SCIENCE

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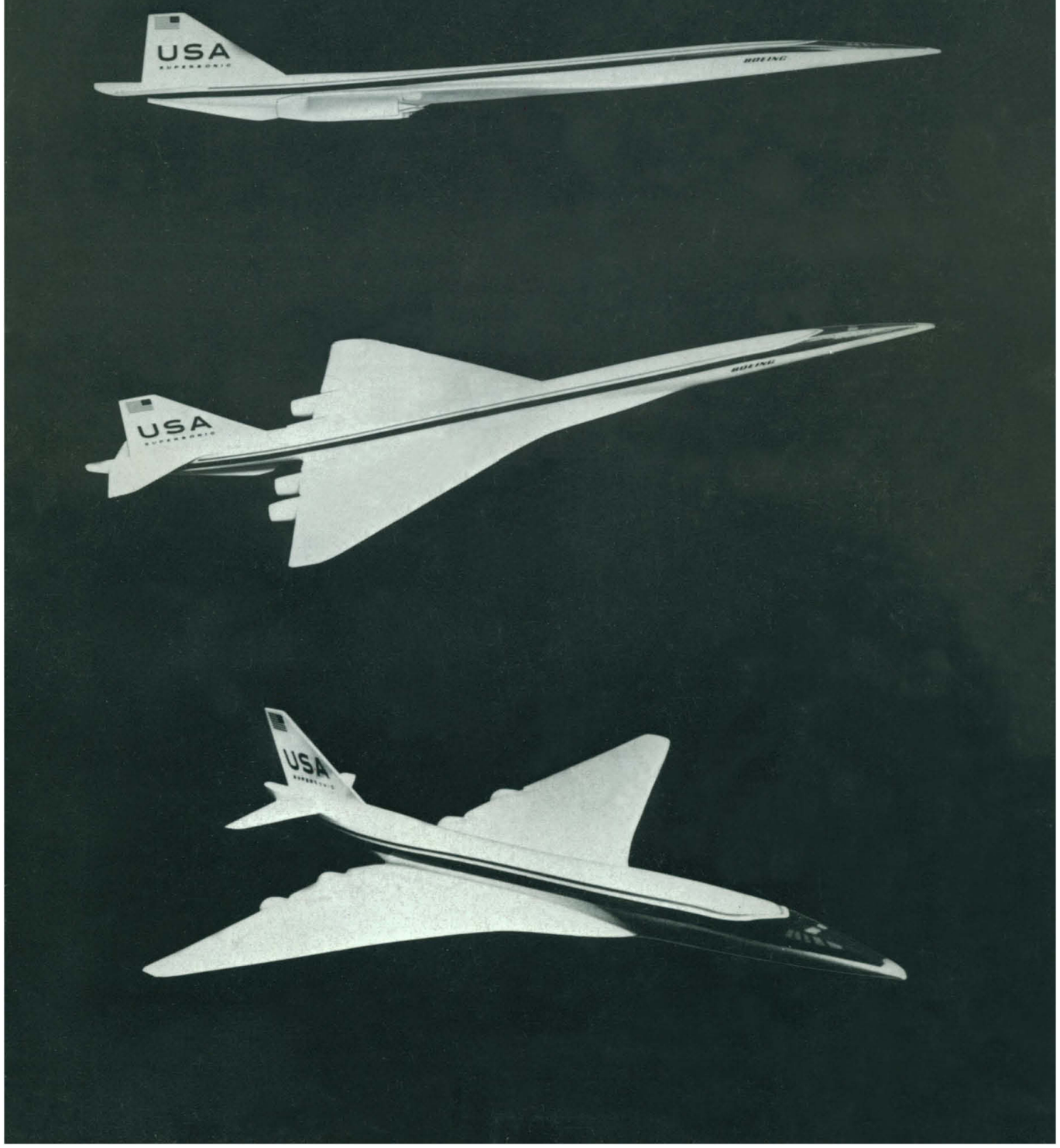

