SCIENCE

29 March 1968

Vol. 159, No. 3822

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Index Issue

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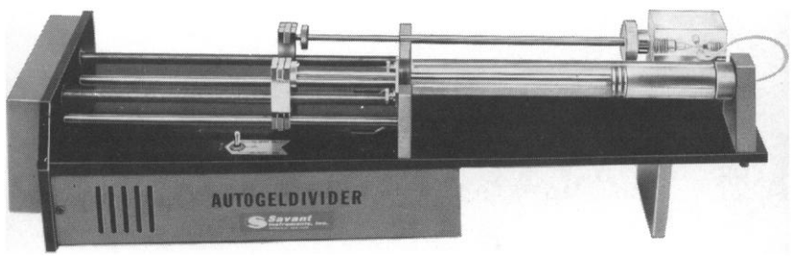

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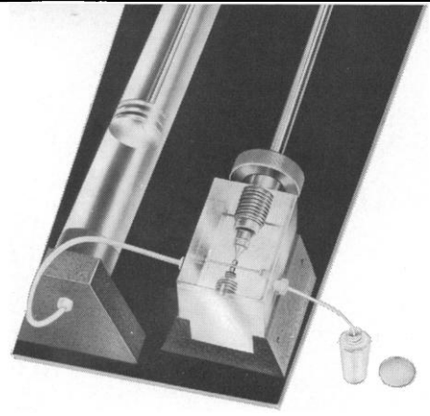

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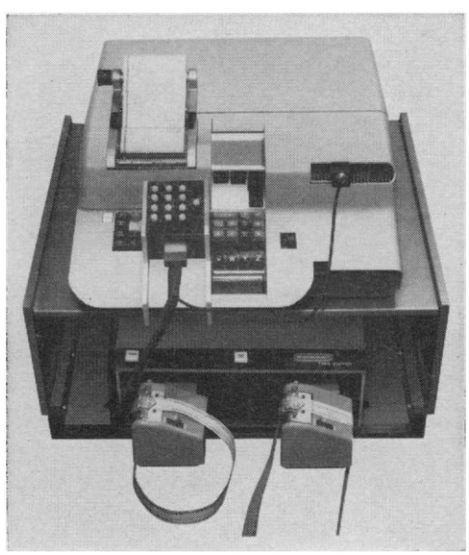

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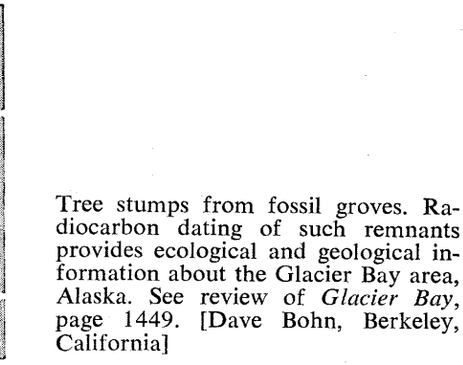

Tree stumps from fossil groves. Radiocarbon dating of such remnants provides ecological and geological information about the Glacier Bay area, Alaska. See review of *Glacier Bay*, page 1449. [Dave Bohn, Berkeley, California]

