the person who becomes a potential organ donor should be paramount, at least until there is not merely a greater public awareness of the nature of transplantation operations but also a better all-round appreciation of the social value of transplantation. Those who go round bewailing the potential shortage of donors should not hope to over-ride this guiding principle.

As yet, it is too soon to know what the benefits will be. The great excitement about heart transplantation is based in part on the knowledge of the large proportions of people who die of heart diseases, at least in industrialized societies. In Britain, for example, it is entirely possible that several tens of thousands of patients may eventually be considered for heart transplantation each year, and even though many of these will be ineligible for all kinds of reasons —age or complications of heart disease, for example— it is likely that the demand for heart transplants will be an order of magnitude greater than for kidney transplants. The use made of heart transplantation will depend, of course, on the survival rate, but it is worth remembering that in some series of kidney grafts the three-year survival rate is already more than fifty per cent. Better tissue typing and the more systematic application of it should bring rapid benefits (and it is encouraging to know that much of what has been accomplished in the past few months depends on the way in which specialists from several countries have been systematically sharing information). Evidently it is not unreasonable to expect that heart transplantation will, within a decade or so, be an acceptable risk for a great many patients suffering from heart disease. It follows that attention should now be paid to the teasing problems of how to allocate scarce organs and scarce medical resources among potential recipients. These are much more difficult problems than the distinction between life and death, and it is only fair to say that nobody knows much about solving them.

The most immediate question to be dealt with is how the problems associated with transplantation are to be resolved. At this stage it may well be too soon to know just what changes will be necessary, although it is quite plain already that many of the issues which must be tackled range well outside surgery and medicine. Moreover, it is plain that public opinion and public attitudes must in the last resort determine how transplantation is regulated, which is why it is essential that public discussion should play an essential part in the making of decisions. This is why there is a particularly pantomimic quality about the way in which the Ministry of Health in Britain has set about the formation of policy. So far, the Minister of Health seems to have been relying for advice on an *ad hoc* committee of advisers which follows British traditions by meeting in private and by reporting only to the minister but which has further refined the techniques of public reticence by being entirely anonymous as well. To be sure, it would be wrong and even impracticable to expect that ministers should always make public the sources of their advice, but the Minister of Health has on this occasion chosen to make public his own summary of the proceedings of the first meeting which is sensible enough as far as it goes, but which is much less valuable than it might be as a stimulant of sensible public discussion by the anonymity of its source or sources—and by the knowledge that the Ministry of Health is, in the last resort, the only route by means of which the committee's conclusions can see the light of day. The result, of course, is quite absurd. Instead of helping to set in train a process by means of which society may be helped towards a coherent and convincing view of how to deal with novel and exceedingly difficult problems, the ministry seems thoroughly embarked on a process of seeming to make public policy out of thin air. If the ministry and its advisers cannot find a way of being more honest, there is a serious risk of real misunderstanding. Elsewhere, particularly in France and in the United States, the authorities responsible have sensibly recognized that the test of successful policies is not whether they are wise but whether they are also recognized as such.

More Transplants

BRITAIN'S first heart transplant operation, performed last week at the National Heart Hospital, has been received with the usual gush of publicity which accompanies such events. But less acclaim has been given to the liver transplantation operation carried out at Addenbrooke's Hospital, Cambridge, on May 2, although this is technically by far the trickier of the two operations. Not only are there numerous fine connexions to be made in rather inaccessible places, but there is also the serious difficulty that the liver begins to lose some of its functions as soon as its blood supply is cut off. Preservation of this organ has therefore been a major issue since the first attempts at homotransplantation of the human liver were made in the United States in 1963.

Biochemically, the metabolic activities of the liver are more complex than those of the heart, and its roles are more diverse. One consolation, though, is that prevention of rejection is, if anything, easier with the liver than with renal or other kinds of homografts. Several attempts at liver transplants have been made in the United States, but met with little success until June of last year. Since then advances in immunosuppression and organ storage have enabled the livers of deceased persons to be maintained in a form acceptable to the recipient's body for several hours. Heterologous antilymphocytic serum (ALS) or its globulin derivative (ALG), together with the advent of improved tissue typing techniques, are now important factors in reducing rejection of all kinds of transplants.

Transplantation of liver in pigs has been extensively studied at Bristol University. According to Dr J. H. Peacock, a member of the transplant team there, the method which has been used since last April to store liver outside the body consists of flushing the liver with iso-osmotic perfusing fluid at 4°–6° C. The cooled liver is then connected by cannulae to a circuit containing an oxygenator and a heat exchanger which maintains the organ at a low temperature, preventing deterioration of its functions. A small amount of plasma

is then passed through the liver, and in this way the organ can be preserved for up to 6 or 7 hours before being transplanted. At St Mary's Hospital in London a liver-shaped plastic box has been designed to keep the organ cool between removal and transplantation, and it seems that this will play a useful part in prolonging the useful life of the liver.