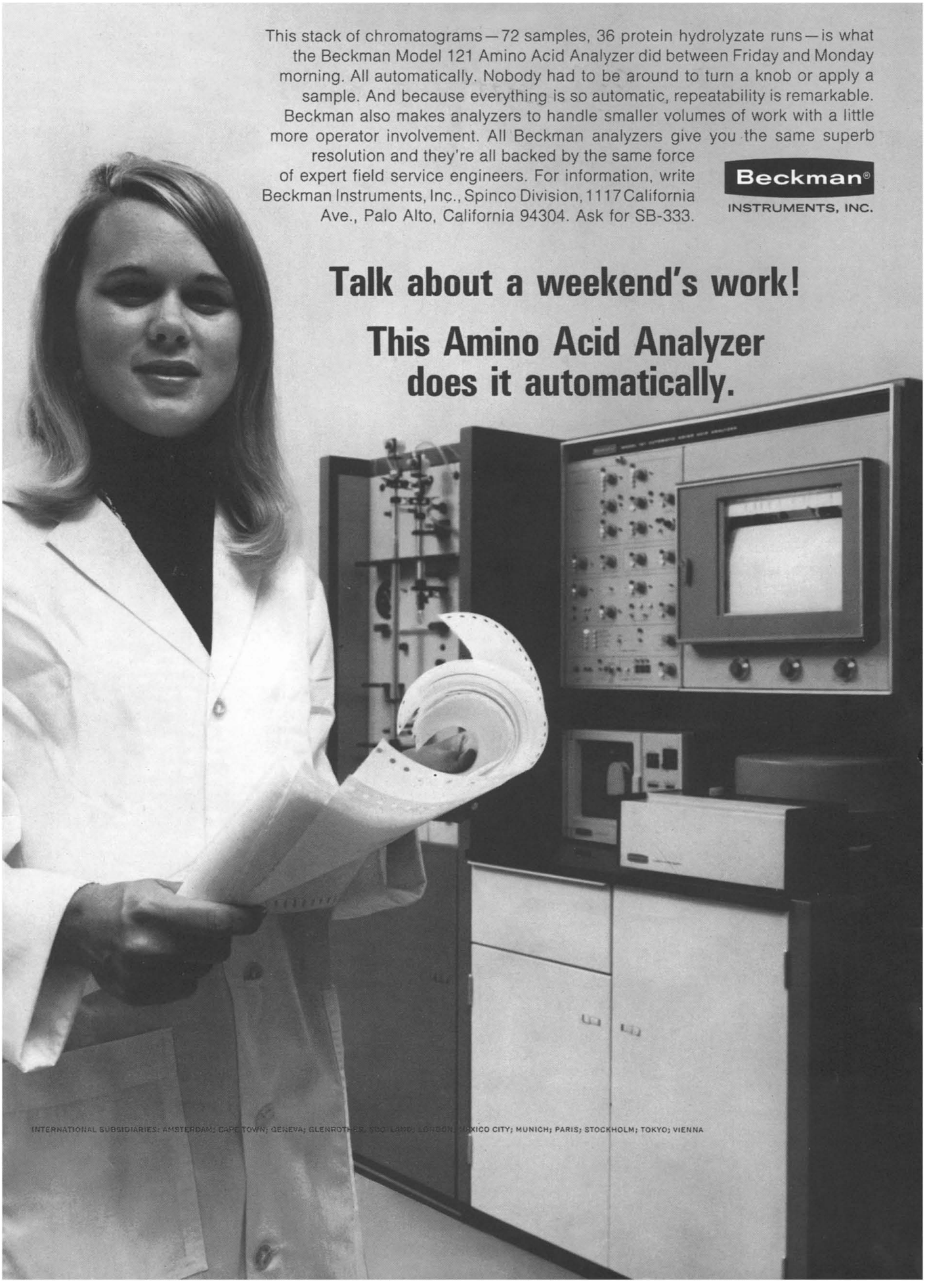
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COVER

Proposed U.S. supersonic transport (SST, Boeing 2707-300). Research in stratospheric meteorology has provided important information for future operational support of this and other supersonic transports. See page 16. [Gary Laurish Photography, Washington, D.C.; model courtesy of Boeing Co.]