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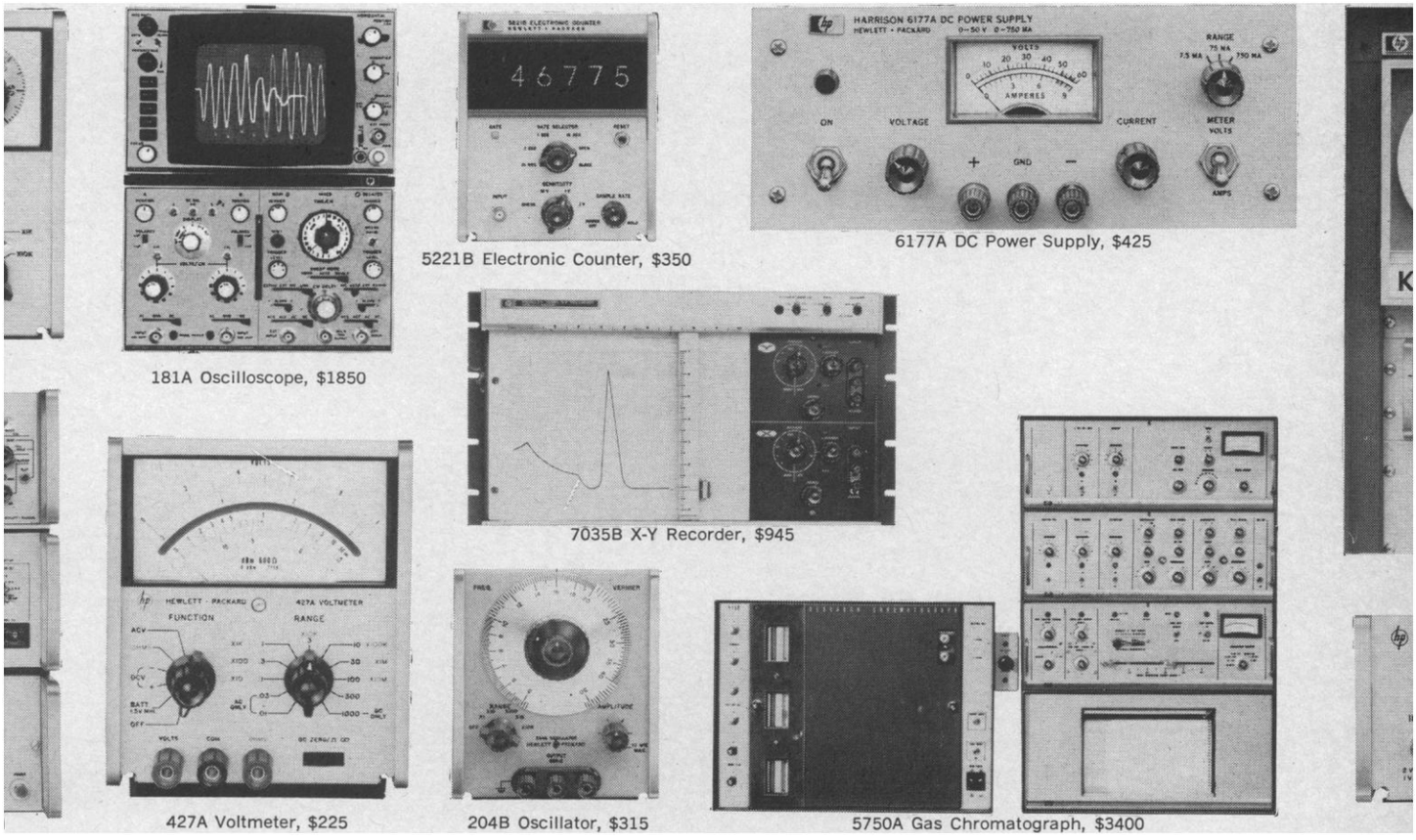

