from British landings have failed at times to find buyers and have had to go for fish meal manufacture."

The problem is, of course, accentuated by increased landings from foreign vessels and imports of processed fish. The statistics for 1967, the latest available, show this trend even if they do not reveal its magnitude in 1968. Britain imported 162,000 tons of fish in 1967 compared with 156,000 tons in 1966, 72,000 tons of canned fish in 1967 worth £35 million compared with 61,000 tons worth £28 million in 1966, 395,000 tons of fish meal (£23 million) compared with 308,000 tons (£21 million) in 1966 and 282,000 tons of fish oil (£15 million) compared with 178,000 tons (£12 million) in 1966. And while imports of almost all fish and fish products have increased, exports have declined marginally from nearly £10 million in 1966 to about £9·5 million in 1967.

In 1967 the Torry Research Station spent £377,000 on research designed to halt and reverse these trends. Its work ranges from improving methods of freezing fish at sea to trying to persuade people that canned mackerel has the taste of canned salmon even if it lacks the appearance. At the end of 1967 there were twenty freezer-trawlers and seven factory trawlers in operation in the British fishing fleet, although since then three factory trawlers have been laid up as uneconomic. The problems are simply that fish frozen at sea often looks of poor quality, with the muscle gaping and the colour unappetizing, even though the flavour may be good. Torry scientists went on seven voyages in an attempt to pinpoint the faulty steps in filleting and freezing and came up with a few seemingly elementary recommendations: the fish ought to be kept below 5° C from the time it is landed to the time it is frozen, the fish should be left to bleed, and each haul should be washed and gutted before the next is landed, for example.

At the other end of the spectrum the Torry station, which now runs the British Food Manufacturing Industries Research Association's fish canning unit, is trying to find products that can replace the £55 million worth of canned fish that Britain imported. Currently sprats and mackerel, fatty fish, are the white hopes. And for the first time Torry's programme includes the development of machines to do many of the processing operations. For example, the station is trying to extend the range of a machine designed in the first place to gut only small fish.

EXPEDITIONS

Endeavour Sails Again

THE bicentenary of Captain James Cook's first voyage of discovery has provided the impetus for a joint British and New Zealand expedition that is just about to set out for the South-west Pacific. Several parties of scientists will be engaged in biological, geological and oceanographical investigations in and around the Cook and Tonga Islands. The expedition is under the auspices of the Royal Society of New Zealand, and includes five British scientists selected by the Royal Society of London, which was invited to participate because of its close connexions with Cook's expedition.

Drs D. R. Stoddart, of the University of Cambridge, H. G. Vevers, of the Zoological Society of London, and P. E. Gibbs, of the Marine Biological Laboratory in Plymouth, will spend four weeks on the coral atoll of Aitutaki. They will concentrate on the geomorphology and ecology of the atoll and its peripheral reef and lagoon. They will be particularly interested in the bottom living fauna of the lagoon—perhaps Dr Vevers will collect some exotic specimens for the aquarium at the London Zoo, of which he is the curator.

Drs P. G. Harris, of the University of Leeds, and P. E. Baker, of the University of Oxford, will be joined by a New Zealand geologist for geological, volcanological and petrological surveys of Tofua and Kao, two small islands in the Tonga chain. There is apparently a good chance of discovering something about the origin of andesites—it has still to be resolved whether their source is the mantle or the crust of the Earth. There are also hopes of obtaining new information about the evolution of the Pacific Ocean and its margins during the expedition.

Work at sea is to be based on HMNZS Endeavour, the New Zealand Navy's Antarctic supply ship and a particularly appropriate choice for an expedition commemorating the voyage of Cook's Endeavour. At the beginning of October the various land parties will board HMNZS Endeavour, which will take them to Gisborne where Cook's first landing in New Zealand will be marked by national celebrations.

SPACE

Pioneering Solar Activity

THE latest in the series of Pioneer spacecraft, Pioneer 10, should be launched from Cape Kennedy as *Nature* goes to press. This vehicle is expected to provide valuable information on solar activity for up to two years, and will be part of a programme including four previous Pioneers, Mariners 4 and 5 and seven of the Explorer series. The chief purpose of the mission is to monitor solar disturbances and to collect data on plasma, energetic particles and magnetic and electric fields radiating outwards from the Sun towards the Earth. Data relayed simultaneously from several Pioneer spacecraft are processed by computer to produce solar weather tables, which should throw light on solar processes, the interplanetary medium and the effects of solar activity on the Earth.

Pioneer 10 is being launched by the well tried three stage Delta rocket into a unique solar orbit (see figure), which will keep it within ten million miles of the Earth during its operational lifetime. The spacecraft will pass inside and outside the Earth's orbit, alternately speeding up and slowing down relative to the Earth, and will transmit for between six months and two years.