The simultaneous transplantation of heart and lungs would have several advantages, not the least of which is the reduction in time required for this operation compared with transplantation of the heart alone. The heart surgery team at the National Heart Hospital says that the heart transplant operation is the first of a series of operations leading to a combined heart–lung transplant before the end of the year. Whether the recent achievement—and the resultant publicity—will in any way affect the recommendation in the Royal Commission report for the combination of the hospital with the so-called "Chelsea" group remains to be seen.

Meanwhile, in the United States the hunt for another transplantable organ is on, and attention is being focused on the spleen. In the current issue of *World Medicine*, Dr J. Norman of Harvard University reports success in arresting canine haemophilia in three animals by transplanting healthy spleens from animals of the same species. His suggestion that it may be possible for a non-haemophilic mother to donate her spleen to her haemophiliac son should, however, be treated with reserve, according to Dr E. E. Peacock, professor of surgery at the University of North Carolina.

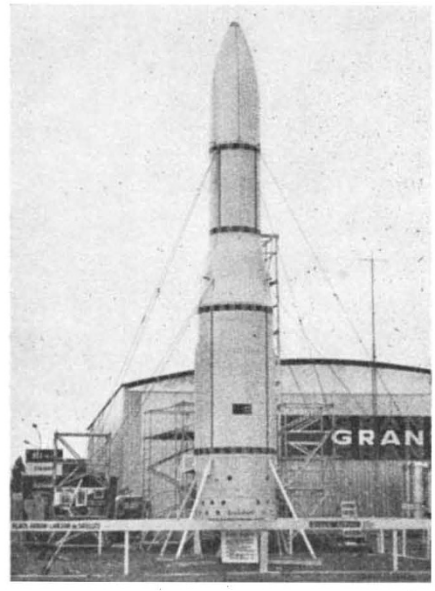
Arrow on the Ground

Now that the demise of ELDO seems to be in sight, probably marking the end of European co-operation on ambitious space projects for some time at least, it is worth asking what the prospects are for a purely national British space programme. This, of course, depends on the availability of a launching rocket, the linchpin of space activities. As a basis for any programme Britain may undertake in the future, three satellite launch vehicles are on order from the Saunders-Roe division of Westland Aircraft. They are Black Arrow launchers, based on the Black Knight ballistic test rocket, and roughly equivalent in capability to the American Scout rocket which last year launched Ariel 3.

Briefly, Black Arrow is a three stage rocket designed to launch satellites of about 240 lb into a 300 mile polar orbit. The first and second stage engines are similar to the Black Knight design and use hydrogen peroxide and kerosene propellants; the third stage has a solid fuel. The first firing is expected to take place from Woomera in March next year, and will be to test the first and second stages, and the separation of the third stage motor together with its payload. The second and third firings, in the autumn next year and early in 1970, will be attempts at satellite launches.

Because the firings are primarily to test the rocket itself, the main function of the satellites carried during the two orbital attempts is to monitor the performance of the third stage. Radio beacons will be carried so that the orbit achieved can be precisely determined. Once the performance of the rocket itself has been proved, the emphasis will be on testing various components of satellite design. A satellite is planned which will test in orbit new telemetry, power supplies and various surface materials to control the temperature of satellites. No Black Arrows have so far been ordered for this stage of the project.

One of the roles envisaged for ELDO rockets in the future was the launching of communication satellites into geo-stationary orbits. Conjecture about Back Arrow fulfilling this objective has been based on the notion that a satellite in a near-Earth orbit could be gradually propelled out to more distant orbits by a so far unproved electric propulsion system. This contrasts with the technique hitherto used to achieve geo-stationary orbits, which is to convert a near-Earth



Black Arrow satellite launcher.

orbit into an elliptical orbit, with apogee at the 37,000 km altitude of geo-stationary orbits. The elliptical orbit is changed into a circular geo-stationary orbit by firing a motor at apogee.

An electric propulsion system involves the acceleration of ions by an electric field, using energy collected from solar radiation by arrays of solar cells. The advantage is that no fuel need be carried to change from a near-Earth orbit into a geo-stationary orbit; on the other hand, an array of solar cells large enough to gather sufficient energy from the Sun have to be incorporated into the satellite, although once a geo-stationary orbit has been achieved these are still available to power electronic systems on board the satellite. Bearing in mind the size of satellite which can be launched into a near-Earth orbit, however, it seems that the launching of a geo-stationary communication satellite large enough to be practicable is beyond the capabilities of the Black Arrow project in its present form.

ESRO-2 Launch

A SECOND attempt to launch the satellite ESRO-2 is expected to be made on May 15 from the Western Test Range in California. The seven experiments on board the satellite are from universities and laboratories in Great Britain, France and the Netherlands,