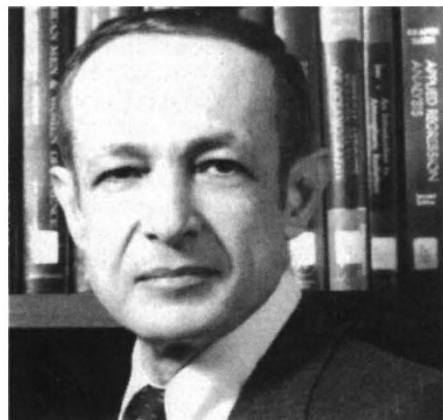


US space

Continuing problems all round

Washington

THESE are trying times for US space scientists. The space shuttle is grounded until at least 1988, and when flights resume, competition for cargo space will be fierce. While there is discussion of launching scientific missions on expendable launch vehicles (ELV), for the time being nothing is decided. Planetary scientists are among the hardest hit. At the end of last month, they learned that new weight restrictions mean that neither the Comet Rendezvous Asteroid Flyby (CRAF) mission nor the Saturn orbiter (Cassini) can fly aboard the shuttle. This news follows a decision to abandon the shuttle/Centaur upper stage that would have been used to take Galileo to Jupiter (see *Nature* 321, 800; 1986). Bruce Murray, professor of planetary science at California Institute of Technology (Cal-



Moustafa T. Chahine — chief scientist at JPL.

tech), puts it bluntly, "the US planetary program has collapsed".

For the Jet Propulsion Laboratory (JPL) in Pasadena, the delays will be especially difficult. JPL is run by Caltech for the National Aeronautics and Space Administration (NASA). Although JPL is engaged in a variety of projects from remote sensing to astrophysics to defence-related research, Solar System exploration has been its bread and butter. Fully 20 per cent of JPL's 1985 budget was spent on three planetary probes, Galileo, Voyager and the Venus radar mapper Magellan.

The uncertain future is beginning to take its toll on the staff of JPL, says Moustafa Chahine, its chief scientist. Chahine says morale is still high from Voyager's Uranus flyby last January, but senior scientists now face tough decisions. The median staff age at JPL is 42, and scientists are at a crucial juncture in their careers. "Would you commit yourself to 10 years of uncertainty?" asks Chahine rhetorically. Although nobody has yet left JPL, Chahine is certain that some will do so in the coming months.

That no major missions can be launched for at least three years does not necessarily have to be a drawback for planetary science, maintains Chahine. With a strong commitment from NASA, JPL would have no trouble assembling a team to plan new missions. Were planning to begin in 1988, a reasonable launch date would be the early 1990s, by which time either the shuttle or some other launch vehicle should be back in operation. Working on long-term projects is something JPL scientists are familiar with. What is needed, says Chahine, is a demonstration from NASA, in deed not just word, that planetary science will not be forgotten as NASA plans for the future.

JPL is not the only NASA centre to have taken a body blow from the delays in the space programme. Noel Hinners, director of the Goddard Space Flight Center in Greenbelt, Maryland, says Goddard also must cope with uncertainty. "Mentally, things are on hold", says Hinners. If the launch delays for Goddard projects such as the Gamma Ray Observatory or the Cosmic Background Explorer are of the order of one to two years, Hinners believes most key people will stay with the projects. But a delay of five years is a different story. Even keeping a launch team together for two or three years is tough, and Hinners reckons people will have to be laid off.

While the Hubble Space Telescope (HST) is in the same boat as the other major satellite launches, the delay seems to be less troubling to Garth Illingworth, deputy director of the Space Telescope Science Institute. He maintains that optical astronomers have never had a chance to become dependent on space-based observations, and can get by with existing ground facilities. "We are not really as subject to the feast or famine as the planetary people", he says.

James Welch, Space Telescope project director for NASA, agrees that principal investigators are unlikely to leave the project. But keeping the engineering team intact will not be easy. Directing routine maintenance while the satellite is in storage is not a stepping stone to career advancement. One challenging engineering problem has, however, recently cropped up for HST. NASA's heightened awareness of safety issues has prompted a re-evaluation of the natural frequency of satellite subsystems. If they coincide with the frequency of shock waves generated by the shuttle, there could be serious problems. Determining these frequencies is not easy, says Welch.

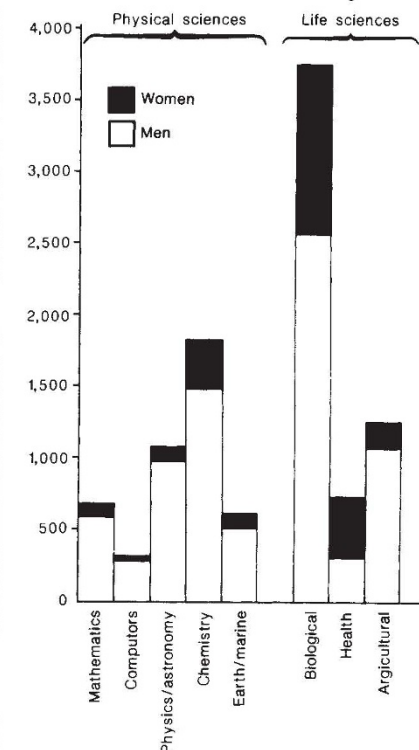
Although NASA and the Reagan administration have not yet enunciated a clear policy on alternative launch vehicles

to the shuttle, most members of the space science community see a new fleet of expendable launch vehicles as crucial. Tom Donahue, chairman of the National Academy of Sciences Space Science Board, told Congress last month that he supports the use of the Air Force's new Titan 34D7 to launch deep space missions. Donahue favours moving to the Titan 34D7 to launch Galileo, Magellan and Ulysses (the joint mission with the European Space Agency to study the Sun's polar region) even if it means postponing acquisition of an orbiter or slowing down work on the space station.

If there is any bright side to the current upheaval, Murray believes it may be the study of Mars. The Mars Observer, the first of a series of low-cost planetary probes, is scheduled for a 1990 launch, and could still make use of the shuttle. Murray says the Soviet Union is planning two major missions to Mars in the next five years, and there have been non-governmental discussions about a joint United States/Soviet Union mission. These factors may make Mars programmes attractive candidates for new funds.

Joseph Palca

US doctorates by sex



THE numbers of doctorates awarded to men and women in the United States in 1985, taken from a report from the National Science Foundation division of science resource studies. In total 4,531 doctorates were awarded in physical sciences (3,817 to men, 714 to women) compared with 5,748 in the life sciences (3,893 men, 1,855 women).