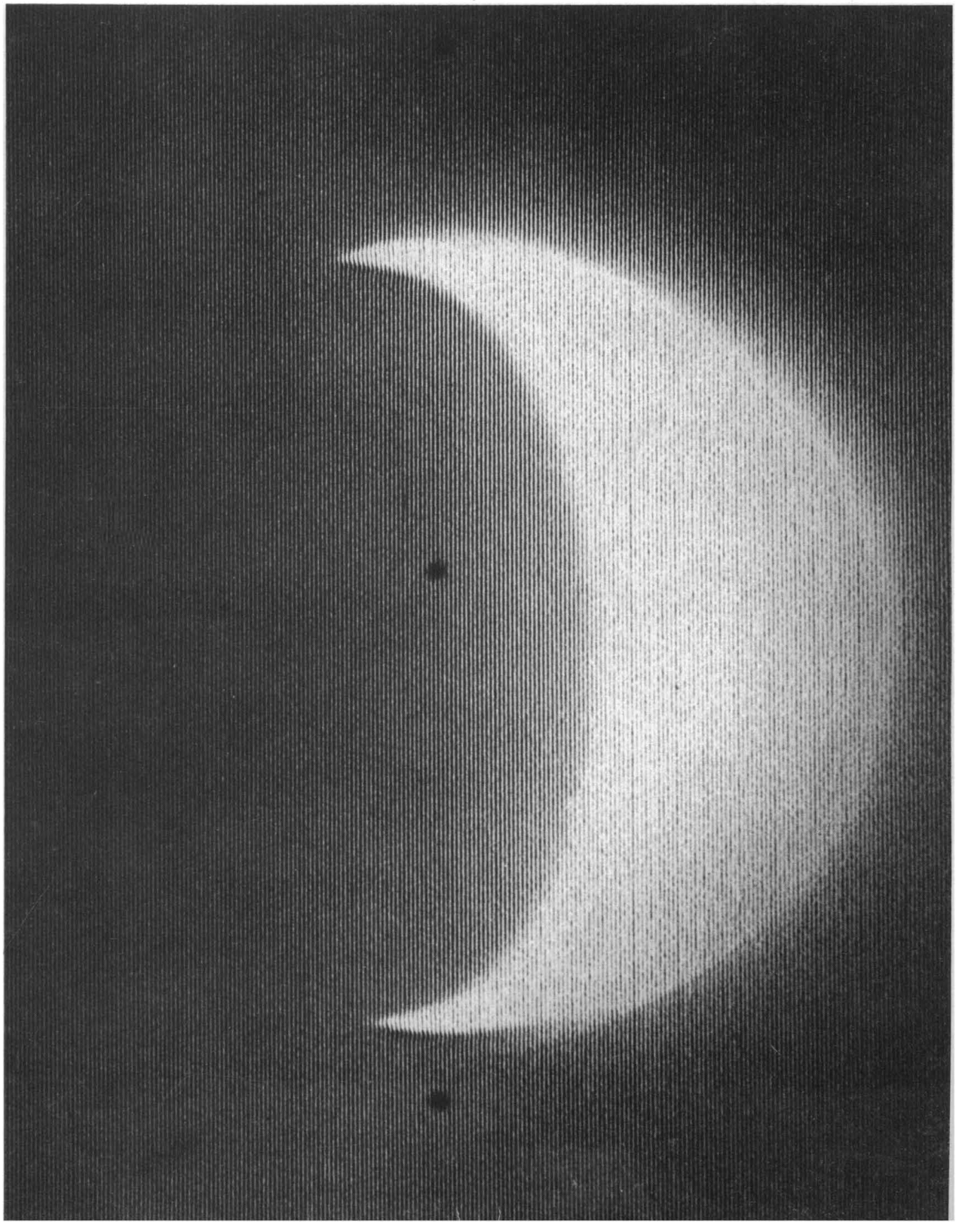
SCIENCE

16 May 1969
Vol. 164, No. 3881

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Western Electric
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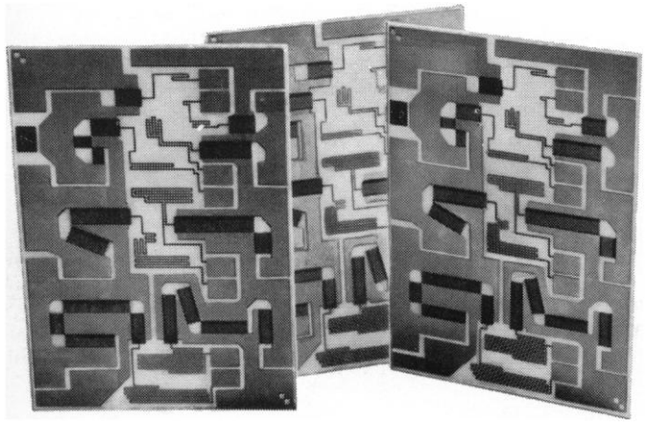
AN EQUAL OPPORTUNITY EMPLOYER

The squares in question are the ceramic bases for the thin-film integrated circuits made at Western Electric's Allentown Works. The plates from which these bases are made have to be scored so they can be separated quickly and easily into bases of appropriate size.

