Where To Go After Mars

by our Washington Correspondent

FLUSHED with the success of Mariner-9's encounter with Mars, space scientists are again beginning to talk with some conviction about the merits of taking a closer look at Jupiter and the outermost planets of the solar system. Soon after Mariner began sending photographs of the Martian dust storm, for example, Dr Robert S. Kraemer, director of NASA's planetary programmes, took the opportunity to call a press conference to remind the public that Pioneer 10 is scheduled for launch to Jupiter early next year, to reach the planet in December 1974, and that it would be followed a year later by Pioneer 11.

These flights, Dr Kraemer reminded his audience, are essential to chart part of the course for the much more ambitious "Grand Tour" of the planets —Jupiter, Saturn, Uranus, Neptune and Pluto—to be launched between 1976 and 1979 (Jupiter, Saturn and Pluto first and then Jupiter, Uranus and Neptune). One much publicized feature of the Grand Tour is that the special alignment of the outer planets that enables one spacecraft to visit three planets in succession comes round once every 179 years.

The recent flurry of interest drummed up in the Grand Tour possibility is being widely interpreted as an indication that NASA officials are trying to sell the idea to the Office of Management and Budget in time to get an increase in funding for development of the TOPS (thermoelectric outer planet spacecraft) in the 1973 budget request. Negotiations between NASA and OMB are now in a critical stage, and if the 1976 and 1977 launches are to go ahead, there will have to be a strong financial commitment to the programme in the near future. NASA officials should be helped in their negotiations by a study published last week by the National Academy of Sciences* which concludes that exploration of the outer solar system should be "one of the major objectives of space science in this decade".

But there is no complete agreement within the scientific community—or even among planetary scientists themselves—on the merits of pressing ahead with the Grand Tour. The broad argument is whether the Grand Tour would soak up so much of NASA's scientific budget that the whole programme would get out of balance, with smaller but worthy projects being squeezed out. Some planetary scientists also argue that a programme based on an intensive study of Jupiter would pay a better scientific dividend than would a quick look at the outer planets.

In a great many respects, the academy report takes account of all these points of view, for while tub thumping for the Grand Tour, it also points out that the project should not be undertaken at the expense of intensive study of Jupiter nor at the expense of other scientific projects in NASA's overall programme. But perhaps the chief value of the report is that it presents NASA with a range of options from the full-scale Grand Tour to a watered down version, depending on the level of available funds. A report on priorities in space research, published by the academy

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Hard Way to Jupiter

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IN February or March next year, Pioneer 10 will be launched on a journey that should take it past the orbit of Mars, through the asteroid belt, to Jupiter and then on to the edges of the solar system. The chief object of the exercise is to take a close look at Jupiter, but just how close the look should be has developed into something of a controversy. Present plans are to take the spacecraft in to about three Jupiter radii, but the working group on outer planetary research of the Space Science Board has suggested that it should be brought as close to the surface as quarantine specifications allow —about 1.3 Jupiter radii. Even at that distance the intensity of the particle flux trapped in the planet's magnetic field may be so great that the craft's instruments could be put out of action.

Why should planetary scientists suggest that a spacecraft costing nearly $100 million should be destroyed by taking it so close to Jupiter? The argument hinges on the importance of assessing the intensity of Jupiter's radiation, to see what sort of a hazard it poses to later exploration of the planet or even to the Grand Tour. Those who argue for taking Pioneer 10 close to the surface point out that even if the instruments are destroyed, most of the scientific work would already have been done, and the choice is really between studying Jupiter's radiation belts or the interplanetary medium beyond Jupiter. Since Pioneer is not designed for a long lifetime, it is difficult to predict how much of the interplanetary medium would be surveyed before its signals become too weak to pick up.

The question was, however, brought up during a meeting of planetary scientists at NASA's Ames Research Center on November 11. According to Dr Charles F. Hall, project manager for the Pioneer programme, the consensus of that meeting was that the distance of closest approach should be kept at about three Jupiter radii on the basis that although the absolute level of the energy and flux of protons in the radiation belts are poorly known, the rate of change of energy with distance from the planet is much better known. In other words, the information relayed back from Pioneer 10 can be extrapolated to determine absolute radiation levels closer to the planet.

Radiation damage is, however, only one of the hazards the Pioneer 10 and other craft venturing much beyond the orbit of Mars must encounter. Before the spacecraft arrives at Jupiter, it must spend about six months crossing the asteroid belt, where it stands about a ten per cent chance of severe or even final damage. During its passage through this belt, two instruments will be set the task of scanning asteroids and measuring the mass and energy of tiny particles impinging on the spacecraft.

Once through the asteroid belt, Pioneer 10 will travel on to Jupiter, reaching the planet in December 1974. Instruments will sample the proton and electron flux, and measure the energy output from the planet with an infrared radiometer, which should also map the temperature distribution and provide some answers about Jupiter's enigmatic red spot, and a magnetometer will measure the planet's magnetic field. Beyond Jupiter, the spacecraft will send back data on the interplanetary medium and cosmic rays, until its signals become too weak to monitor when it reaches about 2,000 million miles past Jupiter.