NORTH AMERICA

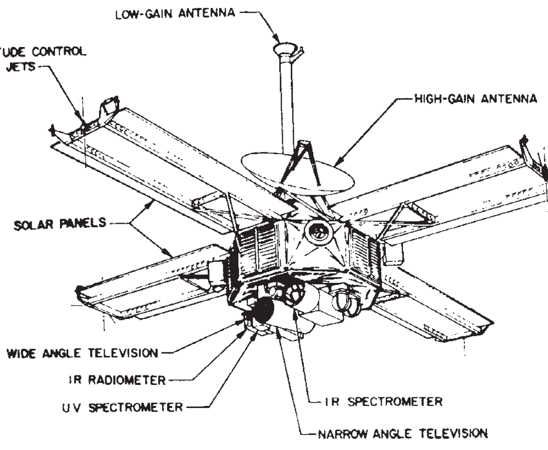
Aiming to Please

from our Astronomy Correspondent

NASA has something for everyone in the weeks ahead. For the critics who want to see more scientific missions, there will be two Mariner spacecraft aimed at a Mars fly-by. For the incorrigible admirers of space spectaculars, there is the last-but-one Apollo test before the Moon landing. But NASA must be hoping that the Russians will not steal their thunder by celebrating the opening of the launch window by attempting a soft landing on Mars. There is still anxiety about contamination of the Martian environment (*Nature*, **221**, 398; 1969).

The plan for Mars is to double the chances of success by launching two spacecraft, the first on February 24 and the second a month later, on March 24. By the time they reach Mars the separation should have narrowed to five days, with nearest encounters on July 31 and August 5 respectively. The two Mariners are identical, and contain neat packages of instruments to examine Mars in several ranges of the electromagnetic spectrum. The chief items of equipment, however, are the two television cameras which each Mariner will carry. With a resolution of 900 feet—compared with two miles for the previous martian Mariner and 100 miles for Earth based equipment—NASA expects the photographs to reveal in what form Schiaparelli's canals exist, if at all. Colour filters should make it possible to build up colour pictures, so that the spacecraft could yet compete with the Apollo 8 views of the Moon.

The lower martian atmosphere will be probed by an infrared spectrometer which will look for the presence of molecules suggestive of biochemical processes—water, carbon dioxide, methane, ethylene and acetylene. An ultraviolet spectrometer will determine the presence and amounts of various gases in the upper atmosphere. As each Mariner goes behind Mars, the way the martian atmosphere affects S-band signals from the spacecraft will yield measurements of pressure, density and electron density. An infrared radiometer will map surface temperature so as to correlate this with the television pictures. As always, careful tracking of the spacecraft should also say something more about the parameters of the solar system.



The Mariner probe.

If, by good luck or management, both spacecraft are successful, they will be complementary, not repetitive, for the two spacecraft will fly over quite different regions of the planet. The first will travel over the equator and the second over the south pole. The plan is for each Mariner to take at least eight and possibly several tens of wide-angle pictures as it approaches the planet. Rotation of the planet should ensure that most of the disk will be covered, with a resolution of up to 15 miles. This is to be followed by a sequence of 24 close-ups taken between 6,000 and 2,000 miles.

The next step in the American exploration of Mars will be in 1971, when it is intended that two spacecraft orbit Mars for three months. Then, in 1973, there will be Project Viking—a soft landing of capsules detached from orbiting spacecraft.

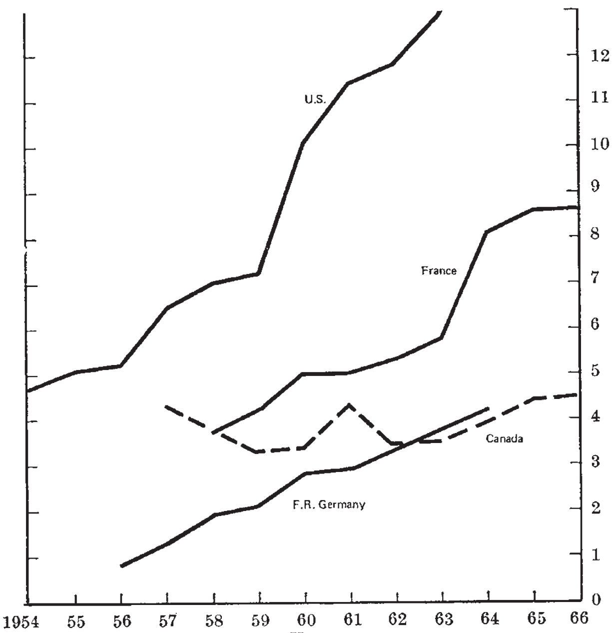
The Apollo 9 firing scheduled for February 28 at Cape Kennedy is a different kettle of fish, aimed chiefly at evaluating the lunar module which will take men from a lunar orbit to the surface and back again. But the testing of the module will this time take place entirely in Earth orbit. The three astronauts, James M. McDivitt, David R. Scott and Russell L. Schweickart, will go through the motions of a lunar landing involving the transfer of Schweickart and McDivitt to the lunar module, its separation from the command and service modules and the firing of the lunar module's engines.