Until, recently, this created two problems. First, each different scored shape (and there are many) required a separate, expensive die. Second, this scoring had to be performed before the ceramic was fired. And since ceramic shrinks when it's fired, some lines which started out straight became crooked, ruining the scored pattern.



We decided that scoring the plates with a laser might prove effective. A serious challenge in this area involved the control of the laser beam itself. Precise control over the powerful beam—getting it to cut only a fraction of the way through the ceramic plates, for instance (and the *correct* fraction at that) —had not been achieved by any other manufacturer up to that time, to the best of our knowledge.

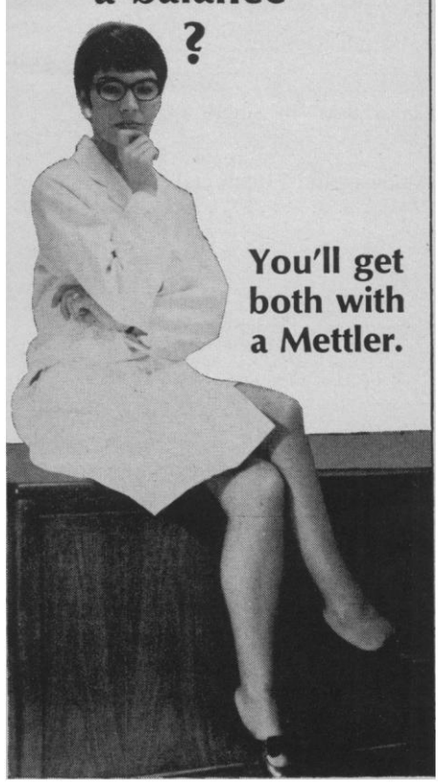
By using a digital control console to control the laser, we were able to control the pattern it cut with great precision. A pre-punched tape was fed into this console. This, in turn, controlled the path taken by the movable base holding the plate under the beam, while the laser itself remained stationary. This device is faster and more flexible than manual control; since tapes are used instead of dies, the cutting shapes can be changed in seconds.

Because the laser cuts tiny holes part way through the ceramic, our "squares," if you'll pardon a play on words, are made out of "circles."

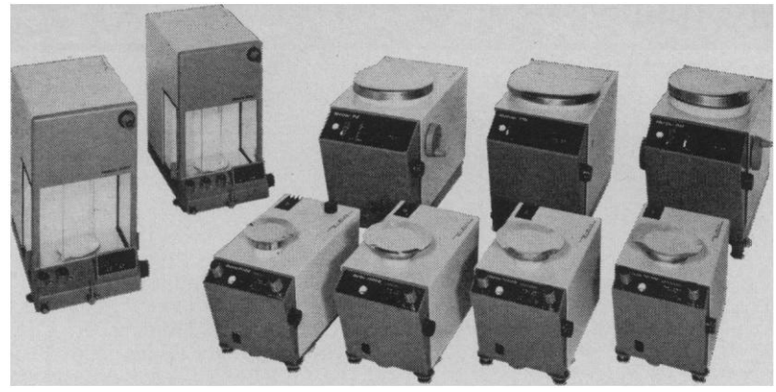
Like most Western Electric manufacturing innovations, the use of the laser beam has resulted in higher-quality telephone equipment at low cost to the Bell System.

We hitched a laser to a computer to make squares out of circles.

Why choose between economy and performance when you buy a balance ?



You'll get both with a Mettler.



Want weighing performance, but worried about exceeding your budget? Here are 38 solutions to the balance buyer's dilemma. Mettler's 16 top-loading and 22 analytical balances.

SPEED + PRECISION = PERFORMANCE

Our top-loaders are tops when it comes to speed and weighing ease. Put the sample on the pan. Then read the weight. If you are filling a container to a target weight, Mettler's helpful filling guide shows the approximate weight on the pan throughout the filling . . . without interruptions.

Newest of the Mettler top-loaders is Model P162. It weighs up to 160 g with a precision of ±1 mg and features 10-g taring ability. Like other Mettler top-loaders, it provides digital and analog readout. Your new personnel will get the same precise results as the old hands in the department.

MANY TO CHOOSE FROM

Select the balance you need for your work from one of our top-loaders. We have one that weighs to 10 kg; another that takes arithmetic out of weight loss studies. Some automatically compensate for changes in level. All will carry out five types of weighings. Weighing unknowns. Check-weighing. Weighing-in. Batching. Weighing objects below the balance.

THE ECONOMICAL ANALYTICALS

One of the major features of all Mettler analytical balances is the impressive precision-capacity ratio. Take our low-cost Model H10. It weighs to 0.1 mg over the 0 to 160-g range. That's one part in 1,600,000.

You get two balances for the price of one with our Mettler Model H20. It combines the capacity of a macro analytical with the precision of a semi-micro. Some Mettler analyticals give an instant reading of the approximate weight on the pan. We call this feature preweighing.

