# Space Program: More Time for Biomedical Research?

President Nixon waited longer than expected to put forward his space program for the 1970's, but when the policy statement came last weekend it contained no big surprises. As was anticipated, he indicated that a manned landing on Mars was to be deferred at least until the 1980's. Nixon called for wide-ranging planetary exploration with unmanned spacecraft in the coming decade. Manned operations would include further exploration of the moon and new activities in space between earth and the moon, involving an orbiting "workshop" and a reusable space shuttle. In effect, the President put his seal of approval on a compromise program fashioned within NASA to maintain momentum but to stay within budget limits that seem unlikely to rise very fast or far above the $3.3 billion requested for the coming year. Action on appropriations by Congress in the coming years, of course, will determine whether the policy will actually define the program; but the recent handling of space matters in Congress seems to indicate an inclination to accept such a compromise program.

### Implications for Research

As for science, Nixon in his statement urged that the country acquire "greater systematic understanding about ourselves and our universe" and said that the space planners should be "attentive" to suggestions from scientists about how the space program could advance research. One of the major questions affecting R&D in the post-Apollo period has been that of the fate of the manned space program. Nixon's answer on the role of man in space amounted to an amber light. And it is possible to see in this some general implications, at least for biomedical research.

Ever since the moon program got off the ground in the early sixties NASA has been the target of running criticism from the scientific community for paying insufficient heed to basic research. This has been a familiar theme even of the university scientists who served as NASA advisers, including those in the fields of biology and medicine. A recent variation on the theme was played in a report on the Biomedical Foundations of Space Flight, released in November by the space science and technology panel of the President's Science Advisory Committee. Discounting any early prospect of manned planetary flights, the PSAC panel argued that the focus of efforts in biomedical research for manned space flight "should be shifted from *tolerance for flights of long duration* to *modes and levels of effectiveness* of man-assisted systems on the moon and in earth orbit.

"We are convinced that the necessary biomedical foundations for the design of optimum flight programs to explore such questions do not exist—either in NASA or the scientific community at large. NASA, without recognition of the importance of these foundations, and without a major modification of its approach to space biomedicine, will only be able to conduct empirically designed manned programs, which promise slow and very expensive progress toward the understanding of man's optimal role and intrinsic capabilities in space."

The criticism can be read as a further expression of the scientist-versus-engineer friction that has been a constant feature of NASA's R&D program. The NASA viewpoint can probably be best understood, if not justified, in historical context. At the beginning of the manned space-flight program, there were some misgivings about whether man could survive in space and there was even more widely held concern over whether he could function effectively. Flight experience soon dispelled these doubts, but the early uncertainties and unknowns shaped NASA's biomedical effort. Through the Mercury, Gemini, and Apollo programs the medical program served the primary aims of insuring the safety of the astronauts and the success of the mission. Working within a tight schedule and with evolving technology, those responsible for the medical program adopted a pragmatic, "incremental" approach. At each step, the emphasis was on gaining enough information to take the next step safely. Much attention was paid in early flights to the effects of weightlessness and radiation on the astronauts; later, apprehension about "back contamination" of the biosphere by microorganisms from the moon caused great stress to be placed on testing and quarantine procedures.

When the goal of a manned round trip to the lunar surface was achieved last year, the medical program, in its own terms, was a success. However, NASA is now looking hopefully to longer, more ambitious missions. Flights of substantially longer duration involve a new order of technical problems, including biological and medical problems, and will demand of NASA what amounts to a new biomedical approach.

### Doctor-Patient Relationship

Because biomedical research is done not only for but on the astronauts, the key NASA group is the Medical Research and Operations Directorate at the Manned Space Center (MSC) at Houston, the astronauts' home office. The directorate is headed by Dr. Charles A. Berry, who has gained a measure of popular identification as "the astronauts' doctor" and in many ways the doctor-patient relationship really does suggest the responsibilities and functions of Berry and his staff. The staff not only is responsible for the medical care of the astronauts between missions as well as during the flights, but is deeply involved in the endless task of improving the life-support systems—participating, for example, in the efforts to see that space food is more palatable and nutritious, water is more potable, and the waste-management system more satisfactory. They also work with engineers, for instance, to make noise and temperature levels in the cabin closer to optimum—and with mission planners to schedule more desirable work-sleep cycles.

Infectious diseases that might disable the astronauts receive much attention. There is a great pressure not to postpone a mission and lose a launch opportunity or to abort a mission after it is begun. An aborted mission could conceivably cost almost the equivalent

# NEWS IN BRIEF

● **HEW FUNDS:** The President has signed a compromise appropriations bill for the Departments of Labor and Health, Education, and Welfare. President Nixon had vetoed an earlier $19.7-billion appropriations bill as inflationary. The House and Senate conferees agreed on a $19.4-billion appropriation for the current fiscal year, but will allow Nixon to trim the bill by 2 percent. This 2 percent cut reduces the final total to about $19 billion.

