reserves are saved from land speculators. Usually at least twelve to eighteen months elapse between the time when Congress authorizes a project and the time when the responsible Federal agencies—the Forest Service, the National Parks Service of the Bureau of Sport Fisheries and Wildlife—actually receive their cash appropriations and can buy the land. Apart from the normal increase in land values, currently rising by about 7 per cent per year on the average, this leaves plenty of time for land speculators to buy key tracts and grossly inflate their price. One example, typical of many, is a 309 acre tract of land in the Ashley National Forest in Utah, an area now within the proposed Flaming Gorge National Recreation Area. In 1965 Congress authorized the Flamingo Gorge Dam and Reservation, and the Bureau of Reclamation valued the 309 acres at $39 an acre. The Bureau purchased 195 acres in 1959 for $43 an acre. By 1966, the Forest Service estimated that the remaining 99 acres at the site were worth $429 an acre, and the year before the State of Utah had to pay $929 per acre for 14 acres.

The Nature Conservancy has been trying to curtail this kind of escalation since it was incorporated in 1954. The conservancy is a private non-profit-making organization with total assets, including land and revolving capital, amounting to $15 million before the Ford Foundation's loan. Although it is a private organisation, the conservancy receives most of its funds from the entrance fees charged at federal recreation areas, federal motorboat fuel taxes and the sale of surplus Federal property. In practice, it acts as a stopgap purchaser of land for parks, buying only land included in projects authorized by Congress at the request of a government agency or at the request of state or local public agencies before speculators can step in. The conservancy then sells the land back to the Federal or state agencies when they have received their appropriations. The conservancy has no guarantee that the public authorities will always buy back the land, but if the public funds are not forthcoming it can always sell the land privately.

By offering $6 million credit, the Ford Foundation, using its capital for land preservation for the first time, has greatly strengthened the conservancy's hand in forestalling substantial losses of the American taxpayers' money. Indeed, it is no exaggeration to say that it may well have saved the whole Federal open-space programme. It is already plain that the federal funds currently available are not sufficient to cover projects that Congress has already authorized, with the result that Congress has lately been considering a moratorium on further purchases, which would, of course, bring the programme to a halt. With luck, as Mr G. Harrison at the Ford Foundation says, although "the funds and lands involved are relatively small, we believe the experiment will establish a significant pattern for considerably larger land acquisitions in the future by joint private–government efforts".

WATER RESOURCES

Bringing Industry in

CANADA has a great deal of water—perhaps as much as a third of the total surface water in the world. This is a resource too important to be squandered by reckless use or devalued by pollution; most Canadian industry, power generation and recreation relies on the continued supply and purity of fresh water. This is why the Science Council and the Science Secretariat, the two bodies responsible for defining scientific policy in Canada, have recently been turning their attention to the question of research on water resources. Both have recently published reports on the subject (*Science Council Report No. 3*, and *Science Secretariat Special Study No. 5*, 75 cents and $2·50, respectively), and both have drawn the same conclusions (which is hardly surprising, as the council used the secretariat's report as a source of inspiration). But there is one revealing difference; the council thinks that more of the research should be done by industry, while the secretariat sticks to the conventional view that government laboratories are the best place for it.

The secretariat report, written by J. P. Bruce and D. E. L. Maasland, concludes that "Canada has seriously underestimated water resource research" and that much more should be spent on it. At present it represents only 1·2 per cent of the total research and development budget; within ten to twelve years, the report says, this should be more than doubled, to 2·5 per cent. An annual increase in expenditure of around 20 per cent would have Canada spending $25 million a year by 1972–73, and $75 million by 1978–79. The council committee, chaired by Dr J. Tuzo Wilson, accepts that expenditures of this order will be called for, though it disagrees about where the money should be spent. It suggests that the need to increase industrial participation is pressing, and proposes that the proportion of the work done in industry should increase from 14·5 per cent now to 28 per cent by 1972–73; during the same period, the proportion carried out by government laboratories should fall from 66 per cent to 44 per cent. This view reflects the current Canadian drive to increase industrial research at the expense of almost anything else; the secretariat seems to be uninfected by it. It argues that in water management, government plays the usual part of industry, and that there are therefore no real grounds for recommending a change of emphasis.

The Science Council backs its case by pointing out that the production of equipment used in water programmes is now a large industry in its own right, worth $1,460 million in 1966. It also draws a parallel between water source research and geophysical surveying; much of the survey work has been done by industrial contract and the council suggests the same should be done in water research, while government laboratories should have only a small growth rate in their annual expenditures, enough to ensure that the administrators are kept up to date. A few major water research institutes should be established in the universities, and coordination should be the responsibility of the National Advisory Committee on Water Resources Research. The secretariat recommends certain areas for special attention—these are precipitation, streamflow, environmental aspects of pollution, groundwater, economic and social science aspects and network design and instrumentation. But the last of the Science Council recommendations returns to the familiar theme; in 1971, it says, there

should be another review, intended to see how far industrial participation has gone.