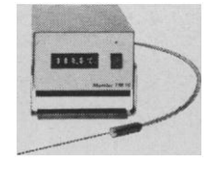
WEIGHT WATCHING MADE EASY

With digital readout — standard on many Mettler analyticals — you'll weigh with unsurpassed speed, convenience and accuracy. A filling guide cuts your weighing-in time by 50 percent. Optical taring allows you to compensate for container weights.

Need clearly printed records of your weighings? Check our Models H10P and H20P which print out results on adhesive-backed paper. Then there's our sophisticated H20E electronic. As it weighs, it generates an analog signal which can be fed to compatible instrumentation such as recorders. The H20E can also be interfaced with computer or other control equipment to continuously monitor and keep weight changes within predetermined limits.

There are more: from our $550 basic balance that's ideal for classroom use to our $2,550 ultra-micro with ±0.1 microgram precision.

When is a Mettler NOT a balance?



When it's our TM 15 digital platinum resistance thermometer. Portable and precise, it provides absolute accuracies up to ±0.15°C over the −20 to +300°C range. The sensors may be changed without recalibration and provide a linear output to other instruments.

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16 May 1969
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SCIENCE is published weekly on Friday and on the fourth Tuesday in September by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW Washington, D.C. 20005. Now combined with **The Scientific Monthly**10. Second-class postage paid at Washington, D.C. Advancement of Science. Annual subscriptions $12; foreign postage: Americas $3; overseas $5; single copies, 50¢ (back issues, $1) except **Guide to Scientific Instruments**, whic is $2. School year subscriptions: 9 months, $9; 10 months, $10. Provide 4 weeks notice for change of address, giving new and old address and zip codes. Send a recer address label. SCIENCE is indexed in the **Reader's Guide to Periodical Literature.**

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Crescent earth televised from the moon by Surveyor VII spacecraft. See page 774. [National Aeronautics and Space Administration]

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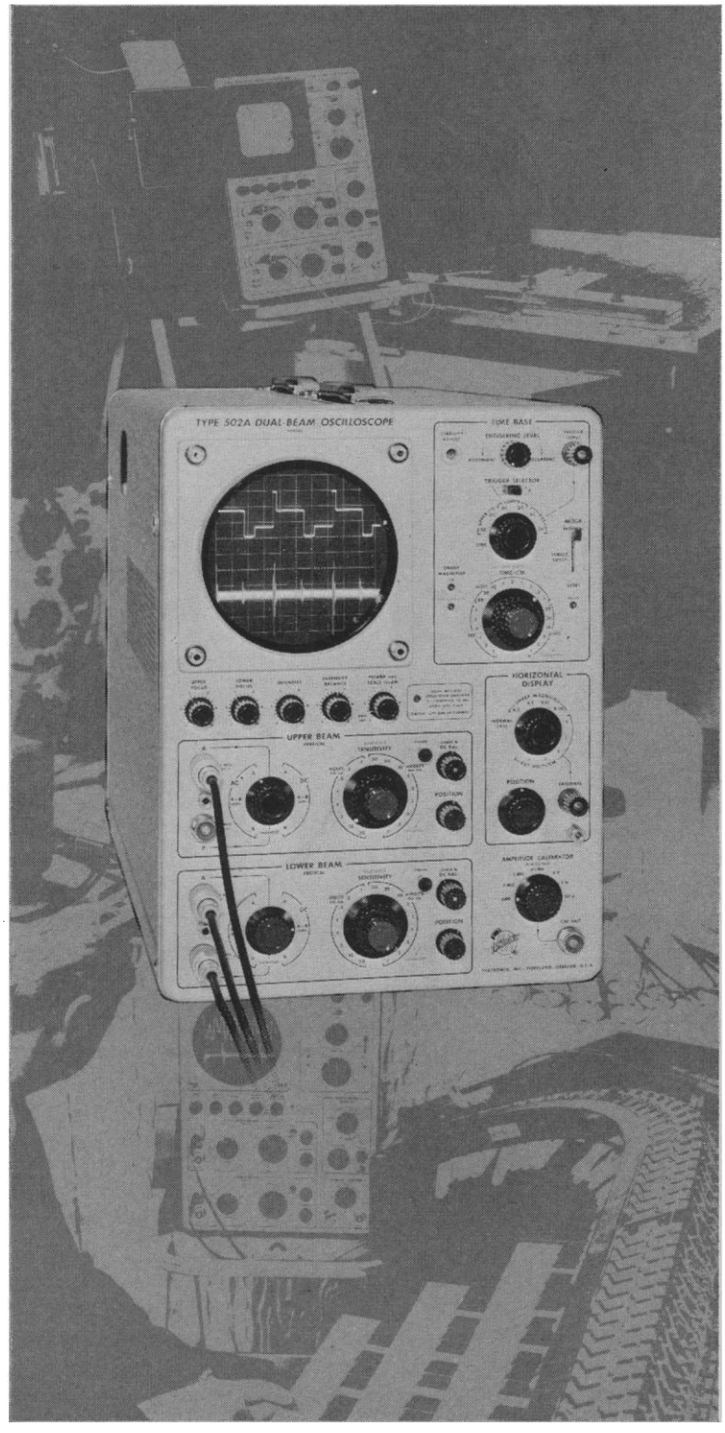

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In a number of sessions, some information was presented on slides. Authors should be contacted directly for copies. Because of a serious epidemic of influenza at the time of the Dallas meeting, a few of the contributions were not given by the originally announced authors.

