

will seem to many high energy physicists to be a cold douche of reality, predictable though it may have been. In practice, even the funds available for the construction of the 200 GeV accelerator are less than had been hoped for, but the director of the project, Dr R. R. Wilson, has apparently told the AEC that he will finish on time, in 1972, in spite of the cut. Altogether, high energy physics will get \$1.1 million less in the coming year, while the AEC's expenditure on physical research will be \$3.8 million less than in 1970 at \$274.4 million.

Thermonuclear research has, however, come back into favour. During 1971, the AEC is planning to spend an extra \$1.9 million on fusion work, and much of this will go on two new machines—a device incorporating some of the features of the old accelerator and the new Tokamak at Princeton and a new toroidal pinch machine at Oak Ridge. In his statement at the opening of the examination by the Joint Committee on Atomic Energy of the new budget, Dr Glenn T. Seaborg, chairman of the AEC, said that there had been "significant advances in this field of research in the past year".

As it happens, however, the joint committee is unlikely to swallow without protest the new budget which seems to the chairman of the committee at least to fall short of what is needed. Last week, Mr Chet Holifield said that he took a "dim view" of some features in the budget and that he was especially "disappointed" with the lack of funds for the cascade improvement programme by means of which it had been hoped that output of enriched uranium could be increased and by the lack of elbow room in the programme of development for the liquid metal fast breeder reactors (LMFBR)—it will be necessary during the coming fiscal year to make a decision between alternative designs for a prototype reactor. With all this, however, there is hardly a tear shed for the decline of interest in the Plowshare programme. With environment all the rage, who will defend a device for leaving accumulations of radioactive rock in potential gas wells or even Panama Canals?

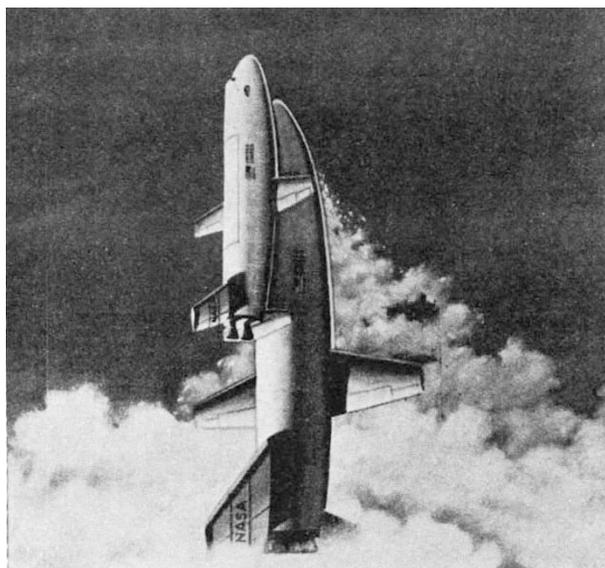
## SPACECRAFT

### Shuttles in Space

"I STAND before you a man who has just had his budget cut 12 per cent", jauntily remarked Dr Thomas O. Paine, administrator of the National Aeronautics and Space Administration, who was in London last week to receive various trophies commemorating the first manned lunar landing from the British Interplanetary Society. The general demeanour of his agency that he sought to put across in this predicament was one of buoyancy and optimism. Rationalization of programmes and ingenuity in place of blunt power were the means of economizing without compromising.

Central to NASA's revised thinking is the concept of re-usable vehicles and in particular the manned space shuttle for which definition studies are already in hand. It is calculated that fifty flights a year of the space shuttle could be carried out for less than the price of just one flight of the Saturn V. This reflects economy in ground support as well as of hardware.

The concept is for a craft that would take off vertically and land horizontally. Dr Paine indicated that the vehicle would be in two parts; a booster of the scale of a jumbo jet (such as the Boeing 747) and a detachable powered cabin about the size of a 707 or DC-10 which would carry the freight, whether passengers or supplies, and connect up with the orbiting space station for transfer. At the end of mission, each stage would return to base and land separately. Lift-off weight (3.5 million pounds) has been specified but not the payload. The payload compartment's size, however, has been defined; a volume of 15 feet diameter by 60 feet long. A number of configurations are possible but no choice between them has yet been made. They include fixed geometry and variable geometry craft; straight wing as well as delta wing types and lifting bodies. A design lifetime of not less than 100 re-uses is aimed for.



One of several possible configurations for the proposed space shuttle.

Economy in trained manpower and skill is also achieved by the concept. One of the points of the system is that it will get rid of special astronaut training for space visits. "Anyone, regardless of sex, with special reason to be in space—for instance, for scientific research—will be able to go this way", commented Dr Paine. "I would hope to see the first British astronautess fly before the end of the decade..." Inherent in the system is that the passenger and cargo environment will be comparable with that encountered in commercial airline practice. In the same way, of course, the craft will be flown by highly trained and specialized crew, but the passengers will not need to share this specialization.

The conventionally powered space shuttle for commuting to Earth orbital space stations is seen as a logical predecessor to a nuclear-powered shuttle for transporting visitors to lunar orbit and on interplanetary missions. The new promise of the space shuttle is so compelling that the British Aircraft Corporation, whose MUSTARD concept dates back to the early sixties, has been asked if it could revive it either for national or international consideration.