Nuclear Power Plants: How Many?

In his letter (7 Nov., p. 686), Hull calls my book *The Careless Atom* "a one-sided picture" of nuclear reactors, and Rossin in another letter (p. 687) recapitulates the usual arguments for nuclear plants, as though the book does not include them. It does. But the title would warn most readers that I am less impressed by these arguments than Hull and Rossin seem to be.

Hull cites "100 reactors in the United States, that operate routinely and dependably." We have heard a lot about these 100 reactors lately, and I am sure there are some utility executives who would like to know where they are. Only 17 civilian nuclear power plants (and one military plant at Hanford) had been completed by the end of 1968, when my book was printed. Of these, five had already been shut down prematurely as impracticable or unsafe; a sixth, the Fermi reactor, was never made to operate properly and finally suffered an accident which took it out of service; a seventh, the Humboldt plant, has operated within allowable radiation release limits only by reducing power output. The remainder have had various degrees of difficulty, and another was shut down this year. Only two reactors have gone into operation since my book appeared, so the situation has not changed very much.

It is therefore not clear what 100 reactors Hull is talking about, but to get such a large number he must be including the various research reactors in use in universities, as well as the reactor experiments conducted by the Atomic Energy Commission. Most of these machines share little but a name with central-station power reactors. One small research and training reactor, not dealt with in my book, caused the only deaths—three—that have occurred in the reactor program so far, but I assume this was not one of the 100 reactors whose operation so gratifies Hull.

In view of the limited operating experience with power reactors, and the failure of about half those constructed, it is hard to evaluate Hull's statistic that such reactors have kept within 1 percent of allowable radiation-release limits. The data he cites indicate that emissions increase over time, and the plants which have operated at all have achieved only a fraction of their expected lifetimes. In any case, the argument is only persuasive if one forgets that the allowable limits are set by the same agency that approves the designs of the plants in question. The standards themselves, not AEC's success in meeting its own requirements, are the source of concern.

The only point on which Hull, Rossin, and I are agreed is that the costs and risks of nuclear power should be weighed against those of other means of power generation. Only open debate will settle the merits of the various approaches that are possible. The recitation of platitudes and irrelevant numbers will not advance the debate in a useful direction.

SHELDON NOVICK

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NAS Collaboration with SSRC

Unfortunately, Walsh's story ("Behavioral and social sciences: NAS report stresses applications," 31 Oct., p. 585) carries a headline which gives the impression that this was a report exclusively of the National Academy of Sciences. Although the joint sponsorship by the Academy and the Social Science Research Council is correctly mentioned in the middle of the article, the reader does not get the impression that this was a truly joint effort in every way.

HARVEY BROOKS

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Drug Detection

We know from testimony given in October in San Francisco before the House Select Committee on Crime chaired by Congressman Pepper that drugs are being diverted in alarming amounts from the manufacturers to illegal markets. This diversion requires, of course, very complex political and social "cures." However, it would help enforcement agencies if drugs were to be tagged at the manufacturing source with minute quantities of harmless isotopes (deuterium, oxygen-17, carbon-13) or with trace elements (zirconium, rare earths) which could be neutron-

activated. The tagging which would be made a legal requirement could be done in such a way that the "code" added elements and quantities would vary from batch to batch. This procedure if followed and buttressed with proper safeguards should interdict domestic drug sources. It may ultimately be applied to foreign supplies by international agreements.