Tapes are sold as self-contained, half-day sessions. They can be purchased as conventional open reels (3¾ inches per second speed) that can be played back on any conventional audiotape player, or as cassettes for playback on a cartridge player. Each half-day session is identified, for ordering purposes, by a number ("1/68," "2/68," and so on). An order form is at the bottom of this page.

Acknowledgment is made to Ampex Corp. for assistance in recording and distribution and to WAMU, American University, for aid in editing.

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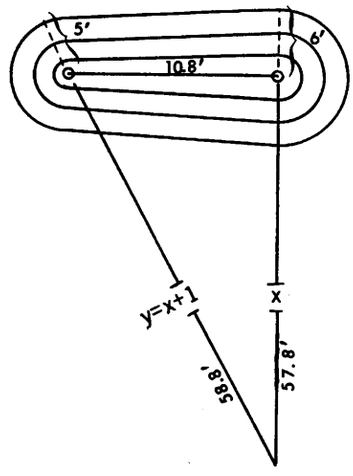
10.8 feet, 57.8 feet, and 58.8 feet (see computation). On Mondays when it is not raining, she also hangs her wash on the clothesline connecting the two posts, creating a truly beautiful spectacle.



$$y + 5 = x + 6$$
$$y = x + 1$$

$$y^2 = x^2 + (10.8)^2$$
$$(x + 1)^2 = x^2 + (10.8)^2$$
$$x^2 + 2x + 1 = x^2 + 116.64$$
$$2x = 115.64$$
$$x = 57.8$$

MICHAEL P. FROMAN
913 36th Avenue,
Tuscaloosa, Alabama 35401

Frogs and Humans

With regard to the report "Bullfrog (*Rana catesbeiana*) ventilation: How does the frog breathe?" (14 Mar., p. 1223), frogs breathe exactly the way that people do who, having lost most of the use of their intercoastal muscles and diaphragm, perform what physicians have long called "frog breathing."

FRANK COLE
Lincoln General Hospital,
Lincoln, Nebraska 68502

Odoriferous Ancient Lamps

Four hundred years before Pliny, Aristotle wrote: "Mares miscarry at the scent of an extinguished lamp; this happens also to some women." This is the probable source of Pliny and others who make the same remark (Letters, 21 Mar.) . . . Montagu will find out about lamps if he plows on through the *Natural History*. The ancients preferred clear olive oil for lighting, but burned anything they could, including castor oil and tallow. The wicks were of any capillary material—papyrus waste, rope, and wool were used, and the wick might contain sulfur to help it catch. There were many nauseous possibilities. . . .

KIFFIN A. ROCKWELL
Department of History, Northern Illinois University, Dekalb 60115

University Gains from Federal Research

A realistic discussion of the indirect costs of project grants should include a consideration of the indirect benefits that the institution derives from such projects. In his examination of the Mansfield Amendment, Pettit states that the university is not the grantee ("Congress, confusion, and indirect costs," 21 Mar., p. 1301). According to the Public Health Service a grantee is "the university, college, hospital, public agency, or nonprofit research institution. . . ." (*1*). Some principal investigators who have transferred to another institution have experienced the truth of this definition and have found it very difficult or impossible to obtain institutional release of equipment purchased with funds awarded for their projects, even if these projects are active and are to be continued in the new institution. I submit that such equipment may certainly be regarded as an indirect subsidy, since accountability is usually waived and title is customarily vested in the original grantee institution. This is not the only or the most important of the indirect benefits that accrue to grantee institutions because of the federally supported research and training activities of their principal investigators or program directors. It is at least a defensible argument that the benefits thus received by the grantee institutions roughly compensate them for their contribution to the indirect costs of those activities. This, in fact, may be one reason, as important as academic competition, why universities have not agreed to refuse grants or contracts providing what they consider only partial reimbursement of indirect costs.

ANTONIO E. COLÁS
University of Wisconsin Medical School, 1300 University Avenue, Madison 53706

Reference

1. *U.S. Public Health Serv. Publ. No. 1301*, rev. 1967, p. 2.