Investigations of solar disturbances are particularly valuable because of the possible effects of solar activity on the Earth. Geomagnetic storms, which are thought to be caused by solar disturbances, can modify the orbits of spacecraft, and charged particles degrade or damage solar cells and other instruments used in space vehicles. In addition, these storms have caused trouble for years for equipment which depends on a stable magnetic field. Disruptions, sometimes lasting for a week or more, are caused in wireline communications and in systems utilizing high frequency radio signals. With luck, increased knowledge of solar disturbances will result in more effective protection against these geo-

magnetic storms, but perhaps the most practical application of solar data is expected to be an improvement in the ability to predict or control certain aspects of our terrestrial environment. US weather statistics have already found correlations between solar disturbances and the frequency and intensity of Earth storms, and some theories suggest that climate, earthquake activity and even life pattern and growth rates are directly related to solar activity.

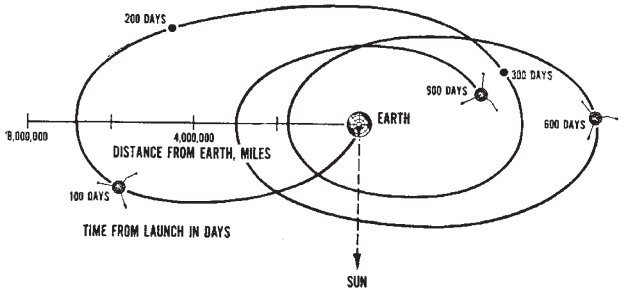

Fig. 1. Pioneer 10 positions relative to Earth for first 2·5 years of mission.

The Pioneer programme has already provided information with immediate practical application. During the Apollo landings, hourly reports on solar activity were sent to Houston to guard against any unexpected arrival of intense showers of protons, and this type of monitoring will become more important as supersonic aircraft fly on the fringes of space. And a geomagnetic storm, forecast six days in advance from solar disturbances picked up by Pioneer spacecraft, took place within three hours of the predicted time.

This mission does not, of course, possess the glamour of manned flights, but it could be just as valuable in terms of results which have immediate application on Earth. The Pioneer programme, if it leads to a clearer understanding of the links between solar activity and the climate on Earth, will strengthen the case for concentrating on unmanned explorations, rather than repetitions of the lunar stakes.

RESEARCH

Who Does What Where?

THE Department of Education and Science and the British Council have again published their annual three volume guide—*Scientific Research in British Universities and Colleges, 1968–69* (HMSO, Vol. 1: Physical Sciences, £3 5*s*; Vol. 2: Biological Sciences, £3 2*s* 6*d*; and Vol. 3: Social Sciences, £3). In spite of its usefulness, the guide is as usual marred by minor irritations and inconsistencies—the fact that some of the entries are out of date, and the infuriating practice in a few cases of lumping all research projects together under the head of a department instead of crediting the individual members of the department. These inconsistencies are perhaps inevitable in a series which has to rely on the cooperation of individual institutions, but the editors could surely smooth out a few of the irregularities. On the grounds of cost, the subject index cannot be expected to be fully comprehensive, but some categories are defined precisely and others much more broadly. One lapse which has persisted from the previous year is the absence of an index entry for antilymphocytic serum which is currently the subject of so much exciting research. ALS cannot be traced under either antibodies or lymphocytes but only under serum (where seven projects are indexed).

In spite of criticisms, however, the guide is invaluable, and it must be wished that there were a similar comprehensive guide to research in progress in Government departments and research institutes. Social scientists are better served in this respect than biological or physical scientists, because the compilers of the social sciences volume in this series, helped by the Social Science Research Council, have continued their useful practice of including some of these and other institutions. It also includes research projects of PhD students. This volume has nearly 100 pages more than the last edition—it includes about 30 more institutions—and with some justification the publishers have increased its price by £1. The first two volumes have also increased their coverage by including more of the designated polytechnics such as the Leeds College of Commerce, the John Dalton College of Technology in Manchester, and the Oxford College of Technology, but with only 52 (Vol. 1) and 39 (Vol. 2) more pages there is less justification for a 30 per cent increase in price.

BRAIN DRAIN

Doctors Departing

A SURVEY of the present whereabouts of medical graduates of Aberdeen University who received their degrees in 1956–58, which was published in last week's *Lancet* (ii, 427; 1969), has once again drawn attention to the large losses of medical graduates. A third of the 186 graduates included in the survey are no longer working in British medicine. Forty-nine of the graduates are now living permanently overseas; thirty-eight of these are emigrant Britons and eleven are people from other countries who were trained at Aberdeen and have since returned to their homelands. Of the emigrants the largest group chose Canada (13), followed by Australia (8) and the United States (6), and only three graduates emigrated and then returned. Eighteen of the emigrants had received some sort of postgraduate qualification before emigrating.

The reasons for emigration given by the twenty-one emigrants who completed questionnaires are all familiar; the GPs reported their frustration with the National Health Service, in particular the size of the executive council lists, the unlimited demands of patients and the lack of access to hospitals. Those who had been in hospital practice described the usual grievances of lack of prospects for promotion, the rigid career structure and the low wages. Emigration has provided not only better facilities and more satisfying work but also more pocket money. Family considerations tinged with a sentimental attachment to Britain kept forty-nine of seventy-five men who had considered emigrating from doing so.

Of the fifty women in the survey, thirty-three who were living in Britain replied. Only four were in full-time medical employment, nine had regular part-time employment, four took occasional jobs and eight had nothing to do with medicine. The married women, of course, hope to return to medicine when their children