

"our neglect of science is something that sets us clearly apart from countries with which we might reasonably compare ourselves. In the United States, in France, in Germany, even in beleaguered Britain, the support of basic science has roughly kept pace with inflation. Only in Canada has inflation been used, year after year, as a device for diminishing the nation's investment in this fundamental activity."

In a letter to the same newspaper, Dr Gordon Forstner said that in medical research "somewhere between 150 and 300 technicians will lose their jobs, and a programme which has been deflated steadily during the last five years will be shattered."

● In such a climate, it was with mixed feelings that some Canadians heard that the heavy water plant at Glace Bay, Nova Scotia, was starting up and would shortly produce heavy water not only for nuclear reactors in Ontario and Quebec but also for those in Britain, Argentina and South Korea. Although heavy water is vital to Canada's CANDU reactors (in which it acts as coolant and moderator), the Glace Bay plant has been one of the most disastrous undertakings of an otherwise successful nuclear programme.

In 1964, the province of Nova Scotia brought in a US nuclear scientist, Jerome Spevack, to design the Glace Bay plant. There were difficulties from the outset. Completion was delayed from 1966 to 1967, then again to 1969. Technical difficulties occurred as a result of using salt water from the nearby Atlantic Ocean in the process, instead of fresh water. Finally, in 1970, inspectors discovered that the salt water had corroded the pipes, and a \$30 million repair was needed.

By that time, Spevack's company, Deuterium of Canada Ltd, had spent \$100 million on the plant, all of it public money, because Nova Scotia was the major shareholder and provided the finance. The province had bought out Spevack's interest for \$3 million in 1966, and taken full control in 1969. In 1971, the federal government provided the funds for the plant's purchase by Atomic Energy of Canada Ltd (AECL), and spent another \$130 million on what has been almost a complete reconstruction.

Eventually, the plant is expected to become self-sustaining and make enough money to pay back AECL's investment. The Nova Scotia government is to get the plant back after AECL has recouped its investment, but the province plans them to sell it back once more to AECL—finally washing its hands, as it were, of the whole affair.

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Alternative technologies urged in pesticide report

Carried to excess, the best things may do more harm than good. Colin Norman reports from Washington on a study of pesticides.

A COMMITTEE of the National Academy of Sciences has warned, in a mammoth study published last week, that unless alternatives to conventional chemical pesticides are swiftly developed and adopted, agricultural production in the United States could soon begin to suffer. The committee bases that conclusion on the fact that several potent products have been either severely restricted or banned entirely because of environmental and health hazards, and also the fact that several pests are developing resistance to the poisons which are sprayed on them in copious quantities each year.

The study, which took more than three years to complete and which runs to five massive volumes, is an attempt to assess the current state of the art in pest control and to pinpoint some of the problems which lie ahead. In the course of its analysis, the committee has questioned the costs of some government regulations, criticised current pest control practices, cast doubt on the value of some of the Department of Agriculture's most ambitious and costly efforts to eliminate particular insect species and, by implication, criticised the federal government's agricultural research efforts.

The basic theme running through the huge tome is that although chemical pesticides have served agriculture—and, for that matter public health pro-

grammes—very well, the problems of declining effectiveness "warrant substantial expansion of present efforts to promote alternative technologies, including integrated pest management". The chairman of the committee, Dr Donald Kennedy, professor of physiology and zoology at Stanford, said last week, for example, that genetic resistance to toxic pesticides is growing at an "alarming rate", and he suggested that unless effective alternatives are developed, some agricultural land could conceivably be taken out of production.

As for specific alternatives, the committee notes that so-called 'third generation' compounds, which affect hormonal development or reproductive processes in insects, have some desirable qualities, but it suggests that "there is reason to be pessimistic about the prospects for controlling major crop pests with these compounds." One potential problem with third generation agents is that resistance is likely to develop to them, the committee states.

Insect control by pathogens, such as baculoviruses, is especially promising, but the committee cautions that large-scale use of such agents will require improved methods for culturing insect host tissues. Moreover, the development of new agents will require some advances in basic research. The use of genetic techniques, such as breeding resistance to pests into crop plants, and introducing genetically modified pests into the environment, are also promising, but again the committee



Crop-dusting: must an alternative be found? (Photo: Popperfoto)

cautions that there are potential problems facing widespread application of some of the techniques. The use of sterile male insects to reduce reproduction in a target population, for example, is effective only when the population has been reduced by other means. Moreover, since potential markets for sterile male insects are likely to remain small, there is little commercial incentive for private firms to get into the business of producing them.

