ABM: Scientists' Loyal Opposition Finds a Forum

In deciding to alter the pattern of deployment of the Sentinel antiballistic missile (ABM) system by moving ABM sites away from cities, President Nixon last week appeared to avert a head-on clash with well-informed scientists who have been increasingly vocal in opposing ABM deployment. The scientists' criticism has focused on the McNamara-Johnson program for "area" defense based on ABM sites close to cities, and the critics have been particularly apprehensive about the possibility that the new administration might decide to expand the planned "thin" missile system to deal with a Soviet nuclear attack. By opting for what Nixon described as a "safeguard program" designed to protect U.S. offensive missile sites, and by indicating a scaling down of the planned program, the President blunted the scientists' criticism.

When he announced his decision last week, however, Nixon failed to deal directly with serious misgivings expressed by well-known scientists about the effectiveness of the Sentinel-Sprint hardware, the diplomatic consequences of deployment, and the process by which important technomilitary decisions are made. And members of a bipartisan anti-ABM group in Congress, who have recently provided a forum for scientists of very substantial status and experience who oppose ABM deployment, are apparently shifting their sights to the modified ABM system.

Nixon's "safeguard" program is designed to achieve essentially the same objectives (see box) as the program announced by Secretary of Defense Robert McNamara in September 1967, which was represented then primarily as a necessary precaution against a Chinese missile threat in the 1970's.

Politically, opposition to deployment ignited several months ago when the Army began purchasing land and starting work on ABM sites near major cities. Local protest movements, in many cases involving scientists in prominent roles, rallied opposition to the sites. The protesters achieved their greatest impact by raising the specter of a nuclear accident. In Washington, the effect of the issue of the ABM in the suburban backyard was most visible in the House of Representatives, where a number of Congressmen with protest movements in their districts challenged the Army plans.

The center of opposition in Congress, however, is the Senate Foreign Relations Committee, particularly its subcommittee on international organizations and disarmament, whose chairman is Senator Albert Gore (D–Tenn.). A significant number of senators feel that Senate authority in foreign affairs, embodied in the Senate's "advise and consent" powers over treaties, has been badly eroded, and they are particularly concerned about the effects of military decisions which have foreign-relations implications—such as the ABM decision. Last October, when the Senate was taking up the defense appropriations bill, a group of senators, including Fulbright, Cooper, and Hart, forced a debate on ABM deployment (*Science*, 20 December 1968), and while they lost a vote decisively, they opened up Senate discussion on the matter.

Now Gore's subcommittee is holding "educational" hearings on ABM under the rubric of its arms control responsibility. The senators have made a point of bringing in nongovernment scientists, social scientists, and other specialists who, they note, have been largely excluded from armed services and appropriations committee hearings on the ABM.

Last week the committee mustered three witnesses of unusual prestige and knowledgeability when they heard from President Eisenhower's two science advisers—James R. Killian, chairman of the board at M.I.T., and George B. Kistiakowsky, professor of chemistry at Harvard—and from the man who served in the top research post in the Pentagon in the later years of the Eisenhower administration, Herbert F. York, former director of defense research and engineering and now professor of physics at the University of California, San Diego.

Killian, Kistiakowsky, and York all opposed deployment of an area-defense ABM. And the committee could point to unanimity on the matter among emeritus presidential science advisers. M.I.T. provost Jerome B. Wiesner, who served as science adviser to presidents Kennedy and Johnson, has been an outspoken ABM critic. And Donald F. Hornig, who left the science adviser's post when administrations changed, sent a telegram, which Senator John Sherman Cooper (R–Ky.) read into the hearing record, in which Hornig said he had opposed ABM deployment while in office and had certainly not changed his mind.

The Gore hearings will continue, and it appears that the anti-ABM senators will regard the hearings record as a prime source of ammunition for a floor fight on ABM appropriations later in the session—J.W.

Excerpts from the York, Kistiakowsky, and Killian statements, which may be particularly pertinent to any continuing discussion of ABM systems, follow.

From Nixon Statement

The modified ABM system has been designed so that its defensive intent is unmistakable. It will be implemented, not according to some fixed, theoretical schedule, but in a manner clearly related to our periodic analysis of the threat.

The first deployment covers two missile sites; the first of these will not be completed before 1973. Any further delay would set this date back by at least 2 additional years.

The program for fiscal year 1970 is the minimum necessary to maintain the security of our nation.

This measured deployment is designed to fulfill three objectives:

1) Protection of our land-based retaliatory forces against a direct attack by the Soviet Union.

2) Defense of the American people against the kind of nuclear attack which Communist China is likely to be able to mount within the decade.

3) Protection against the possibility of accidental attacks from any source.

