funding devoted to basic research.

The distribution of manpower among various sectors parallels the division of funds, with corporations employing substantially more researchers and technicians than both universities and research institutes combined. For the calendar year 1976, total Japanese R&D manpower was 488,000, divided into 53.3% researchers, 16.2% assistant researchers, and 18.3% technicians. If one allows for differences in defining "researcher", the number of scientists and engineers is about half that in the United States and three times that in the United Kingdom.

Since much of the technological underpinning of Japan's most successful industries has been borrowed and adapted from abroad, a recurring theme of recent science policy statements has been the need to improve domestic research so that more in-

novations could be produced in Japan. One indication of progress has been a strong positive shift in Japan's 'balance of patents', with more Japanese applying for patents abroad than foreigners applying for patents in Japan. But a more important figure is the balance of cost between buying and selling rights to technology, and here Japan runs a large and increasing deficit. Using after-tax figures for all enterprises involved in such trade, 1976 receipts were only 20.4% of sales, down from 22.6% the year before. Clearly Japan remains strongly dependent on research conducted in other countries for much of its industrial technology.

Finally, when comparing Japanese research to that of other countries, the question of professional salaries is often brought up, only to degenerate into a welter of contradictory statements. Interviews with the officials of the

Science and Technology Agency who produced the white paper provide the following basis for limited comparison. In 1976 a 40-year-old researcher had an average monthly income of 225,538 yen, then equivalent to about \$760, including some overtime. A base annual salary would thus come to \$9,125, but to this must be added a lump-sum "bonus" of nearly six months' wages, bringing the total to \$13,687. Since Japanese income taxes are quite low for this salary range, the researcher's after-tax income would be equivalent to that of an American or European with substantially higher gross wages. But since pensions in Japan are substantially less than those abroad, the researchers would have to set aside more of his income for retirement, which generally comes at a younger age than for his foreign colleagues.

John Douglas

THE dispute about gene-splicing typifies some of the current hostility towards science. There is one important exception: gene-splicing dangers are purely theoretical. Recombinant DNA has never been accused of producing a tumour in the bladder of a rat, or of making a brown pelican lay a soft-shelled egg. Nevertheless, the rank-and-file defenders of the environment respond to the summons of their leaders, and sally forth to do battle with the mysterious shadows of manipulated molecules that could envelop and ruin our 'space-ship Earth'. Three billion years of organic evolution will be like an evening we are told, when the fantastic new life-forms escape from the test-tubes.

Perhaps so. In any case, I have been fascinated by the eagerness with which lawyers, clergy, and lawmakers enter the dispute. It was to be expected that the issue would be seized by bureaucracies for purpose of self-proliferation. There were good precedents. The return of predictably lifeless rocks from the surface of the moon gave rise to a scramble for authority as to who should shield us from the dangers of contamination. The officials in charge of plant quarantine demanded that the samples be tested for wheat-rust spores.

The more successful assaults on technology are based on projected rather than actual hazards. The real catastrophes don't seem to be as interesting. Dams collapse and many people are drowned. These tragedies are soon forgotten, and dams for hydroelectric power continue to be built. Plutonium is a better target; it is new, it is dreadful, and it must be

exorcised—just in case. Cigarettes kill thousands with lung cancer and emphysema, but advertisements in the United States still assail us with

Wandering minstrels

THOMAS H. JUKES

gigantic pictures of nicotine-loving cowboys and liberated women smokers. Currently, the carcinogen of interest at the US Department of Agriculture is bacon, not subsidised tobacco.

The most unusual of all targets is the phantom menace of genetically-engineered organisms; a legislated, institutionalised and regulated figment of the imagination. People who know least about DNA are the most eloquent among those who fear it. They don't quote Jim Watson, who, on the subject of recombinant

DNA, was reported to have said recently: "Science is good for society. We are being attacked by everyone who doesn't have the guts to go ahead. The dangers of this thing are so slight—you might as well worry about being licked by a dog".

He was too late. The molecular biologists did themselves in at Asilomar. After this, it was a foregone conclusion that DNA would be placed under official guidelines. Like a layer of molasses, the non-ebbing tide of regulations has crept over the field of gene-splicing. How can a danger ever become trivial if the livelihood of an echelon of bureaucrats depends on writing rules to cope with it? The officials now need to demonstrate their public zeal.

In *The Mikado*, the Emperor of Japan is angry because there haven't been any executions lately in the town of Titipu. A victim must be found, or, by imperial decree, Titipu will be reduced to the level of a hamlet. So the civic leaders schedule a simulated beheading for a wandering minstrel, Nanki-Poo.

Recently, in Boston, a victim was apparently needed to show that the National Institutes of Health guidelines on gene-splicing were being enforced. The prototypic Nanki-Poo was Charlie Thomas, who had been caught red-handed for filing a document too late. Watson was unkind enough to liken such infractions, when committed knowingly, to "cheating at tiddlywinks", but this particular sin seems to have been inadvertent. Anyway, Boston was saved, and let us hope that, like Nanki-Poo, Thomas will escape from the Lord High Executioner.