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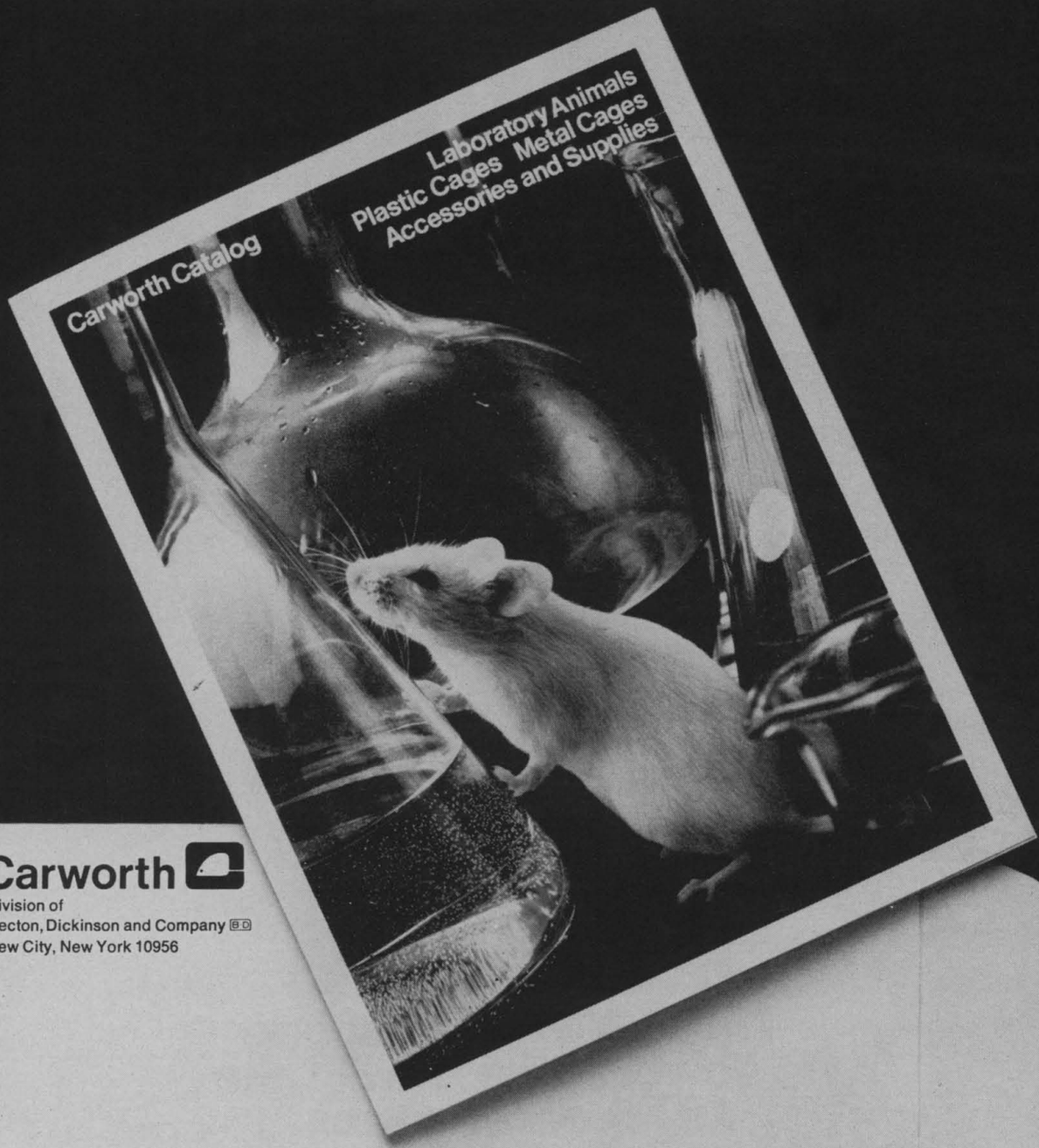

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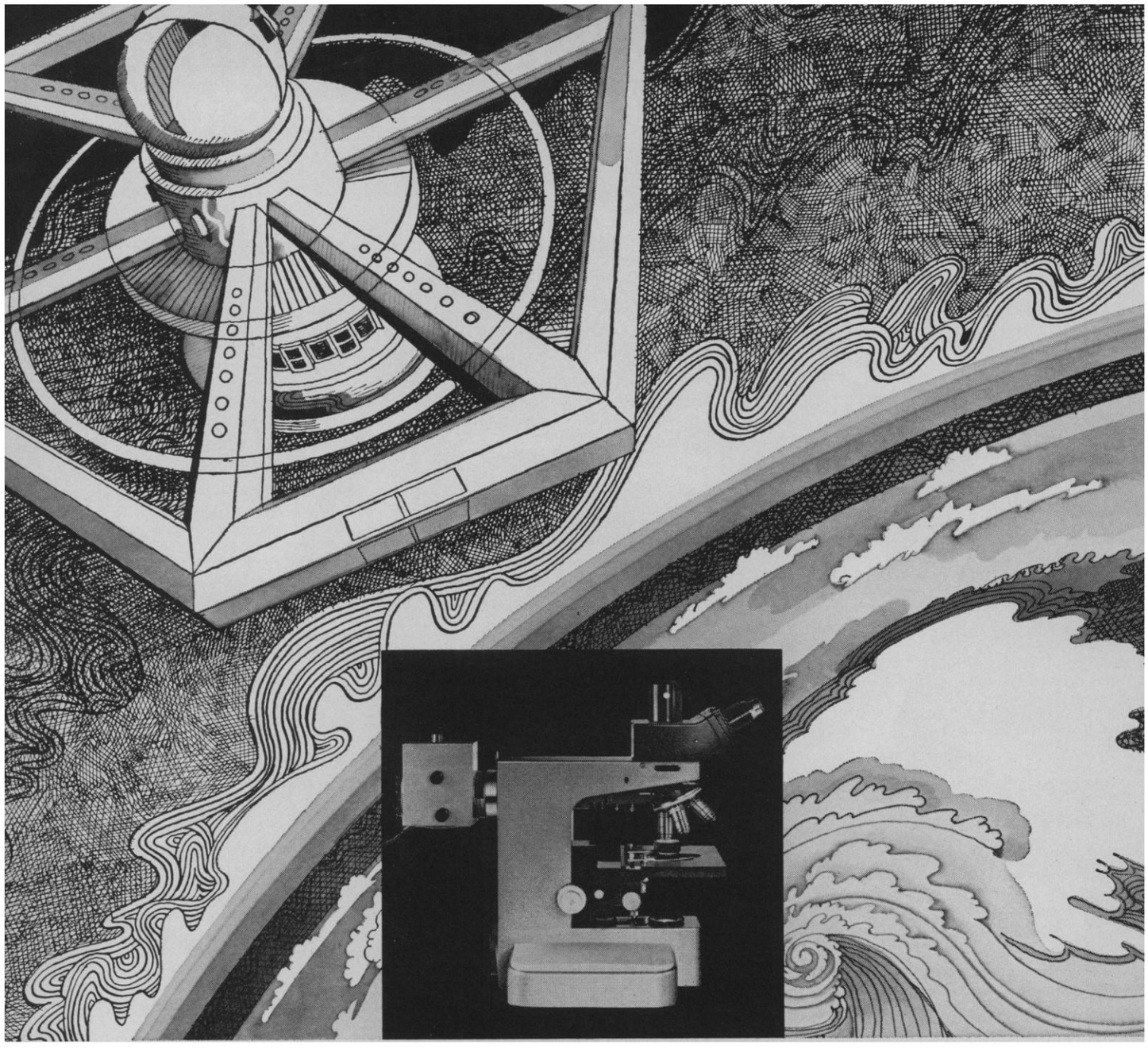