● **PILL WARNING:** The Food and Drug Administration announced last week it plans to require insertion of a simply worded leaflet about possible health hazards into packages of birth control pills. The leaflet cautions women about blood clots and other possible side effects. It notes that the hormones in the pills have caused cancer in animals but that there is no proof they cause cancer in humans. No other prescription drug requires a warning aimed at the user; usually such warnings go to doctors and druggists instead.

● **NUCLEAR PACT:** The Nuclear Nonproliferation Treaty was officially declared to be in force last week after more than 40 nations ratified the pact. The treaty was originally signed by the three sponsors, the United States, Britain, and the Soviet Union, on 1 July 1968. Under the pact, adhering nations pledge not to transfer or acquire atomic weapons. Two of the five nuclear powers, Red China and France, did not sign.

● **BRAIN DRAIN DECREASES:** The number of scientists, engineers, and physicians immigrating to the United States decreased sharply in fiscal 1969, according to the National Science Foundation. The total of immigrant scientists and engineers dropped by 21 percent—from 13,000 in 1968 to 10,300 in 1969, and the total of physicians by 8 percent—from 3,060 in 1968 to 2,800 in 1969. The brain drain decrease is attributed to changes in the immigration laws.

● **ATOMIC PIONEERS AWARD:** The special Atomic Pioneers Award was presented by President Nixon to Vannevar Bush, James B. Conant, and Leslie R. Groves for their "exceptional contributions to the national security." Glenn T. Seaborg, chairman of the Atomic Energy Commission, prior to reading the citations said, "This is the first of a kind, and the only presentation that will be made of this award. . . ." Bush was cited for his work as director of the Office of Scientific Research and Development during World War II. Conant and Groves were cited for their work in the development of nuclear weapons systems, including the atomic bomb.

● **ABORTION RULING:** The Supreme Court has let stand a decision by California's high court declaring the state's abortion law unconstitutional. The law, since superseded by a more liberal one, prohibited abortions except when "necessary to preserve" the mother's life; California's Supreme Court had ruled this phrase was too vague for a doctor to know when his actions were legal.

● **INSTRUCTIONAL TECHNOLOGY:** The Nixon Adminstration has relayed to Congress without comment a report calling for massive federal spending to promote use of instructional technology in the schools. The report was written by the Commission on Instructional Technology, chaired by Dean Sterling M. McMurrin of the University of Utah's Graduate School. It recommends establishment of a National Institutes of Education, patterned after the National Institutes of Health, to train teachers and promote use of instructional technology. The commission recommends an initial financing of $565 million. The report is available from the Academy for Educational Development, Inc., 1424 16th St. NW, Washington, D.C. 20036.

● **NATURAL GAS AUTO FUEL:** More than 1000 federal cars and light trucks will be converted this year to use of natural gas as fuel, according to officials of the General Services Administration. In testimony before the Senate Commerce environmental subcommittee, officials said that an experiment with natural gas fuel, begun last October with federal cars in Los Angeles, has cut noxious exhaust emissions by about 80 percent and fuel costs by 25 percent. The vehicles, however, can travel only 52 miles before their fuel tanks must be refilled or replaced, so each of the experimental cars is equipped with a device permitting reconversion to gasoline, thus giving the cars a normal range.

of the annual budget of the National Science Foundation. Illness that could hamper or endanger the astronauts' activity on the moon surface was a particular worry as the time for the first Apollo landings drew near, and preventive medicine became a watchword in the medical program.

Physically, the program has been centered in the MSC's Lunar Receiving Laboratory, in which quarantine facilities for both moon rocks and astronauts returning from lunar landing missions are located. The medical labs are in the quarantine area of a building, which, like chemical and biological warfare research facilities and virus research labs, is kept under negative air pressure. What the NASA facility looks like, in fact, is a viral isolation unit combined with a very well equipped clinical pathology laboratory that has somehow been transported from an affluent medical center.

The work of the Houston group did not change radically from the Gemini to the Apollo periods. The Apollo missions required the astronauts to pass through the earth's atmosphere, which provides protection from galactic radiation and solar flares should they occur. But flight experience through Apollo 12 has proved radiation exposure to have been well within limits established as safe. No serious solar-flare episodes occurred during missions and it is estimated that the worst recorded flares of the past decade would have given astronauts a depth dose of some 25 rads, less than that acquired in routine diagnostic procedures. The record proves not that there is no danger but that risks are minimal.

The astronauts seem to have found the one-sixth gravity on the moon much pleasanter than the zero gravity of space, but weightlessness can apparently be regarded as much less of a drawback to spaceflight than was foreseen by many. Motion sickness affected five of the six Apollo 8 and 9 astronauts to some degree, but all ultimately adapted. The Apollo cabins are larger than those of the predecessor spacecraft, and motion sickness seems to have been related to the astronauts' greater ability to move about.