Thus, the general message is that although various alternatives are promising, there is no magic insect zapper", as Kennedy put it, to replace chemical poisons in the near future. "The task of pest control over the next 10 years will almost certainly become larger rather than smaller", the committee concludes. It therefore recommends that research efforts be stepped up, and in particular that basic research on organisms and ecosystems be given more attention by various government agencies.

As for efforts designed to eradicate individual pest species entirely, the committee warns that such schemes have limited chances of success and frequently turn out to be inordinately expensive. In particular, the committee recommends against a programme,

strongly urged by some scientists in the US Department of Agriculture, which is designed to eradicate the boll weevil from the cotton fields of the southern United States. The scheme, which would employ a variety of pest control techniques, would cost about \$1,000 million. Although extensive trials conducted in 1972 indicate that the programme would have a good chance of success, the committee suggests that there is considerable doubt that the boll weevil could be eradicated entirely. The committee cautions that if the programme fails, it may endanger public confidence in the alternative methods of pest control which would be used.

One of the problems which the committee encountered in its research was an appalling scarcity of data on pesticide use in the United States. "The pest control enterprise places a billion pounds of toxic materials into the environment each year", the committee states, "but it is considered 'normal' for us to have only the vaguest idea of how much each compound was used where, and then only after a decade lag". It therefore urges that much more effort be put into monitoring pesticide use and that chemical companies be required to report their production and sales figures to the federal government. □

OSETP progress

A longstanding desire of the scientific community in the United States came a step closer to reality last week when the Senate unanimously approved a bill to re-establish a science policy office in the White House. The bill is similar in many respects to a version passed by the House last November, but there are a few important differences which must be ironed out before the measure is sent to President Ford for his signature. The Senate bill would establish an Office of Science, Engineering, and Technology Policy in the White House, headed by a Director who would also be the President's Science Adviser. Unlike the House bill, the Senate version specifies that the director of OSETP would sit on the powerful Domestic Council and be a statutory adviser to the National Security Council. The Senate version would also set up a programme designed to strengthen science policy arrangements at the state level, and to provide grants to states for the application of technology to various pressing domestic problems. It is now expected that the bill will be ready for Mr Ford's signature by the end of March.

Triple resignation

THE embattled nuclear power industry in the United States suffered a potentially severe political setback last week when three senior engineers in the reactor division of the General Electric Company (GE) quit their jobs and announced that they will campaign for anti-nuclear groups. They said in their letters of resignation that they have become so concerned about questions of reactor safety, proliferation of nuclear weapons, and radioactive waste disposal that they can no longer work for the industry and keep their doubts to themselves.

Each had spent his entire professional career working for GE and, until they quit on February 2, all three were employed at the company's facility in San Jose, California. Although they have raised no new issues, their espousal of the anti-nuclear cause will clearly have substantial impact on public concern about the hazards associated with nuclear power.

That impact is likely to be most keenly felt in California where, on June 6, voters will determine the future for nuclear power in that state. All three have announced that they will campaign heavily in support of a

proposition, to be put to a state-wide vote during the California Presidential primary election, which would almost certainly halt construction of nuclear power plants in California and eventually lead to shut down of existing plants there.

News of the resignations prompted swift reactions in Washington. Congressmen and Senators who have previously expressed concern about nuclear power issued statements publicising the development; Senator John O. Pastore, the chairman of the powerful Joint Committee on Atomic Energy, has tentatively scheduled a committee hearing on February 18 at which the three engineers will testify; and the head of the Nuclear Regulatory Commission, William A. Anders, met with them last week to hear their concerns.

At a press conference called by the Union of Concerned Scientists, an outspoken anti-nuclear organisation, the three engineers said last week that no single event prompted their departure from the world's largest manufacturer of nuclear equipment. All three said that their concerns have been growing for some time, and they felt that the nuclear industry has been seriously downplaying the risks

associated with nuclear technology.

The three engineers are Dale G. Bridenbaugh, formerly Manager of Performance Evaluation and Improvement, who has headed a special project to assess the adequacy of the primary containment vessels of GE's nuclear reactors; Gregory C. Minor, former Manager of Advanced Control and Instrumentation, who has been responsible for design of safety systems and control room instruments; and Richard B. Hubbard, former Manager of Quality Assurance, who has been responsible for ensuring that GE's reactor equipment meets federal quality standards.

Though all three said they reached their decisions to leave the nuclear industry independently, Minor's letter of resignation probably sums up their feelings with the statement that he is "convinced that the reactors, the nuclear fuel cycle, and waste storage systems are not safe. We cannot prevent major accidents or acts of sabotage. I fear that continued nuclear proliferation will quickly consume the limited uranium supply and force us into a plutonium-based fuel economy with even greater dangers of genetic damage and terrorist or weapons activity".