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16 May 1969, Volume 164, Number 3881 **SCIENCE**

Changing Research Emphasis

Faculty members are being accused, by themselves and by others, of devoting too much attention to their individual scholarly interests and too little to the big problems that worry the world and the nation. Scientists are increasingly concerned over the uses to which their findings are put and over their own responsibility for the ways in which new knowledge is exploited. Some academic leaders are asking how the universities can take a more effective role in analyzing and helping to solve some of the large social problems.

The values and attitudes being challenged will not change easily, for the traditional academic emphasis on individually chosen problems of research and scholarship is part of the concept of academic freedom, is widely judged to be the most effective way of advancing knowledge, and has been strongly reinforced by extensive federal use of individual grants, each judged by a group of the applicant's peers. Not only in science departments but in the professional schools as well, the highest prestige has often gone to fundamental research and individually selected studies rather than to work on practical problems and collectively determined areas of investigation.

Nevertheless, a change now seems likely. The force of money will push in the same direction as the growing concern over social issues, and will tend to increase the percentage of the total R & D effort that is centrally or collectively planned and to decrease the percentage individually and locally planned. The social and environmental problems that are high on the national agenda require concerted, large-scale work, and, increasingly, basic research does too; no one can now construct his own accelerator, atmospheric research laboratory, oceanographic vessel, urban renewal project, national collection of social statistics, or other expensive research tool or facility.

Some private foundations have decided that work on the large problems is the order of the day, and an analysis by the Battelle Institute* of trends in federal financing shows a government shift in the same direction. The authors analyzed federal expenditures from 1961 through 1969 for 12 functional areas, such as health, national security, and housing and community development. They also took account of the 1968 Republican and Democratic party platforms, the actions and expressed intentions of the 90th Congress, and other indicators of the trends of the coming decade. Two conclusions emerged most strongly.

1) Functional areas which have had a large research and development component—such as national security, health, and education—will have a relatively smaller part of their total budgets for R & D in the years ahead, and those which have had a relatively small R & D component—such as transportation, communications, and community development—will have a larger share for research in the future.

2) In comparison with the R & D funds each area has had in the recent past, the most rapid future growth can be expected for welfare; health; commerce, transportation, and communications; labor and manpower; housing and community development; and natural resources and the environment. Growth will be smaller, or negative, in funds for R & D in the areas of national security, education and knowledge, space, and agriculture.

Budgetary trends by themselves will not suddenly change academic values, but they are important signs of a growing demand for concerted work on the big problems of society. If the universities do not move with this trend, other agencies will carry out the necessary research.

—DAEL WOLFLE

* Leonard L. Lederman and Margaret L. Windus, *An Analysis of the Allocation of Federal Budget Resources as an Indicator of National Goals and Priorities* (Report No. BMI-NLVP-TR-69-1 to the National Aeronautics and Space Administration), Columbus, Ohio, 10 February 1969.