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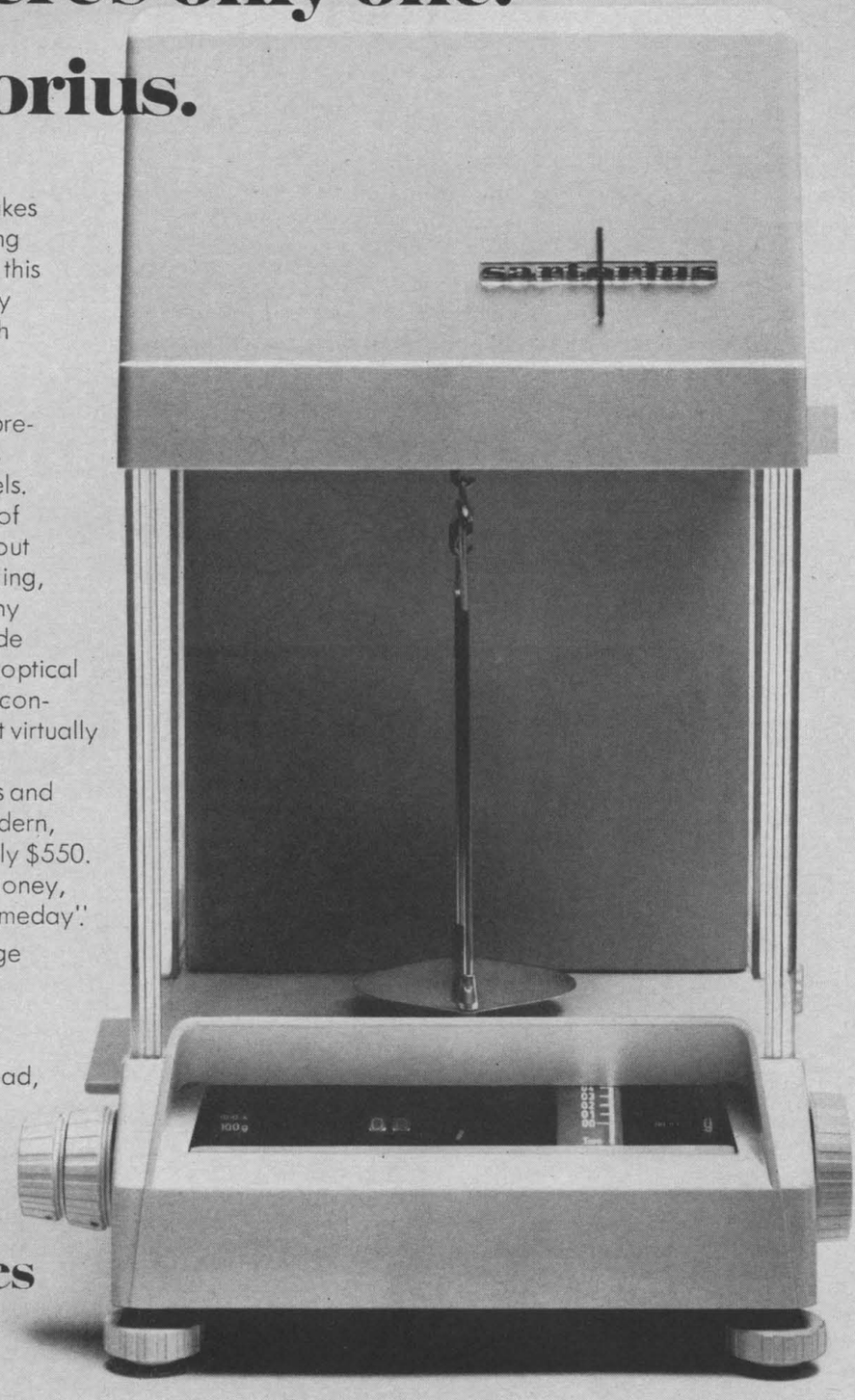

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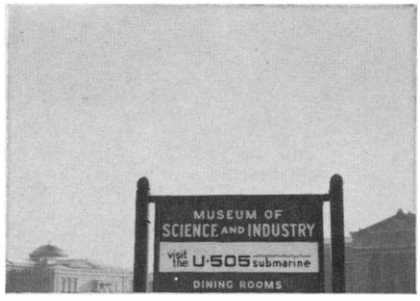

Science and Industry, Romeo and Juliet, ham and eggs—common speech employs certain close associations. Ham *is* good with eggs, Romeo and Juliet *did* feel close, but just how close are Science and Industry today? The question is a live one for young scientists trying to make up their minds which way to go. They wonder whether industry really needs them or just likes to think so.

There was a time when identity of interest between science and industry was widely taken for granted and a time before that when such congruence was a fresh idea. Kodak's history dates back to that olden time. Lord Kelvin—a mighty name in the history of physics—paid us enough attention to take over the vice-chairmanship of our Board of Directors in 1899. The eminent chemist Sir William Ramsay, isolator of the noble gases, persuaded one of his more scintillating students to cast his lot with industry, with the result that the young man became our research director in 1912 and embarked on making color photography as easy and ubiquitous as it is today.