OCEANOGRAPHY

New Antarctic Ship

A NEW polar vessel is to be provided for the British Antarctic Survey by the Natural Environment Research Council. It will cost about £1·75 million to build and it is hoped that it will be ready for operations in the Antarctic in October 1970. The new vessel will not be an addition to the polar fleet, because it will replace one of the survey's existing vessels, RRS Shackleton, and it will also replace a ship chartered each year by the survey to supply bases which the Shackleton cannot reach in some ice conditions.

The new research ship will be built by Robb and Caledon at Leith, Scotland. It will be 326 feet long, with a beam of 60 feet, and it will be specially designed for ice breaking. There will be accommodation for 62 survey personnel and the crew, approximately 130,000 cubic feet of space for general cargo, and a laboratory equipped for biological and oceanographic work. There will also be a helicopter deck. Propulsion will be by a diesel-electric system and there will be a service speed of 14 knots. If necessary, the ship will be able to operate for 50 days at full speed—a safety factor when it is operating over long distances in ice-filled waters.

RAILWAYS

Turbines on Rails

BRITISH RAIL now seems to have reached agreement in principle with the Ministry of Transport about the financing of its advanced passenger train. Discussions have been in progress for some time, because British Rail, though enthusiastic about the new train, is in no state to finance its development—likely to cost up to £5 million. But the ministry confirmed this week that agreement over the sharing of costs had been reached, although detailed discussions continue.

The new train, designed by a team at the British Rail research centre at Derby, is designed to be powered by Rolls-Royce Dart engines, de-rated to 1,500 HP. Construction will owe more to aircraft technology than it will to conventional railway engineering; the structure will be stress skin light alloy, producing a weight per passenger very much less than normal trains, lower even than some motor coaches. The maximum speed of the advanced train will be around 150 mph, cutting the time taken to get to Bristol from London to less than an hour, and the time from London to Newcastle to 145 minutes. The train is designed to operate on the existing track, though some improvements will be necessary.

As well as the advanced passenger train, the design for which has been common knowledge for eighteen months or more, British Rail is now talking of a less ambitious plan making use of the new Leyland gas turbine engine introduced at the Commercial Motor Show. This engine, designed for a large truck, produces 400 HP, and could be fitted into conventional rolling stock. In this case, the top speed would be 100 mph, no greater than the existing British Rail Inter-City services, but the gas turbine might offer greater comfort and quietness. Because it has been designed for use with a heat exchanger, it might also be a more economic proposition. A typical train, according to British Rail, would use ten Leyland engines, eight for power and two for auxiliary services.

Despite British Rail's enthusiasm, it is certain that its advanced passenger train will be beaten into service by gas turbine trains in other parts of the world. Before the end of this year, both the United States Department of Transportation and the Canadian National Railways expect to be operating turbine trains built by the United Aircraft Company. These trains are based on the ST 6 gas turbine engine developed by United Aircraft of Canada Ltd, and each engine will develop 550 HP. The trains, designed for Canadian National, should be brought into service between Montreal and Toronto, and each will consist of fourteen cars capable of carrying a total of 600 passengers. Designed like an aircraft, the train will be about one third of the weight of a conventional diesel train, and will travel at speeds of up to 100 mph in Canada.

SAFEGUARDS

Slow Progress

THE achievements and aspirations of the International Atomic Energy Agency in developing safeguards against the secret production of nuclear weapons were outlined by Mr B. W. Sharpe, a member of the Division of Safeguards and Inspections of the IAEA, in a lecture at Imperial College, London, last week. Inevitably most of the talk was devoted to the problems, both political and physical, that must be overcome in order to maintain a viable inspection system. Some observers were left with the feeling that the difficulties involved in trying to carry out inspections on the sort of budget available to the IAEA may well be overwhelming.

Mr Sharpe made no attempt to disguise the difficulties facing his department. About eighty nations have already signed the non-proliferation treaty, and although many of the countries most likely to wish to produce nuclear weapons have not yet ratified the treaty (as distinct from just signing it) an IAEA staff of one or two hundred would spread very thin through this number of suspects. A staff of about 200 is expected to be available by 1974, but Mr Sharpe conceded that the IAEA would have to make use of the domestic safeguards systems which many countries have already instituted for their own purposes. He expressed confidence, however, that a small bunch of observers placed at key spots in the conveyor belt of fuel production—whether on reactor sites or at an earlier or later stage—should be capable (logistically) of uncovering any frauds perpetrated by the home team. But even if this were conceptually sound, the political and legal barriers to its implementation are considerable.

Why should a non-nuclear country accept the inevitable encroachment into its commercial activities when the nuclear powers are exempt? Can the staff of the IAEA themselves not only be trusted but also be seen to be trusted? These are questions which are receiving realistic appraisal from both the IAEA and its member states, and the governments of those nuclear powers that have ratified the treaty have