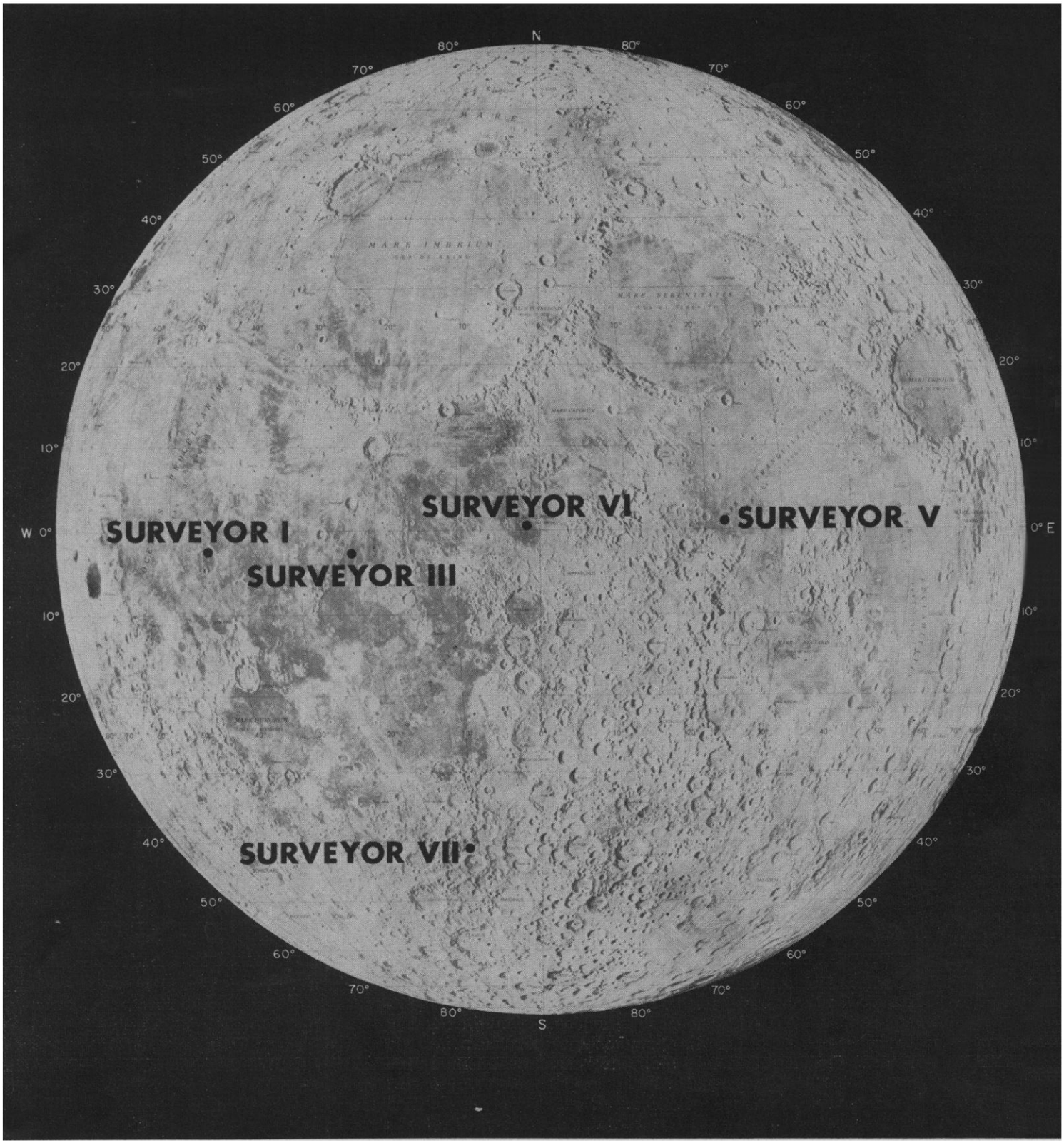

Fig. 1. Surveyor landing sites. Surveyor 1, touchdown 06:17:36 U.T. 2 June 1966 on level mare floor of Flamsteed ring in southwest part of Oceanus Procellarum [inertial coordinates from on-surface tracking (*36*) 43.32°W, 2.46° to 2.50°S; selenographic coordinates, Atlas/ACIC system from surface features (*37*) 43.23°W, 2.46°S]. Data transmitted until 07:30 U.T. 7 January 1967; 10,341 pictures were taken the first month, 899 the second. Surveyor 3, 00:04:17 U.T. 20 April 1967 on wall of 200-meter crater in southeast part of Oceanus Procellarum (23.32°W, 3.06°S; 23.34°W, 2.99°S). Data transmitted until 00:04 U.T. 4 May 1967; 6326 pictures returned. Surveyor 5, 00:46:42 U.T. 11 September 1967 near top of crater (9 by 12 meters) in southwest part of Mare Tranquillitatis (23.20°E, 1.42°N; not located in Atlas/ACIC system). Data transmitted until 04:30 U.T. 17 December 1967; 18,006 pictures returned the first month, 1048 the second, and 64 the fourth. Surveyor 6, 01:01:04 U.T. 10 November 1967 on level mare area, near mare ridge in Sinus Medii (1.37°W, 0.46°N; 1.39°W, 0.51°N). Data transmitted until 19:14 U.T. 14 December 1967; 29,952 pictures returned. Surveyor 7, 01:05:36 U.T. 10 January 1968 on hilly highland on flank of Tycho rim (11.44°W, 40.97°S; 11.45°W, 40.88°S). Data transmitted until 00:24 U.T. 21 February 1968; 20,993 pictures returned the first month, 45 the second.

sure is promising in this regard although the effects thus far studied are rather small. For example, the dT/dP slope of the Curie temperature curve for nickel is 0.35°C per kilobar. Other materials, such as ferrites, may show larger effects.

