

mixed strategy, with some interest in immediate applications and some in the more distant future. Then, too, it would be easier for the institute to diversify its structure, by forming closer links with a university or with a teaching hospital. Perhaps the most serious lack in the discussions of the past few months has been that of an exploration of alternative structures. But that, of course, is what new directors are for. Everybody will wish Professor Symington luck.

LUNAR SCIENCE

Apollo 12 springs Surprises

from our Astronomy Correspondent

IT now seems certain that the samples recovered from Oceanus Procellarum are sufficiently similar to those from Mare Tranquillitatis to prevent any heart searching, yet different enough to whet the appetite for more. The ages of the rocks from Oceanus Procellarum, for example, seem to be 500 million to 1,000 million years less than the 4,000–4,500 million years for the Tranquillitatis samples, which compare with the 4,700 million years estimated for the age of the Solar System. Something like 34 kg was returned by Apollo 12, half as much again as from Apollo 11. According to preliminary reports from Houston, there is far less dust in the Apollo 12 collection—half of the Tranquillitatis sample was material finer than 1 cm—and there are forty-six rocks up to 4.9 kg in weight. They include a specimen of about 0.7 kg with an unusually coarse-grained appearance which is suspected to be impact debris originating from deep within the Moon, possibly excavated from Copernicus 200 miles away. The other rocks range from fine-grained to coarse-grained. Only two of them are breccias, a much smaller proportion than from Apollo 12, although to what extent the distribution of rock types is a subjective effect of the astronauts' sampling technique is not known at present. Chemical analysis shows that the rocks tend to have less titanium than the surprisingly rich Tranquillitatis material, but they contain more iron.

More staggering this time than the sample analysis are the data from the package of experiments left behind on the Moon. It now looks as if it will take several months and a large amount of computer time before the surprising results of the crashdown of the upper stage of Intrepid are interpreted (*Nature*, 224, 836; 1969). Estimates of the impact are narrowing down to a TNT equivalent of one ton, trivial by the standards of seismologists. Yet the disturbance at the seismometer took five minutes to build up, and about an hour to decay with a period of one second. On Earth such behaviour would be unthinkable, first because the terrestrial disturbance would have disappeared within a few minutes and, second, because the periodicity would have been longer than one second. It seems probable, however, that the trace is more likely to be explained by the overall structure of the Moon than by the resonance of a hypothetical underground structure.

It is also surprising that the magnetometer left behind should have registered a lunar magnetic field between 30 and 40 gamma, when 2–3 gamma were what was expected (1 gamma is 10^{-5} gauss, so that the strength of the Earth's field at the equator is

35,000 gamma). The question people will be asking is what this implies about the lunar interior and whether it can be interpreted in terms of remanent magnetism in the lunar rocks. Clearly a network of magnetometers would help to pinpoint the field, and this will be one of the aims of future missions.

People are now looking forward to Apollo 13, scheduled for lift-off at 1528 EST on March 12 next year, when the landing will be on a completely different kind of surface from the maria sampled so far. The site is at $17^{\circ} 36'$ west and $3^{\circ} 48'$ south in the highland region of the Fra Mauro formation, about 110 miles east of the Apollo 12 site. Nobody knows what to expect, except that the landing site is likely to be the most rugged so far. This is why the separation from the command module will take place at the lowest altitude yet to allow the lunar module more fuel to manoeuvre. Meanwhile lunar scientists will be going over the results from Surveyor 7 which landed near Tycho two years ago to become the only Surveyor in a highland area.

ENRICHED URANIUM

Go-ahead for Centrifuge Project

THE jigsaw puzzle of the British nuclear fuel policy took a step nearer completion last week with the news that Britain, West Germany and Holland have approved the terms of an agreement to do with collaboration on the centrifuge method of enriching uranium. This is not the same as signing the agreement. Before this can be done it has to be vetted by Euratom under Article 103 of the Euratom Treaty which lays down that any agreements between members and non-members of Euratom—and Britain is not a member although West Germany and Holland are—have to be approved by the Euratom Commission. But nobody is expecting any objections and when the agreement is signed the exchange of technical information between the three countries can begin. The announcement means, of course that the extension to the gaseous diffusion plant at Capenhurst, which is the traditional and (largely because of its electricity consumption) the less economic method, will not now be built. The next part of the jigsaw to fit into place is the British nuclear fuel company which the Minister of Technology, Mr Anthony Wedgwood Benn, promised as long ago as July 1968 would be hived off from the Atomic Energy Authority. The Bill establishing the company is to be presented to Parliament in the New Year.

Last week Mr Benn was making no secret of the fact that the negotiations for the centrifuge agreement had been long and extremely difficult. They began just over a year ago with a meeting at the Hague which started a round of speculation about the magnitude of the economies which the centrifuge process will achieve as well as about the political implications of West Germany's participation which the announcement has done nothing to stop. All Mr Benn will say about the selling price of the enriched uranium is that it will be competitive with the American product.

