific effort aimed at achieving these goals. To be sure, in many cases, the public's judgment as to whether a given end will yield to scientific inquiry may not agree with the bulk of the scientific community's views. A field must be ripe for exploitation, to borrow jargon from the scholarly debate on priorities, if it is to merit strong support—and the public is generally less competent than is the scientific establishment to make this judgment. The public therefore runs the danger of wasting money—but, so to speak, it is the public's money: the public can choose to spend it wisely or foolishly.

Though the public has a right to establish the ends of science, it does not have the right to designate the means. I have no trouble with the public, through politics, deciding we ought to spend more on cancer or on solar energy. I believe science is endangered if politicians go further and specify how to attack these problems—for example, by directing scientists to spend on nutritional etiology rather than on genetic or viral etiology of cancer, or on the solar satellite rather than on biomass.

What is at issue is the integrity of Michael Polanyi's Republic of Science—the complex institutional structure with its intricate checks and balances that maintains Science as a responsible undertaking. As the political republic encroaches on the scientific republic, it seems inevitable that the latter's integrity is diminished. Science for the People may waste money; Science by the People could cause the whole scientific edifice to crumble. □