New developments in shockwave research now permit a derivation of the fusion curve (P versus T) of copper extending into the million-bar range. When combined with accurate measurements of temperature and pressure in the static high-pressure range (1100° to 1300°C and 0 to 60 kilobars) the fusion curves of several substances, such as copper, silver, and others, could be used for *in situ* checking of calibrations of high-pressure, high-temperature apparatus. However, in a broader perspective, accurately determined fusion curves may permit solution of some rather fundamental questions in geophysics and astrophysics involving extrapolation of phase diagrams to very high pressure and high temperature.

The kinetics of shockwave processes are being investigated from several viewpoints. These include lattice dynamic models of shocks in solids and experimental investigation of nonequilibrium processes at relatively low shock strengths in many cases. The behavior of shocks in regions of phase changes are especially interesting. The rate at which such changes occur depends upon the types of lattices involved and the orientation of the lattice with respect to the direction of the shock. From the viewpoint of pressure standards, additional studies of the transformation of iron at about 126 kilobars were reported in the meeting. These confirm this fixed point as being the most accurately determined fixed point above 100 kilobars.

The symposium was sponsored by the National Bureau of Standards and the Geophysical Laboratory of the Carnegie Institution of Washington. Expenses were covered by a grant from the National Science Foundation. The papers presented, together with discussion from the floor and summaries of panel sessions, will be published as a Special Publication of the National Bureau of Standards.

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Oceanology

The American Management Association's briefing session, Oceanology—The Challenge to Industry, was held 24–26 February 1969 in New York City. The meeting was attended by 250 persons and addressed by Vice President Spiro Agnew, Senator Clairbone Pell, Rear Admiral O. D. Waters and many other leaders of industry, commerce, government, and the academe.

Its stated purpose was an attempt to supply answers to certain questions concerning the future of oceanology, such as:

1) How much time, planning, and money will the new Administration be willing to commit to oceanology?

2) What is the most effective way to manage the specialized, technical, and personnel functions of oceanic business?

3) What changes is the status of oceanology can we expect to see in the next 5 to 10 years?

4) What is the immediate and long-range profit outlook?

The sessions of 24 February dealt with the current status and immediate outlook for oceanology.

Senator Pell's keynote address presented a general analysis of the report of the Marine Science Commission report. He conceded that few people would agree with it completely in its present form. However, he advocated the two principal thrusts of the report—the need for the establishment of a new independent agency to spearhead the national oceanographic program and the recommendation for a substantial increase in expenditures for the program in the coming decade.

Pell further noted that ocean programs must be justified by "pay-off" rather than "spin-off." Our ocean programs involve roles of government and industry, and government's role in development of technology ends when its programs have established the feasibility of economic "pay-off."

Further presentations concerning the Marine Sciences report were made by Richard Geyer, Charles Baird, and James Crutchfield. They suggested that the concentration of government agencies and effort into a single, powerful, national oceanographic and atmospheric agency (NOAA)—a kind of "wet NASA"—would materially enhance our effectiveness in dealing with oceanography's complex problems.

Vice President Agnew's invitation had come at a time when he was still

governor of Maryland. He explored areas of conflicts between states, such as that of Maryland and Virginia in Chesapeake Bay, and the need for conservation as related to the oil spill at Santa Barbara.

Papers were presented by Admiral Waters, oceanographer of the Navy, who expressed the belief that the word "oceanology" would never replace the now too deeply ingrained "oceanography."

J. L. McHugh discussed (by telephone) the role of the Department of Interior and James Gulick, that of the Department of Commerce.

Some general indications, resulting from discussions, are:

1) Offshore leases for small companies are favorable.

2) Offshore mining will be unattractive for some years to come.

3) Desalination has limited opportunities.

4) Marine electronics has great potential.

5) Technical considerations are more important in oceanography than in most other activities.

6) Three basic objectives of ocean law are: (i) to establish and protect the rights of individuals, groups and nations; (ii) to mediate conflicts short of war; and (iii) to promote effective development of the sea.

7) Insurance companies must still feel their way concerning total-loss rates for underwater studies.

8) All types of technical personnel are needed but that Ocean Engineering has the brightest future.

The closing sessions considered aspects of international cooperation and competition in oceanology. Presentations were made by Ambassador Donald L. McKernan (Department of State) and Ritsuro Harano (Japan).

The closing paper by Dr. Paul M. Fye was entitled "A scientist's recommendation for active participation in oceanology." The general tone was one of optimism both for the present and for the International Oceanographic decade of 1970–80. This impression was most succinctly expressed by Vice President Agnew in his quotation of a Welsh proverb that "Three things are untamable: fools, women, and the salt sea." He noted we are on the threshold of taming the sea, but that fools and women may take a little longer.

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