

flights can be fitted into NASA's budget. He also pointed out that the lab will be a unique capability of the shuttle, and thus direct cost comparisons with missions using conventional launchers are difficult to make. One possible extension of NASA's reasoning is that if the shuttle is used to carry out many sortie missions, there will be less justification for building a space station, which will also free more money in the 1980s for other missions.

Although NASA's new estimates have made the GAO's investigation of the economic arguments for the shuttle redundant in some respects, the accounting office's report contains much information which will undoubtedly be used to good effect by the project's critics. In short, the GAO concludes that it "is not certain that the space shuttle is economically justified . . . even though NASA's calculations show that it is". The report has reservations about possible cost overruns in development of the shuttle, and, more important, uncertainties in the overall size of the space programme.

In particular, the GAO points out that if there is an austere space budget so that there are many fewer shuttle flights than planned, development costs of the shuttle would not be spread so thinly, and the economic balance may be tipped in favour of expendable launchers. The report notes in several places that uncertainties in shuttle costs suggest that the choice of launcher system "should not be based principally on cost estimates".

Only in one instance does the GAO come up with a figure that is radically different from NASA's analysis, however. NASA officials have suggested in testimony before Congressional committees that the shuttle will be able to put a pound of payload into orbit for only \$160, compared with between \$900 and \$5,200 with expendable launchers. But the comparison is "not a meaningful one", the accounting office suggests, because NASA neglected to include the cost of development and production of the shuttle, and also computed the figure on the assumption that the shuttle would be used to maximum capacity. If corrections are made for those factors, the GAO suggests that the launch costs per pound are nearly \$3,500.

The GAO report and NASA's new mission model are sure to generate considerable controversy, and cloud the issue even further. But there are signs that Congressional opponents of the shuttle are beginning to use more straightforward arguments that go to the heart of the project. During hearings earlier this year before the Senate Committee on Aeronautics and Space Science, and the Senate Appropriations subcommittee that deals with NASA's

budget, Senator James Abourezk and Senator Proxmire have been asking some sticky questions about the short term effect of shuttle development on other items in NASA's budget.

This year, NASA is spending \$200 million on shuttle development. Next year the figure is expected to rise to \$475 million, and by 1977 it is expected to reach nearly \$1,200 million. Critics of the project want to know what effect that growth will have on NASA's space science and applications programmes. The crux of the matter is whether the Office of Management and Budget will allow the agency's budget to recover from the decline which has set in during the past few years. NASA officials say that they are confident that they will soon get back to the \$3,400 million level, but its critics say that there is no such guarantee.

The fact is that OMB allowed NASA only about \$3,100 million for 1974, and the projections for 1975 which were published with the 1974 budget request allow for only a modest increase to \$3,160 million. If the agency's budget stays at that level, critics of the shuttle have been suggesting that the science, technology and applications programmes will clearly suffer.

Whatever the force of those arguments, however, it is unlikely that the project will be stopped by Congress this year. Already the House of Representatives has easily turned back an attempt to delete funding from the shuttle from the NASA authorizations bill, and even the chief critics in the Senate are not optimistic about their chances. For one thing, they could only garner 21 votes last year against the shuttle, and that was the crucial vote which allowed NASA to go ahead and let contracts for the project. Another reason why the shuttle will be hard to stop is that the spectacular success of the improvised repairs to Skylab have at least demonstrated that man has some use in space. NASA will be sure to use that argument with telling effect in support of the manned space flight programme.

BIOMEDICAL RESEARCH

More Protests

NINE Nobel laureates, backed by the 6,000 members of the Federation of American Scientists and 2,000 other scientists last week sent a letter to President Nixon protesting at cutbacks in funding for biomedical research. The letter indicated two "fundamental complaints" about the Administration's proposed budget for 1974, namely the fact that increases in the budgets of the National Cancer Institute and the National Heart and Lung Institute are being offset by cutbacks elsewhere, and the decision to phase out NIH training

grants and fellowships. Those complaints are by now familiar, for the biomedical community has kept up a barrage of protests since the Administration's budget was unveiled in January.

The letter does point out, however, that in the face of financial stringency in all parts of the federal budget, funding for biomedical research cannot be expected to increase rapidly in the next few years, but adds that "we have a right to expect that the funds which are available to our discipline are allocated in a sensible way".

VENUS

Still Planning to Go

by our Washington Correspondent

IN spite of two setbacks, NASA officials are pushing ahead with plans to study Venus. A team of investigators has been chosen to provide experiments for a Pioneer spacecraft which, if all goes well, will send four probes into the Venusian atmosphere in 1978, and plans are also being drawn up to send an orbiter to the planet in the same year. In addition, there is another launch window in 1980 which will probably be used to launch a second orbiter or, if the 1978 probe mission fails, a second set of probes.

Those plans are, however, less ambitious than the programme that was being talked about last year, when NASA was hoping to send two sets of probes to Venus in 1976, an orbiter in 1978 and another orbiter in 1980. The first to be dropped was one probe mission which went by the board in November during bargaining between NASA officials and the Office of Management and Budget over the agency's 1973-74 budget (see *Nature*, 240, 177; 1972). But OMB officials still refused to allow NASA to put in for the money, and the 1976 launch has slipped to 1978. The second setback came earlier this year, when the European Space Research Organization decided not to join in the orbiter mission because of the uncertainties about US funding.

The 1978 probe mission will be launched in May, and arrive at the planet in December of that year. It will send one large probe, carrying about 60 pounds of instruments, and three small probes each carrying three pounds into the atmosphere. The large probe will take about 90 minutes and the small probes about 75 minutes to reach the surface, when their data transmission will stop. As for the orbiter mission, scientific experiments will be chosen in January 1974, and although ESRO has opted out of the mission, NASA officials are exploring the possibility that Britain or the Federal Republic of Germany will join in.