Herbert F. York

Any active defense system such as the ABM, must sit in readiness for two or four or eight years and then fire at the precisely correct second following a warning time of only a few minutes. This warning time is so short that systems designers usually attempt to eliminate human decision-makers, even at low command levels, from the decision-making system. Further, the precision needed for the firing time is so fine that machines must be used to choose the precise instant of firing no matter how the decision to fire is made. In the case of offensive missiles the situation is different in an essential way: although maintaining readiness throughout a long, indefinite period is necessary, the moment of firing is not so precisely controlled in general and hence human decision-makers, including even those at high levels, can be permitted to play a part in the decision-making process. Thus the trigger of any ABM, unlike the trigger of the ICBMs and Polarises, must be continuously sensitive and ready, in short a "hair" trigger for indefinitely long periods of time. On the other hand, it is obvious that we cannot afford to have an ABM fire by mistake or in response to a false alarm, and indeed the Army has recently gone to some pains to assure residents of areas near proposed Sentinel sites that it has imposed design requirements which will insure against the accidental launching of the missile and the subsequent detonation of the nuclear warhead it carries. These two requirements, a "hair" trigger so that it can cope with a surprise attack and a "stiff" trigger so that it will never go off accidentally are, I believe, contradictory requirements. This problem exists only in the real world and not on the test range; on the test range there need be no such concern about accidental misfires, the interceptions do not involve the use of nuclear weapons and the day, if not the second, of the mock attack is known. Another essential (but again difficult to quantify) difference between the real world and the test range lies in the fact that the deployed defensive equipment will, normally, never have been fully exercised and even the supposedly identical test range equipment will never have been tested against the precise target or targets that the deployed equipment would ultimately have to face. In the case of other defense systems which have worked after a fashion, practice using the actual deployed equipment against real targets has been possible and has been a major element in increasing their effectiveness. Thus, the Soviet SAMs in North Vietnam work as well as they do because both the equipment designers and the operating crews have had plenty of opportunities to practice against U.S. targets equipped with real counter-measures and employing real tactics.

For these and simliar reasons, as well as because of the technical problems detailed for you last week, I continue to have the gravest doubts as to the capability of any ABM system I have heard of, whether or not the problem has been defined into being "easy" and whether or not it "works" on a test range. I am not here talking about some percentage failure inherent in the mathematical distribution of miss distances, nor statistically predictable failures in system components, but rather about catastrophic failure in which at the moment of truth either nothing happens at all, or all interceptions fail.

George B. Kistiakowsky

It seems reasonable to assert that an attack on the United States by a modest force of ICBM's which the People's Republic of China is likely to deploy sometime in the seventies is wholly irrational, since it would invite a retaliatory blow which would totally destroy China. If none-the-less the Chinese decide to attack, they would certainly be capable of adding some penetration aids to their ICBM's if, as assumed, they would have the technical and other resources to deploy a significant ICBM force. For an irrational action such as we are hypothesizing the certainty that penetration aids will succeed would not be required and hence the presence of Sentinel might not be a deterrent. The Chinese, of course, could also use other means than ICBM's for an irrational nuclear attack in which case Sentinel might be of no use. Thus the basing of the United States policies on the assumption that Sentinel would prevent large American casualties in the case of a Chinese attack in the seventies would not be very prudent. On the other hand, the deployment of the Sentinel, especially in the mode begun last fall, fore-shortens greatly the lead time for a conversion of it to a heavy ABM deployment. This the Soviet military planner would have to take into account and thus the likelihood of an all-out missile race between the super-powers might increase.

Another form of ABM deployment has contemplated the exclusive defense of our hardened missile sites. Under proper circumstances such a move would not be inviting an arms race and could in fact stabilize mutual deterrence by protecting the retaliatory force against a preemptive strike. It is highly doubtful, however, considering the present threat, whether such deployment need be started immediately. Furthermore the Sentinel system is over-designed for this application, since the intercept of incoming warheads could take place much nearer to hardened Minuteman silos than to cities and the probability of kill of the incoming warheads could be relaxed. Thus, for instance, an interceptor of shorter range and less acceleration than the Sprint could be largely employed and other simplifying changes made. To avoid the dangers of the arms race that I have already discussed, the defense of missile sites must be unambiguously designed just for this purpose.

Having followed the development of weapon systems over the past quarter of a century, I cannot remain unaware of the very substantial momentum that a technological development of the magnitude of our ABM creates. I am therefore concerned that even a limited deployment would be open-ended and, with assembly lines operating, could lead to a continuously expanding system, which would obviously be a stimulus to a heightened arms race. . . .

James R. Killian

In my invitation to come before the committee, I was encouraged to comment on the urgent need today better to mobilize and draw upon the intellectual resources of the country in aiding the publicly accountable officers of government, both in the legislative and executive branches, to secure the assessments and analyses they need in considering intricate technological developments, such as the ABM, which are intertwined with policy and strategic questions. Because of the growing impact of technology on policy-making, we need better methods of assessment in order to assure that technology will

be used beneficially to enhance our security and to improve the quality and tranquility of our society.