Initially the agreement allows for plants at Capenhurst and at Almelo in Holland with each plant able to do up to 50 tonnes of separative work per year by 1972, later going up to a total of 350 tonnes per year. West Germany has been consoled with the design and construction headquarters. The plants at Capenhurst

and Almelo will be owned and run by subsidiary companies of an enrichment organization which will provide 51 per cent of the equity capital of each subsidiary and with headquarters in Britain. Thus the capital for the Almelo plant, for example, will be 51 per cent from the enrichment organization and 49 per cent from West Germany and Holland. The entire arrangements will be supervised by a joint committee from the three countries which will deal with questions to do with the non-proliferation treaty, security, and arrangements with other countries.

There has been no exchange of technical information yet, but it is believed that Britain is going to learn a lot from cooperation with the Dutch. Even so, it looks as though the agreement is meant to be taken as a model of the kind of cooperation in advanced technology which the Ministry of Technology would want to become commonplace if Britain joined the European Economic Community. Mr Benn stressed that the agreement would be different from other European ventures—people hope it will be more successful than some—because it will involve essentially industrial collaboration with a minimum of government supervision through the joint committee. The shares of both the enrichment organization and the organization which builds the plants will be held by commercial enterprises nominated by the three governments. The hope is, of course, that the arrangements will be integrated into the EEC. Collaboration with other countries beyond the three so far extends to informal discussions with Italy and Belgium, and Sweden has expressed interest.

FOOT AND MOUTH

Viruses in the Wind

THREE paragraphs on airborne virus transmission are by all accounts the most scientifically significant contents of Part Two of the Northumberland Committee's report on foot and mouth disease, published on December 16 (HMSO, 12s 6d). The importance lies not so much in what the report says—about the persistence of the virus in humid air and its transport by wind for over sixty miles in ideal conditions—as in the implications of the research on which it is based. Some veterinary scientists now believe that at least 90 per cent of the spread of the disease is caused by the wind, and that the value of some of the control measures to isolate farms and restrict movements within infected areas is chiefly psychological.

The report complements the prophylactic recommendations of Part One, which was published in June, by examining what should be done after the disease has broken out. Nearly all of its conclusions have already been accepted by the Minister of Agriculture: they deal with the organization of control centres, the restrictions of movement and access required to contain the disease, and compensation for farmers whose herds have been depleted. In effect, they tighten up existing regulations in the light of the 1967–68 epidemic, and reject some of the emergency action taken at the time. Disinfected pads on roads, for example, seem to have been useless in that they did not affect any likely route of transmission.

If airborne infection is the main source of foot and mouth disease, the Northumberland Committee's

recommendations are by no means irrelevant. The disease is so obviously contagious that everything possible must be done to keep susceptible animals apart. On the other hand, it may be that the recommendations are silent on the role of wind and rain in spreading the disease because much of the basic evidence has only come to light in the last few months, largely as a result of work by P. B. Wright (*Weather*, 24, 204; 1969) and L. P. Smith and M. E. Hugh-Jones (*Nature*, 223, 712; 1969).

Smith and Hugh-Jones showed that in four British epidemics the pattern of spreading was almost entirely downwind, and suggested that rainfall was important in depositing virus particles. There is some controversy over how the disease was actually picked up, because although animals could have grazed in damp grass on which the virus had been deposited it has been claimed that the virus is much more infectious when it is inhaled in the form of an aerosol. What seems to be agreed, however, is that virus will travel in the wind when the weather is humid. There is no evidence that virus particles actually are deposited on to foodstuffs in rain rather than inhaled from the atmosphere, but there are plenty of correlations between the way the disease has spread and the direction of the wind, and it is significant that outbreaks always seem to begin in wet weather.

Buried in the report's suggestions is the idea that an epidemiological team should be based on each control centre. Whether such a team would be expected to make full use of the knowledge about airborne transmission is not clear, but at the moment an epidemiology unit of the Ministry of Agriculture, said to be existing on paper rather than in practice, does include meteorologists. The report itself mentions that meteorologists who this year studied an outbreak that occurred in 1960 were able to predict from weather data alone exactly how the disease spread. If such forecasts could be made rapidly in the event of a fresh outbreak, they would presumably be useful in determining areas to be placed under restriction; but on this possibility the report makes no explicit recommendations, saying in a postscript simply that "this approach will be valuable . . . in indicating where to look for secondary outbreaks".

By keeping the wind evidence separate from its suggestions for governmental action, the report thus gives the appearance of concentrating its attention chiefly on stopping paths of transmission that may be relatively unimportant. The committee kept to the view expressed in Part One of its report that voluntary vaccination of animals should not be permitted. If, however, virus can travel sixty or so miles in the air, unvaccinated animals could be susceptible to infection that is imported by an otherwise uncontrollable route, and Wright has pointed to the possibility of airborne transmission from the Continent in several recent outbreaks.

BOTANY

Cancerous Peas

from our Botany Correspondent

THE study of neoplastic pea pods has become one of the chief concerns of the applied genetics department of the John Innes Institute according to the latest