should pay closer attention than in the past to the environmental problems occasioned by science and technology—pollution and the like. This movement is already well under way, and the reputation of science will benefit as well as the general population if scientists are seen to play a leading part in this campaign. But what about the diminishing intellectual reputation of science among the academics on the other side of the fence? What is Dr DuBridge going to do about that? The problem is nothing like as sharp as the theorem of the two cultures. Rather, there has been a curious sense in the past few years that the scientists have been less intellectually inventive than their fellow academics. To be sure, there have been all kinds of excitement—pulsars, for example—and there are many more just round the corner, yet the profession of science has lost the pride of place which it occupied in the decade after the war. A part of the trouble is that academic science has necessarily been preoccupied by the problems of adjusting to rapid growth, but too many academics have also spent too much of their energy on local politics—grant-grubbing and the like. A more serious cause of discontent is the difficulty of sustaining the quality of science teaching when potential teachers are constantly snatched away to other socially useful jobs. In the long run, only the academics themselves can find a remedy for this state of affairs, but it will be interesting to see whether Dr DuBridge can bring this problem within his sights. That would be a still more valuable objective.

SPACE

ESRO in Luck

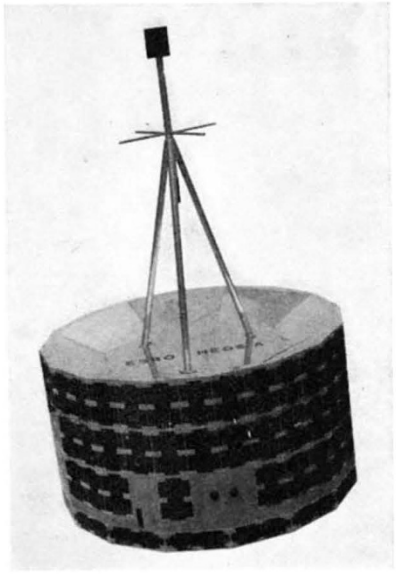
LAST week the European Space Research Organization celebrated the reprieve granted by the Bonn European Space Conference with the launch of its third satellite this year. On Thursday last week HEOS-A was fired into a highly eccentric orbit with an apogee about 225,000 km from the Earth, roughly two-thirds of the distance to the Moon. The launch was from Cape Kennedy by a Delta rocket, and after nearly five days in space all the indications were that the satellite systems and experiments were working perfectly.

After the cliff-hanging events of recent weeks, Professor Hermann Bondi, director-general of ESRO, is delighted with the outcome of the Bonn meetings and the successful launch of HEOS-A. "Everything in the garden is perfect", he said last week, referring to the assured support which ESRO now has for a further three years. In Professor Bondi's view, the most important result of the November discussions was the agreements which have been reached on the use of European launchers. Much of the dichotomy in ELDO, Professor Bondi believes, has arisen from conflicting interests between the launcher countries seeing satellites as launcher fodder, and the more scientifically inclined countries.

Professor Bondi is particularly pleased that ESRO has been allotted $1 million a year to do work on communications satellites (although this figure may be cut to $800,000 because of French monetary difficulties). Admittedly a trifling figure, it is at least a start on a road which Professor Bondi has wanted to see his organization take. The only disappointment is the decision to postpone a decision on the CETS programme to March or April next year.

The problem now is how to maintain ESRO's new-found enthusiasm through the three-year hiatus before the next European satellite is launched in September 1971, when a second HEOS is to be orbited. This will be followed by TD 1 in March 1972, the culmination of hard rescue efforts which followed the cancellation of the project for financial reasons earlier this year. ESRO is also hoping to find ways of flying a fraction of the eleven experiments planned for TD 2, chiefly concerned with solar physics.

How does Professor Bondi see ESRO's future now? Big projects such as TD 1, costing of the order of $40 million, should be possible every two or three



years. These will be backed up by a fair sprinkling of small satellites, costing $10 million or even less, important to give experience to the less sophisticated research teams.

The scientific importance of the HEOS-A satellite launched last week is in its elliptical orbit, which takes it well beyond the magnetosphere, the region of space dominated by the Earth's magnetic field. (HEOS is an acronym for highly eccentric orbit satellite.) Its apogee and perigee are roughly 225,000 km and 440 km respectively, although precise values will not be known until the satellite has been in orbit for some days. This is because not all the influences on such an eccentric orbit, which is perturbed by the gravitational effects of the Sun and Moon, can be taken into account.

The seven experiments on board are to measure magnetic fields, solar and galactic cosmic rays, and the solar wind. Three of the experiments are the work of the team at Imperial College, London, led by Professor Harry Elliot. Their equipment is to measure magnetic fields with an accuracy of 0·5 gamma (10^{-5} gauss), cosmic ray protons of energy greater than 350 MeV, and low energy solar protons between 0·9 and 20 MeV. A joint experiment involving the Universities of Florence, Rome and Brussels will measure the energy

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distribution and angle of arrival of solar wind protons. The Centre d'Etudes Nucleaires de Saclay is to measure electrons, protons and alpha particles of solar and galactic origin; and together with the University of Milan will look at the spectrum of cosmic ray electrons in the range 50–600 MeV.