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Planning for PEOPLE

As an economist, I share Dubos' concern ("A social design for science," 14 Nov., p. 823) that the current rate of increase in total world industrial output may be considerably greater than the continuously maintainable or "steady state" rate. Equally important, however, is the fact that, given the present rate of increase in population, even this high rate of increase in total output may not be adequate to maintain the existing level of per capita output. Until the latter problem is solved in such a way that no individual or group is effectively excluded from enjoying some "acceptable" minimum standard of living, solution of the steady state will be impossible. Aggregate equilibrium with internal instability is likely not to be an equilibrum at all!

In support of Dubos' call for new directions in scientific thinking, I suggest that one of the things that administrators and social scientists need most is the cooperation of physical and natural scientists in constructing a "socioecological economics" that can jointly consider the social, ecological, and technical consequences, as well as the purely economic consequences, of proposed activities. Hopefully, such an analytical structure would make it possible to converge over time toward simultaneous solution of the many parts that must be in balance in an eventual steady state.

With luck, such a steady state might even include the continued existence of mankind . . . and the process of seeking it systematically might be called "planning for PEOPLE" (Productive Economic Opportunities in a Pleasant Living Environment).

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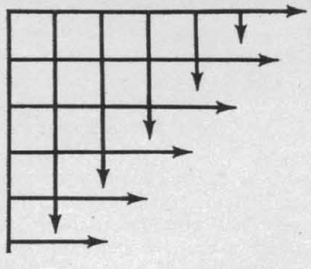

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A Crisis of Crises

In his perceptive and disturbing article (*Science*, 28 November) Dr. John Platt has identified a possibly tragic outcome for the human race, one that could mature during the remainder of this century unless forthright action is taken soon. By presenting the case in probabilistic terms, by invoking the notion of a "half-life"—one that is uncomfortably shortened when various potential crises are considered together—we are left with a sense of inevitability and a question of whether it may be too late for science to contribute solutions. Thus the threat of nuclear escalation can only be solved by men of goodwill and by arrangements that would avoid overreaction to accidents. But it is the character of the problems themselves that places a new kind of responsibility on science.

The most serious problems listed present a common feature: they will be settled principally by political decision, by economic choice, and by the education of people. If such solutions are to be truly effective, however, they must be buttressed by sound knowledge and understanding. It is precisely at this point that the problems that confront us today differ from those that led to the massive scientific efforts during and following World War II. Thirty years ago much of the basic science was available and was used to devise urgently needed technologies; today, much of the requisite knowledge simply does not exist. We know far too little about the interactions that occur within any ecological system. We do not really understand the dynamics of our environment or the effects of technology upon it. We know little about the more subtle effects of pollution. We cannot predict with confidence the behavior of individuals nor that of social groups and institutions. We are not in a position to assess adequately the relative costs and benefits to society of any technology or any course of action. The special crisis that confronts us, as scientists, and that confronts our political leaders, who need and who must support our efforts, is thus one of perspective. We must devote a large share of our work to developing the kind of scientific base that is so desperately needed by mankind today.

In responding to this challenge there are two directions that support of science must take. First, it is of the greatest importance that the nation maintain its strong base of fundamental science. And here the criterion of choice for support must remain one of scientific opportunity uncovered by scientists during the course of their work. Our basic scientific knowledge and understanding form the ultimate source of all that science can contribute to society, and the National Science Foundation must continue to assume increasing leadership in supporting such fundamental investigation.

Second, and this is a new, albeit supplemental, direction for the National Science Foundation, we must devote ever growing effort to the study of the types of problems that Dr. Platt has summarized so well. These problems have a distinctive character. They are essentially multidisciplinary and require the contributions of specialists of many kinds in cooperative endeavors to seek new kinds of solutions. They may also require the formation of new types of research centers and institutes. Here too the National Science Foundation must take the initiative in sponsoring this type of activity.

The time may well be short and the need is certainly great, but so also is the opportunity to put the enormous scientific and technical strength of America to work on helping to shape a constructive and rewarding future for all of us.

—W. D. MCELROY, *Director, National Science Foundation*

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