BOOK REVIEWS

The Space Telescope: A Study of NASA Science, Technology and Politics *by Robert W. Smith, P.A. Hanle, R.H. Kargon, and J.N. Tatarewicz*
(Cambridge University Press, Cambridge, U.K., 1989), pp xviii + 478, $A90.00, ISBN 0-521-26634-5.

Given the current problems of the Hubble space telescope caused by manufacturing errors in the mirrors, it would appear that one important element is missing from the title of this book, namely, 'management'. In practice this book more than makes up for this lack, and in fact gives riveting, detailed and sometimes hair-raising insight into all aspects of the program, including the management disasters at Perkin-Elmer during the manufacture of the OTA (NASAese for 'optical telescope assembly').

The genesis of the problems of the space telescope dates back to the era of NASA managers who gave us the twin concepts of 'success-oriented schedules' and 'all up testing' of space hardware which, in the fullness of time, gave us the Challenger disaster. Thus, instead of incremental development through intermediate sized telescopes, an all or nothing program was implemented. In order to win the support of the astronomical community, an ambitious scientific instrument package concept was adopted. In order to sell it to the politicians on Capitol Hill, who were not much interested in pure science, the program was tied to a hopelessly optimistic budget, which crippled the testing and verification program, and which in turn sometimes promised to throw the scientific baby out with the fiscal bathwater.

At an early phase in planning, the decision was taken to give Marshall Space Flight Center the program management. This was unusual, since Marshall had been predominantly concerned with manned space flight. Goddard Space Flight Center, which had much more experience in scientific payloads, would have been the more logical choice. This decision, and the later one which gave Goddard the responsibility for the scientific instruments, and effectively put Goddard in the position of a contractor to Marshall, led to an atmosphere of bickering and squabbling between the Centers that persisted through much of the program. The decision to go with "a streamlined project office and streamlined technical monitoring, a minimum in-house engineering effort, and no support contractors at Marshall" quickly led to disaster in the form of cost overruns and inability to properly monitor the activities of the subcontractors. Money, or rather, the lack of it, was the root cause of many of the evils the program fell into. Shortage of money meant compromising the spares program, reducing the testing, and downgrading the reliability. Penny-wise decisions led to pound-foolish outcomes.

Robert Smith has captured, through his archival research and through many personal interviews the sense of the pressures on those who had to try to carry through an unworkable program with inadequate system design, funding, and manpower. In view of the current problems of the Hubble space telescope, it is instructive to quote from an interview with the program manager Marc Bensimon reflecting on the period in the summer of 1982, shortly after he had found himself in the hot seat:

> In preparing for "Optical Test Number Two" Perkin-Elmer had pads to install on the bottom of the mirror that weren't machined properly. The bonding agent also

> came into question. They had to go back to do some tests on the bonding agent. The fixture that was supposed to hold it (the primary mirror) in turned out to be totally unsuitable. And then there were five or six other things in addition to that. Also the roof of the facility, the clean room the mirror was stored in, had leaks . . . So every day you'd call up and try to find out "What's going on?". You would hit another problem. Just one after the other, bang, bang, bang! (p. 299).

Given these problems, it seems to me to be somewhat surprising that, not only has the Hubble space telescope been finally launched, but that it works as well as it does. It is undoubtedly true that a technical fix will be found to the image quality problems in the second-generation imager, and that then, finally, the telescope will revolutionise our understanding of the universe. Robert Smith's book is an extraordinarily well-documented analysis of a high-risk, high-gain, big science project that could have only happened in the United States. This statement is not intended as a criticism. Indeed, without visionary scientists, dedicated engineers, and energetic political lobbyists, an imaginative and innovate pure science project like the Hubble space telescope would have never got past the starting blocks. The climate was right. The ethos that big science is good for industry was already developed. Scientists were respected, and given the liberty to set their own long-term goals for their scientific work. Certainly, Robert Smith's case study of the Hubble space telescope shows that, although the existing mechanisms and organisations may be imperfect for the job, at least things do get done.

Having read the book, I could not help but reflect on the dismal comparison with the Australian experience in space science. Here, current space policy is governed by an economic rationalist viewpoint directed at short-term development of space industry. Space science is seen as an expensive luxury rather than as a tool to focus that development of space industry. Scientists are seen as a cheap renewable resource, whose advice can always be freely obtained, and equally freely ignored. The dead hand of centralised bureaucracy rules supreme to stifle scientific and technical innovation. While that attitude persists, we will never have a viable space program or space industry in Australia. Robert Smith's book should be required reading for all members of the Space Office, but I somehow doubt whether even one of them will ever get round to picking it up.

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Ethics of New Reproductive Technologies: The Glover Report to the European Commission *by Jonathan Glover and others*
(Northern Illinois University Press, DeKalb, 1989), pp. ix + 159, ISBN 0-87580-147-1.

The phrase 'New Reproductive Technologies' refers to a range of mainly medical techniques aimed at assisting human reproduction. Two techniques are central: artificial insemination, and *in vitro* fertilisation. As the title of the book suggests, this monograph is the result of collaboration by a Working Party established to advise the European Commission on the possibility and desirability of arriving at a common set of European Communty goals and public policies on the ethical use and further development of these technologies.