At the beginning of the Apollo program there was some medical concern about a recorded loss of red blood cell mass and cardiovascular deconditioning in earlier flights. In the Project Gemini and first Apollo flights it was found that there was a decrease in mass in the astronauts' red blood cells. After

the tragic Apollo fire in 1967, in which the deaths of three astronauts were blamed in part on the pure oxygen atmosphere, a change was made so that a mixture consisting of 60 percent oxygen and 40 percent nitrogen was used in the cabin on launch. Postflight tests on crews led to the conclusion that the nitrogen which persisted in the cabin atmosphere exerts a moderating effect on loss of red blood cell mass.

From the time of the earlier flights there has been some accumulation of blood in the astronauts' legs which seemed ascribable to relative inactivity. Signs of "cardiovascular deconditioning" have also been noted with high heart and pulse rates persisting for rather short periods after flights.

As NASA looks ahead to longer missions —1- and 2- month missions in the orbiting workshop—there seem to be no medical specters haunting NASA, but some things will have to be watched. The implications of long periods of weightlessness for motion sickness of vestibular origin are not fully understood. Cardiovascular deconditioning and a decline in work capacity observed in the immediate postflight period require study. In the longer run, the radiation effects of nuclear power sources or nuclear rockets will also require study.

As the duration of flights increases, so does the need for research of a more fundamental kind. Berry and his colleagues are acutely aware that longer flights will bring new dimensions of physiological and psychological stress, and they cite studies on the vestibular and endocrine systems as examples of basic research offering opportunities to gain results useful beyond space operations.

The NASA answer to why a formal basic research program wasn't flown seems to be that finite resources and operational priorities prevented it. It is pointed out, however, that very extensive medical records have been kept on the astronauts, as well as detailed data from the in-flight monitoring of vital functions and from a careful biological sampling program. This has been done to accumulate a data base necessary for the development of space medicine as a science, and the data and samples are available for future study.

The PSAC panel's report last November, however, represents the kind of criticism that will surely grow more insistent.

The report rather sharply observes "It has been customary for investigators to explore the stresses of a new environment by cautious empirical approaches and withdrawals, solving the immediate problems which become apparent and procrastinating over the risk of injury from chronic or delayed effects of the new environment."

What the panel asks is that NASA participate in a rapid development of the science of environmental medicine. They urge that the clinical medicine, the general biology, and the fundamental physiology divisions of the agency be linked more closely and that more emphasis be given to the latter. One suggestion is that biomedical-scientist astronauts be attracted to the program, since the kind of testing and experimentation needed in space will require specialists. In general the panel wants to see NASA establish more substantial ties with the biomedical community and find ways to give scientists outside the agency an active role in biomedical policy-making for the manned spaceflight program.

There appear to be practical limits other than the budgetary ones on the expansion of basic studies in the manned space program. It will be a long time before astronauts on missions operate in conditions anything like those of the laboratory. Berry and his staff have been responsible for establishing medical protocols for the missions, in a way that balances the need for biomedical data with operational demands and the willingness and ability of the astronauts to cooperate. Some medical procedures are tedious, unpleasant, and even humiliating, and, when the work load on astronauts is heavy, data gathering has to be limited. For this reason in part, then, tension between biomedical insiders and outsiders is likely to continue. At the same time the interests of the two groups are nearer to converging than ever before.—JOHN WALSH

# Fisheries Research: Rejuggling of Priorities Is Assailed

According to some biologists and certain members of Congress, the Bureau of Commercial Fisheries (BCF), an agency of the U.S. Department of the Interior, is behaving as though it were deaf to all the talk by President Nixon about arresting environmental deterioration and using resources wisely. A major case cited in point is the bureau's plans, which are part of the President's fiscal 1971 budget, to reduce research activities at its Ann Arbor Biological Laboratory, an institution which has had a major part in identifying and combating problems threatening the Great Lakes.

And the bureau is closing altogether its biological laboratory at Milford, Connecticut, a shellfish research facility which has been doing pioneering work in aquaculture since 1940. The decision to close the Milford laboratory has brought an outcry from a number of fishery biologists who feel that top officials of the BCF are foolishly emphasizing fishing for diminishing stocks of wild fish in the open ocean. What BCF should be doing, these critics contend, is devoting increasing attention to aquaculture, or the production of fish and shellfish under controlled conditions.

The fund cutback at Ann Arbor, which will reduce the laboratory's research effort by nearly a third, is being justified largely as a part of the administration's program to check inflation. But it also reflects the BCF's intention to give less emphasis to biological research in the Great Lakes. The Great Lakes no longer have an important commercial fishery, and BCF officials clearly would like to turn the Ann Arbor laboratory over to a sister Interior agency, the Bureau of Sport Fisheries and Wildlife (BSF&W). The possibility of such a transfer is now under consideration by the two bureaus and the Fish and Wildlife Service, of which they are a part.