Thus was the house built and the pattern set. To work in the house, a degree in chemistry or physics or in their engineering counterparts has been particularly desirable as a ticket of admission, largely because it is then easy to find useful tasks the bearer can do as he learns what the business is all about.

Paper on which are printed one's personal name and some words of truth has been the ultimate product for only a tiny fraction of the technical people in industry. The percentage shrinks because that's really what the campuses are for, and the campuses are booming with money and people. We cheer and even help.

Still, the scientist who decides to go with us is not renouncing his opportunities to be challenged by his subject. As long as he feels the challenge and responds to it, we have the wherewithal (in both problems and rewards) to keep him happy. **Here's the sneaky part, though:** if when looking inside himself 5, 10, 15 years later he discovers that he is less interested in the subject than he had thought he was, the bottom doesn't fall out. We count, in fact, on that to happen in most but not all cases. That's how we get the people who run the house, joining on an equal footing those who had felt nonacademic from the start. That's also the process that makes room for fresh talent from the campuses.

The process ought to be more widely understood.

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If color slides from 135- or 120-size film constitute serious business for you, buy a supply of a new item which the Kodak dealer has just laid in: KODAK Special Processing Envelope for KODAK High Speed EKTACHROME Film. Then, when you encounter a situation that makes you wish that this fastest of Kodak color films were yet 2½ times as fast, the special processing envelope will make it so. You may be unable to detect any sacrifice in quality. We make film and do processing on the assumption that you turn to color photography not just to relieve the monotony of black-and-white but to re-create more accurately the perceptions engendered on viewing the subject.

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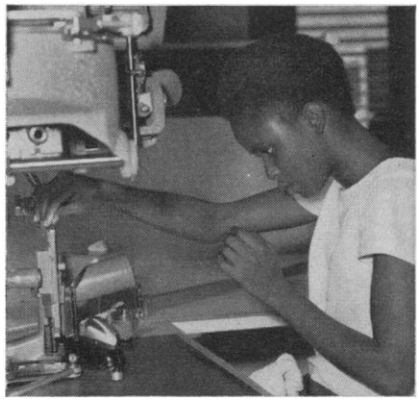
—and a minor in Photo-Interpretation



United Nations

When setting off to the isle of Jamaica for some fun, forget about looking up the place where this picture was taken. The establishment is supposed to improve the quality of life on the island. That's no fun.

Ruth Masters is working here with aerial photography. The United Nations is helping the citizens of Jamaica learn to use it more effectively both for mapping and for "P.I.," which is a military term. Photo-interpretation, a fallout from the art of war, is now rapidly moving into a new phase. People are getting into it who know nothing about war. They operate on the understanding that objective study of the physical environment must guide improvement of the economic, social, and psychological environments. Yet what's good economically may be bad for the body or the spirit, whether or not your choice in theologies tells them apart. The physical world does matter.

There is a citizen of Norway at the U.N. Secretariat in New York who argues that peaceable photo-interpretation should now drop its guise as a separate craft, that students preparing themselves to serve in fields from political science to limnology, from geology to anthropology, need firsthand knowledge of photo-interpretation if they are to do a better job for humanity, including themselves.

The man may be addressed as follows:

Chief, Cartography Section
Resources and Transport Division
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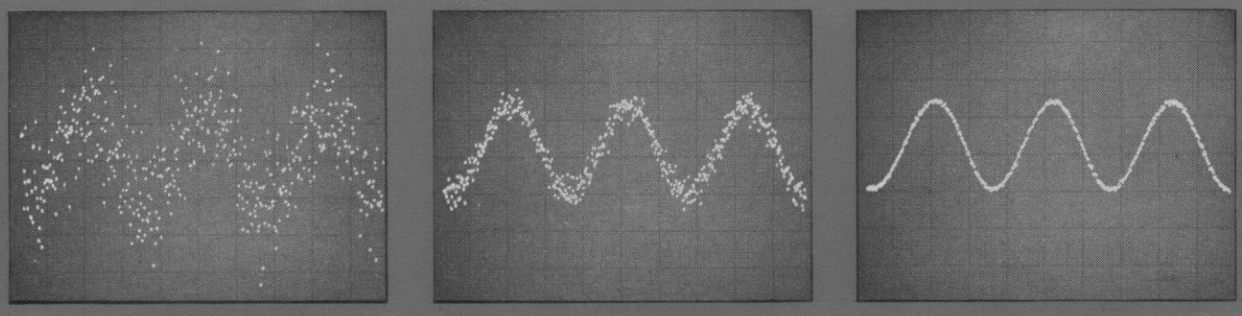