What does all this imply for the future of the space programme in the United States ? In the past few days, Dr L. DuBridge, the new science adviser at the White House, has let it be known that he intends to spend most of the coming year working out a balanced programme of research and development, no doubt in close consultation not merely with NASA but with the other closely interested parties—the Department of Defense, the various parts of the Department of the Interior which are concerned with Earth resources satellites as they are called, and with external agencies such as Comsat. The outcome is now, however, relatively easy to predict. By the end of the year, the first landing on the Moon will have taken place, and it is extremely unlikely either that the Apollo programme will be entirely shut down or that it will be followed by an enterprise on a similarly ambitious scale. Most probably there will be a trickle of Apollo flights. Collaboration between the DOD and NASA on orbiting laboratories would be a great economy, and would give the US Air Force something interesting to do with all the equipment it has manufactured. But for the rest, there is a great need for a sober and balanced programme of research. The chances are that this is what Dr DuBridge will be pushing for. There will be lots of people on his side.

SCIENCE POLICY

Growth Ahead in Canada

The Science Council of Canada clearly believes in getting its opinions off its chest before it publishes the figures which back them up. The document published some months ago which gave guidelines for Canadian science policy has now been followed by a valuable collection of statistics, prepared by R. W. Jackson, D. W. Henderson and B. Leung of the Science Secretariat. The study falls into three parts: the supply of qualified manpower, the inflation–sophistication factor, and estimates of the gross expenditure on research and development in Canada until the year 1978.



The figures suggest that this year a total of 10,760 Canadian students will graduate with a degree in science, mathematics, or engineering, out of a total graduation of 58,300. By 1977–78, the numbers will be swollen to 20,000, from a total of 115,000 graduates. To this will have to be added the substantial net immigration of scientists and engineers which has been a feature of the past few years; in 1966, for example, Canada gained just over 3,000 scientists and engineers by immigration, over a third of the number graduating. The report suggests that from 1970, net immigration will represent about 20 per cent of the numbers graduating, but this figure is clearly subject to a great deal of uncertainty—the course of the Vietnam War, for example, could be a very significant factor. Another uncertainty is whether Canada will experience the swing away from science which has been observed elsewhere; the report concludes that so far there is no evidence for a pronounced shift in the total numbers reading for science and engineering. Within the total, however, there are shifts out of engineering and into pure science.

The section of the report devoted to calculating the "sophistication–inflation factor" for Canadian research relies heavily on reports published elsewhere. Canadian science statistics have not been sufficiently reliable to enable a characteristically Canadian figure to be extracted, but it is probably fair to assume that Canada will follow the United States pattern. The authors conclude that the costs of research and development will grow at the rate of 6 per cent a year over the next few years, a figure which takes into account both inflation and the growth of sophistication; roughly one third of this annual increase is attributed to inflation and the rest to sophistication. If anything, the authors say, this figure is likely to prove conservative.

The manpower predictions and the rate at which research becomes more expensive come together in the third section of the report, which attempts to predict gross expenditures on research and development in Canada projected to 1978. It is first assumed that the GNP will continue to grow at around 5 per cent a year until 1970, and 4·75 per cent a year after that, giving a GNP of $127·7 thousand million in 1978. By taking an arbitrary proportion of this and devoting it to research and development, a series of very simple trends can be drawn as extrapolations of the present growth curve. These show, for example, that if R and D is to represent 5 per cent of the GNP in 1978, it will have to grow at a rate of 19·2 per cent per year. A more likely prediction—that R and D costs will represent 3 per cent of the GNP—implies a growth rate of 14·2 per cent (compared with an average since 1957 of 11·0 per cent). An alternative approach is to make estimates of the proportion of the qualified manpower which will be engaged on research and development, and then to calculate what will be needed to support these numbers at any point in the future. As things are, 14·3 per cent of Canadian scientists are engaged on research and development; if this proportion is maintained, it will imply a rate of growth of expenditure of 14·6 per cent a year, to a total of about $4 thousand million by 1978. If the number of scientists in research and development is expected to increase to, say, 17 per cent of all scientists, this would call for a growth rate in financial terms of 16·2 per cent a year, and would have Canada spending nearer $5 thousand million by 1978. If as many as 30 per cent of all scientists were in research and development, the budget by 1978 would be $8 thousand million, no less than 6·2 per cent of the GNP, a level which most people (though not the authors of the study) consider improbable. But some growth is clearly vital; the report publishes curves which show that Canadian expenditure on R and D as a proportion of total federal expenditure has actually declined since 1957, an experience shared by few other advanced countries.

EARTH SATELLITES

Satellites Applied

Fears that a two year study of applications satellites carried out by the US National Research Council would