HEOS-A also contains an experiment devised by the Max Planck Institute for Extraterrestrial Physics. This consists of a 2·5 kg capsule of barium to be ejected when the satellite is some 20,000 km from the Earth, crossing the boundary of the magnetosphere. The plan is to release the capsule at some suitable time, when the resulting cloud of barium ions can be photographed from Kitt Peak, Arizona, and from the site of the proposed European southern hemisphere observatory in Chile. The motion of the cloud yields information on the magnetic field at the ignition point.

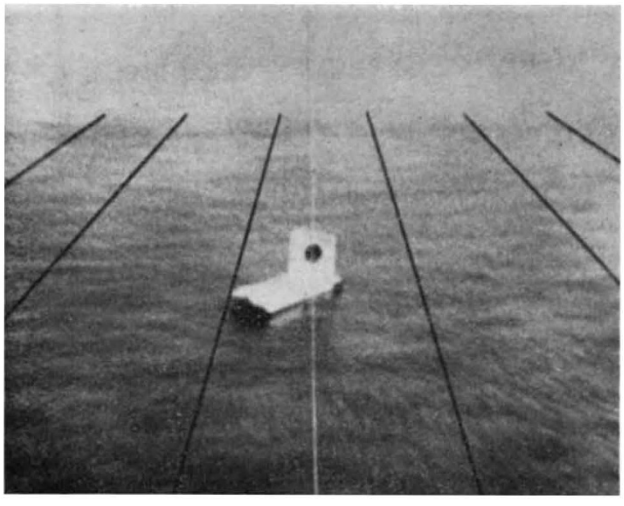
The experiments were tested on Monday this week when HEOS was just outside the magnetosphere. This first test seems to have caused some consternation at the ESRO control centre in Darmstadt, until it was realized that large readings in the Imperial College and the joint Italian–Belgian solar proton detectors did not represent a disastrously high noise level, but arose because the experiments had been fortuitously switched on in the midst of a solar event. Indications are that all the equipment is working well. The total cost of the project is $16 million, which includes the experiments and $3·6 million paid to the Americans for the launching operation.

DEFENCE

Missile by Television

THE completion of a successful series of firing trials of the Anglo-French Martel missile system has sparked off a substantial order for this novel weapon from the Ministry of Technology. The special feature of the British version of this air-to-ground strike missile is the television camera mounted in the nose cone, which sends back to the controlling aircraft a continuous transmission of the missile's forward view.

The missile part of the system has been designed and developed by Hawker Siddeley Dynamics in Britain and Engins Matra in France. Two versions of the weapon have been produced. The television version—for which Britain has the prime responsibility—is controlled from the launcher aircraft by a weapons controller who receives live transmission from the missile's camera. He is then in a position to steer the missile visually on to its target. The job is apparently sufficiently full-time as to eliminate using the pilot as the weapons operator. The picture below shows the view of a target as seen on the operator's television monitor, this particular target being moored at sea. The television guidance system has been developed by the Marconi Company, which claims that the technological barriers overcome in producing the compact electronics necessary to make the weapon operational have given the Anglo-French team a world lead in this field.



The picture shows the target as seen by the weapon operator on his television monitor screen.

The French version of the missile is designed to destroy enemy radar installations. It can operate against multiple targets, and achieves its end by homing directly on to the radar transmitters. Both the French and British versions are equipped with elaborate electronic counter-measure devices, essential to a system so susceptible to jamming.

Although the manufacturers are reluctant to give details of the missile's performance, it seems that the television version has destroyed targets ten feet in diameter from a distance quoted as "some tens of miles". The anti-radar model has had similar successes. The contracts already placed by the British Government seem to cost more than £10 million; Hawker Siddeley alone claims that it is benefiting to the tune of about £10 million, and Marconi claims that the orders are worth several million pounds to it. Both companies are confident of sizable export orders, particularly to NATO and Commonwealth countries.

NUCLEAR POWER

What Price Plutonium?

PLUTONIUM is not one of the metals the price of which is determined by the London Metal Exchange. Even that venerable institution, skilled as it is in determining the balance of supply and demand, might find it hard to keep up with the arguments which go to determine the price of plutonium. But four American utilities, Yankee Atomic, Consolidated Edison, Consumers Power and Commonwealth Edison, are sufficiently confident to have set up a joint association to fix export prices. Other utilities are likely to be invited to join the association, which will be safe from anti-trust action as long as the pricing agreements are intended only for export markets.

It would be fair to guess that the four utilities and any others that join the association will find it hard to agree on prices. Much will depend on the attitude taken towards the fast breeder reactor, for which plutonium provides the ideal fuel. It can also be used to fuel thermal reactors, and at the moment this seems to be the course that American utilities are adopting. But in Britain this attitude is seen as very much the second best, because of plutonium's characteristics. In any reactor, fissile plutonium has the advantage of emitting more neutrons per fission than does fissile uranium. Unfortunately, at the energies used in thermal reactors, plutonium also absorbs more, so it offers little, if any, advantage. In fast reactors, the

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