

these obstacles can be surmounted. In the end, an agreement on Euromissiles (if there is to be one) may have to be quite different in character from Salt II. It helps that the Soviet Union and the United States have at least begun flirting with the problems. It may not be a productive negotiation, but it cannot fail to be educative.

The outcome will not, however, be a formal treaty unless Salt II is ratified. The Soviet Union has made that plain. What, in the circumstances, can be the outcome of the Vienna talks (which are likely to drag on for years to come — unless Mr Reagan is ever in a position foolishly to put an end to them)? If the two sides merely understand each other's views of strategic weapons more fully, that will be worthwhile. In retrospect, it is clear that the negotiations ten years ago about anti-ballistic missiles helped to persuade both sides that their deployment would be counter-

productive, with the result that Salt I (with its limitation on anti-ballistic missiles) was something of a formality. Thus there is something in the view that in arms control negotiations the process may be as valuable as the product. This recognition has tempted some to go further and to argue that, in arms control, tacit understandings between the major powers are in some ways preferable to formal treaties. Mr McGeorge Bundy, adviser on national security to Presidents Kennedy and Johnson, was making this case only last week at a seminar at Massachusetts Institute of Technology. That tacit understandings might be more easily agreed, and even more ambitious, is beyond dispute. The snag is that almost by definition they cannot be policed or relied upon internationally. But if Salt II remains in limbo, or if Mr Reagan is elected and does his worst, they may be the best hope for arms control in the 1980s.

The space agency's neglect of science

The death last week on a climbing expedition in the Himalayas of Dr Thomas A. Mutch, associate administrator of the US National Aeronautics and Space Administration (NASA) will be widely mourned. In the past year, since his move from Brown University, Dr Mutch has helped to give NASA's support of scientific research a sense of greater civility than has often been the case in the past.

Sadly, however, Dr Mutch's death will inevitably prompt further questions about the adequacy of NASA's general strategy on scientific research. From the beginning, the agency has lived in an uneasy and ambivalent relationship with the scientific community. For many people and groups, of course, it has been a source of unaccustomed and even unexpected largesse. But there has also been a constant grumble, from universities and other places where space vehicles are thought of as a means to an end, that the agency takes too short a view of its contribution to scientific research. There is a large stock of anecdotal evidence that it is far easier to wring from NASA quite large sums of money for putting things in spacecraft of various kinds than for the frequently less expensive task of making good use of the data which are eventually collected. What with one thing and another, but especially because of the way in which getting the space shuttle built is eating into NASA's budget, there is a nasty fear that science will be a conspicuous casualty of the years ahead.

The symptoms of present discontents are easily listed. The most evident is the prospect that, in the immediate future, there will be a dearth of Earth satellites and other spacecraft whose purposes are primarily scientific. Each interested party has a particular sense of grievance. Some most of all regret that projects like that to send a spacecraft to Halley's comet (due back within shooting range in 1986) may not get the funds they need in next year's budget. Others weep about the impending premature demise of the Einstein X-ray observatory, and the near certainty that there will not be a comparable instrument to replace it within this decade. The device known as a solar polar orbiter, the chief objective of which is to make measurements of the solar wind well away from the Sun's equator, survived only by the narrowest squeak the budgetary process earlier this year, largely because of the intervention of Dr Frank Press, the President's Science Advisor, and is probably now safe. It is also likely that the Large Space Telescope, the instrument confidently planned as the next big step forward in visual astronomy, will not now see its way into orbit until the second half of the 1980s. Some gloomy folk even fear that the cost of the telescope (likely to be more like \$1,000 million than the original estimate of half as much) will itself turn out to be an internal pressure within the NASA budget.

The prospect that there will be a shortage of hardware in the remainder of this decade is, however, less alarming than that which faces the groups which have grown up in recent years and which are primarily concerned with the design of instruments carried on spacecraft and the interpretation of the results which they produce. NASA has rightly taken the view, since its earliest

times, that one of its objectives should be the encouragement of research in universities and elsewhere. On several occasions, as for example when there was more Moon rock to be cut into specimens than there were suitably equipped investigators, NASA has glad-handed its dependants in an almost lavish way. Yet even where that huge (and expensive) harvest of material is concerned, the first flush of enthusiasm has not been matched by sustained effort. Although the Einstein satellite is reckoned in its truncated life to have produced so much data that those now working with it could be kept busy for six or seven years, there is a suspicion that the funds needed to make the most even of what exists will not be forthcoming. Certainly the data needed to make the most of the data which exist — and which, for example, may be especially important in making sense of variable X-ray sources — will not now be available until the next decade. One result is, that some of those who flocked into X-ray astronomy only a few years ago, when the Einstein satellite was being planned, are now flocking back again to their earlier fields of interest — wiser, perhaps, but also more cynical. People understandably have the sense that NASA as a whole is more interested in the ballyhoo that attends the launching and the operation of a major scientific satellite than in the more tedious but necessarily continuing task of making sure that the mission has been worthwhile.

To those responsible for NASA as a whole, views such as these may seem but evidence of base ingratitude on the eve of the close encounter of Voyager I with the system of Saturn and its rings, planned for 12 November. Between now and then, increasingly spectacular photographs of the planet and its satellites will no doubt be increasingly frequent in the daily newspapers. And in any case, the administrators will say, there is Voyager II, following six months behind, still to come. What on earth can be the complaint? The simple answer is that even at this late stage there is no confidence that there will be funds to support the continuing work of the groups now concerned with harvesting data from these encounters. People who have cut their teeth on these endeavours will find themselves looking for jobs elsewhere.

For NASA, the problem is one not merely of budgets but of procedures — or that, at least, is how the agency should set about putting its house in order. It is of course entirely understandable that an agency committed, wisely or otherwise, to a novel project such as the space shuttle should be unable to keep every programme intact when the costs turn out to be far greater than originally foreseen. It does not, however, follow that the agency has no choice but to sit back and accept the fate which Congress and the Office of Management and Budget decree when things go wrong. And if the need to accommodate the cost of the shuttle within the limits laid down by the Administration means that much valuable scientific data is literally wasted, NASA has not merely a right but a duty to tell its paymasters that money is being wasted. In short, if NASA shares the view that science is being needlessly neglected, it should say so. Otherwise, it should let the scientific community know more clearly where it stands.