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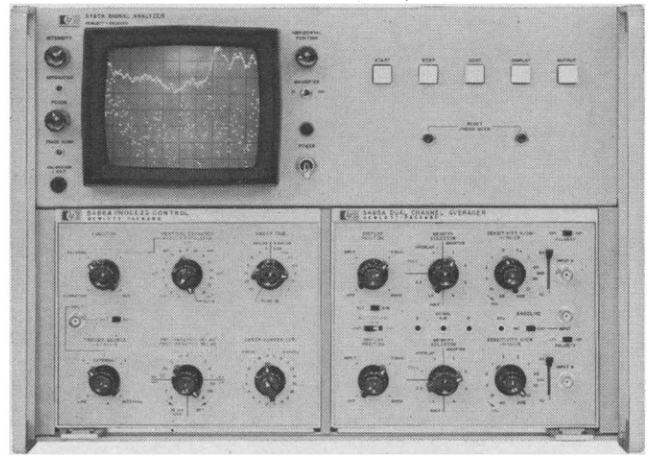

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SIGNAL ANALYZERS

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sample and results were extrapolated. Our article stated that 12 robins was an average of many counts within these study areas, not a single count of 12 robins as Jukes inferred. The potential inaccuracies of extrapolation are quite evident to any scientist, which was why we used the process only as a "rough estimation." Major conclusions were not based on the accuracy of this extrapolation in any event.

Jukes has erected, then demolished, the abominable straw man of robin extinction. We never mentioned this point however, nor have other scientists. While treatment of elms has killed millions of robins, high reproduction rates, increased habitat (suburbia) and decreased predation all contribute to rising robin populations. DDT does contribute to substantial population declines among many other avian species, however (*3*). Jukes's is an example of the kind of thinking that concludes all is well with pesticides as long as there is food on our tables and robins on the lawn.

CHARLES F. WURSTER, JR.
Department of Biological Sciences,
State University of New York,
Stony Brook 11790

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2. D. H. Wurster, C. F. Wurster, W. N. Strickland, *Ecology* **46**, 488 (1965).
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Federal Animal Care Projects

Cohen's report on the evaluation of animal care programs by the American Association for Accreditation of Laboratory Animal Care (Letters, 29 Dec.) should be encouraging to all who believe that peer evaluation within the scientific community can be successful. With the introduction of the Javits-Rogers bills (S. 2481, H.R. 13168), this concept and all issues regarding research-animal care will be increasingly debated.

The debate will probably cause some to inquire about current federal efforts to improve care and treatment of research animals. The Department of Agriculture's role through enforcement of PL 89-544 has certainly been significant in "persuading" some institutions to improve their animal care programs. Other federal agencies contribute through exemplary "in house" animal programs and research on animal care problems.

The National Institutes of Health has a program to assist institutions in meeting their requirements for research-animal resources. This project grant program may support a variety of activities for improvement of animal resources and animal care programs. The projects range from highly specialized unique colonies of research animals to programs for improving the facilities, the scientific medical management of institutional animal colonies, and training programs for specialists in laboratory animal medicine. The program further supports projects for elucidating new model animal systems for more efficient and effective research into human health problems.

As more and more scientific institutions and their investigators recognize the significant contributions that can be made by the use of the correct animal model, properly cared for, we can expect even greater benefits than heretofore realized from animal research.

LOWELL E. WHITE, JR.
School of Medicine,
University of Washington, Seattle

Interstellar Travel

Although I endorse "Clarke's Third Law" (Letters, 19 Jan.), I challenge his statement that "any really competent extrapolation shows interstellar travel to be a rather simple engineering accomplishment."