Let me first make a specific proposal prompted by the current Sentinel debate. In considering the strategic options available to us in the years ahead, it seems essential that we plan not by single systems, such as the Sentinel, one at a time, but for the strategic system as a whole. This and other considerations lead me to suggest that an *ad hoc* commission or task force be appointed to make an independent, comprehensive study in depth of our weapons technology and of the factors which bear upon the decisions the nation must make regarding ongoing strategic forces and policies.

For several months I have become increasingly convinced that such a task force is now urgently needed. The commission that I have in mind should be made up of members who would devote full time over a period of several months to the study. The task force should be independent of the Department of Defense and other government agencies. . . .

I do not propose that the findings of such a commission should necessarily carry more weight than studies conducted within the government. I have great respect for the thoroughness and rigor which the government can bring to the formulation of policy decisions. Independent studies, such as I suggest, might well serve to sharpen the government's own analyses. The task force's recommendations should be critically examined by the normal procedures of the government and considered in relation to proposals which have come from the Department of Defense. Their special value would be that they would be independent conclusions reached by a group of competent citizens who were free of organizational loyalties and who could, therefore, formulate their evaluations and recommendations without being constrained by any departmental commitments or biases. So often the roles and missions interests of the Armed Services influence defense decisions more than they should, and the task force I suggest could transcend these service interests. By virtue of its freedom from any vested interests, such a commission could also provide some reassurance to the growing number of citizens who are concerned about the "military industrial complex" and its alleged influence on our strategic policies and programs. . . . ■

Lunar Science Institute: Link between NASA and Academe

Houston, Texas. The manned space program has been viewed by many scientists as a circus run by the Barnum and Baileys of modern engineering—a technological conceit which, by its vast expense, diverts funds that might otherwise go to science. The $24-billion Project Apollo will, however, produce some scientific by-products, most notably the priceless rock samples which astronauts will bring back from the moon.

These samples clearly would call for special handling even if there were not the remote possibility of their containing dangerous extraterrestrial pathogens. Looking to the return of such samples, the National Aeronautics and Space Administration has laid elaborate plans.

First, the moon rocks will be put under quarantine (as will the astronauts themselves) and will undergo preliminary and "time-critical" analyses at the Manned Spacecraft Center's $8-million Lunar Receiving Laboratory (*Science*, 3 February 1967); then, most of the specimens will be distributed to carefully selected investigators at universities and laboratories in the United States and abroad. Now, in addition, NASA is furnishing funds for a "Lunar Science Institute" (LSI), being set up by the National Academy of Sciences under a consortium of universities. The institute will provide a base for outside scientists, encouraging them to visit the Manned Spacecraft Center (MSC) and use its laboratories, lunar photographs, and (ultimately) its rock samples. LSI is viewed as a major potential stimulus to lunar science at MSC and elsewhere.

The return of rock samples from the first manned lunar landing, now set for July, will be a great scientific event. These specimens, together with those gathered on later missions, may provide clues for understanding the origin of the moon, the earth, and the solar system itself. The National Academy of Science's Space Science Board believes the moon will reveal a decipherable historical record of a kind that cannot be found on the earth.

Active mountain building, erosion, and sedimentation have obliterated most if not all remnants of the primordial earth, with the result that little is known of the early period of the earth's history. By contrast, the geological processes that change the lunar surface are believed to work much more slowly. Analysis of the chemical and isotopic composition of lunar samples may yield major new insights. It may, for example, help settle the arguments as to the moon's origin—whether the moon was a body "captured" by the earth's gravitational field, or one formed by fission from the earth or by independent condensation from a proto-earth nebular mass.

The Lunar Receiving Laboratory (LRL) contains special facilities necessary for handling, analyzing, and storing lunar samples. For instance, there is the ultra-clean-vacuum laboratory system which will allow examination of samples without exposing them to terrestrial contamination. Other LRL facilities include biological test laboratories and various physical-chemical facilities, including a below-ground gamma ray counter which has the lowest background radiation of any radiation-counting laboratory in the world.

This exceptional complex of sophisticated equipment for the handling of specimens from another world will be operated by a staff of NASA scientists and technicians assembled by Wilmot N. Hess. Hess, a physicist formerly at Goddard Space Flight Center, came to MSC about 2 years ago to head its new directorate of science and applications. Taking part alongside the LRL staff in the work of the laboratory will be a number of non-NASA scientists, mostly from universities, serving on two groups which Hess chairs. One is a team which, working inside LRL's biological barrier, will make the preliminary examination of lunar samples. The other group will work outside the the barrier, advising NASA on LRL operations and determining, from data reported by the preliminary examination team, which samples go to which principal investigators.

(These investigators, or "P.I.'s," now number more than 135, about a fourth of them foreign scientists. According to Hess, NASA's choice of investi-