An eminent practitioner of space vehicle design, Maxwell W. Hunter II, concurs with Clarke that fusion propulsion holds great promise for interstellar space ships capable of traveling at fractional speed-of-light velocities (*1*). However, he underscores the incomprehensible energy requirements necessary to propel spacecraft of realistic sizes. These demands would be measured in proportions of the total power output generated by the sun. Accordingly, the radiation-shield requirements, which compound the hazard of inadvertently vaporizing the manned spacecraft itself, appear to pose formidable problems based on any materials or cooling techniques known today. Further, each pound of spacecraft mass would necessitate initial space vehicle weights, which can be measured only in terms of significant fractions of the earth's total weight. Associated with

these masses are the enormous thrust levels required for mandatory accelerations (a minimum of 1g from the orbit of the earth), for acquiring partial-light velocities in order to maintain practical acceleration-deceleration and realistic transit-time spans; that is, within a human lifetime. Moreover, techniques for magnetic containment of stabilized self-sustaining fusion reactions constitute a monumental engineering challenge.

Additionally, travel at even quasi-relativistic velocities would produce contingent cosmic ray fluxes, as the starship impacts the widely dispersed atomic particles of interstellar space. As a further sociological obstacle, the implications of time dilation phenomenon may not prove fully acceptable to either the flight crew, or to their earth-bound families.

Conversely, the promising specific impulse magnitudes (in hundreds of thousands of seconds) and the impressive characteristic velocity capabilities (in millions of feet per second), make fusion propulsion and mass-annihilation rockets the most attractive candidates for the distant future. However, the estimates of $11,000 per kilo of helium-3, coupled with the $275 per kilo of deuterium (heavy hydrogen) fuel, are totally inconsistent with the current budgets for lunar and planetary exploration. For purposes of comparison, today's liquid oxygen-kerosene rocket propellants cost 4.4¢ per kilo. Such fusion propellant costs appear to suggest that this human technological accomplishment is, indeed, two or three hundred years post-Apollo! Nevertheless, it is encouraging to discover that the national space agency is sufficiently far-sighted to sponsor "token" analytical efforts on fusion rockets. In an engineering paper titled "Fusion propulsion for interstellar missions" presented in November 1965 at a New York Academy of Sciences conference, Dwain F. Spencer reported on research conducted by JPL-California Institute of Technology under NASA contract No. NAS 7-100. How long must man's long-range space objectives be postponed until this type of vital exploratory research is again seriously sponsored by any federal agency?

PHIL BONO
Space Systems Center, Douglas Aircraft Company, 5301 Bolsa Avenue, Huntington Beach, California

Reference

1. M. W. Hunter II, *Thrust Into Space* (Holt, Rinehart & Winston, New York, 1966).

29 March 1968, Volume 159, Number 3822

SCIENCE

The Science Establishment: Where Is It Headed?*

The Eisenhower and Kennedy years were particularly good ones for science support. Government research and development expenditures increased by an average of 15.1 percent during the Eisenhower administration, and 16.6 percent during the Kennedy years. Under President Johnson the percentage has continued to increase, but only at a 3-percent annual average, which is less than the cost-of-living escalation. Particularly significant is the current fiscal year, which actually saw a percentage decline in federal R & D money of 1.2 percent. For next year, the total is up 4.6 percent, to $17.3 billion, about 11 percent of the overall federal budget. It is to be noted that R & D's percentage of the total budget has been declining slowly but steadily since President Johnson's first budget in fiscal year 1965.

But percentages and even money totals alone fail to reveal three other significant trends in federal R & D spending: (i) whereas formerly the bulk of the money was spent by the Pentagon and NASA, now more than half of the R & D funds are controlled by other agencies; (ii) whereas previously the share for social sciences was negligible, the fiscal year 1969 budget boosts it to $238 million; (iii) whereas basic research claimed a lion's share in the past, the fiscal year 1969 budget puts an increasing emphasis on applied research. On the other hand, spending by NIH increased by only 1 percent, with an Administration directive to put more emphasis on improved patient-care techniques and less on long-range research.

What has caused this leveling off and change in emphasis of federal R & D spending? My three answers are these. First, the heavy financial cost of the Vietnam war is draining our resources and manpower. Its consequences are felt in every corner of this country, and they increase day by day. The public's love affair with science was cooling anyway, but there is no doubt that the added impact of the war has accelerated the process. Second, events in recent years have focused attention on the neglected problems of our domestic environment. In response to public demands, both the President and Congress want more direct and visible results from R & D dollars. Such things as pollution control, faster and safer transportation, better housing, and crime control now are at the top of the priority list. Third, there seems to be a new emphasis on achieving national goals through R & D, and considerably less concern about the acquisition of knowledge for its own sake. Such concepts as world leadership in science are rather nebulous to the average citizen as compared with immediate social and political goals.

What can the scientific community do about this? I believe it must go back to the equation PE = PM—public esteem equals public money—and consciously rekindle some of the public's former affection for science. The scientific community should take greater pains to make clear that its efforts contribute directly and indirectly to the public good. Research priorities should be adjusted, whenever possible, to the public's priorities. The public should be reminded ceaselessly of scientists' vital contributions to national security. There is no function more appropriate for the federal government than that of providing for national defense. And the scientific community should face the problem of cost cutting as it relates to getting rid of self-perpetuating, outmoded activities and as it relates to consolidation of federal science effort.—CRAIG HOSMER

* Adapted from remarks by Craig Hosmer, ranking House Republican member of the Joint Committee on Atomic Energy, at the Neutron Cross Sections and Technology Conference, Washington, D.C., 5 March 1968.

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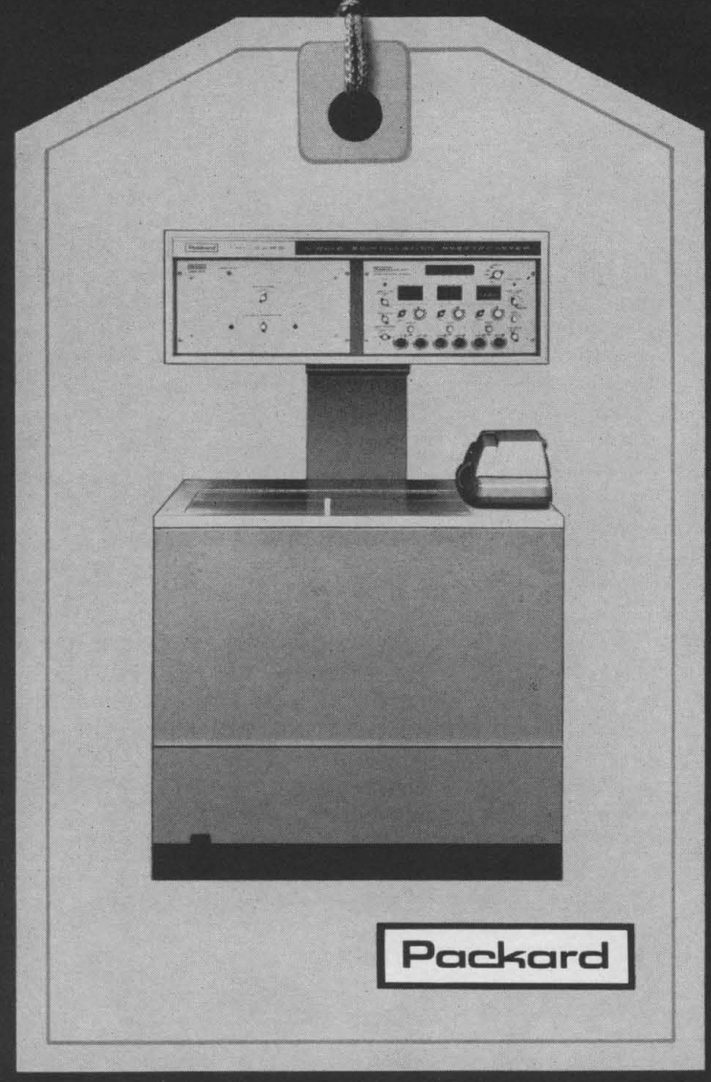

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