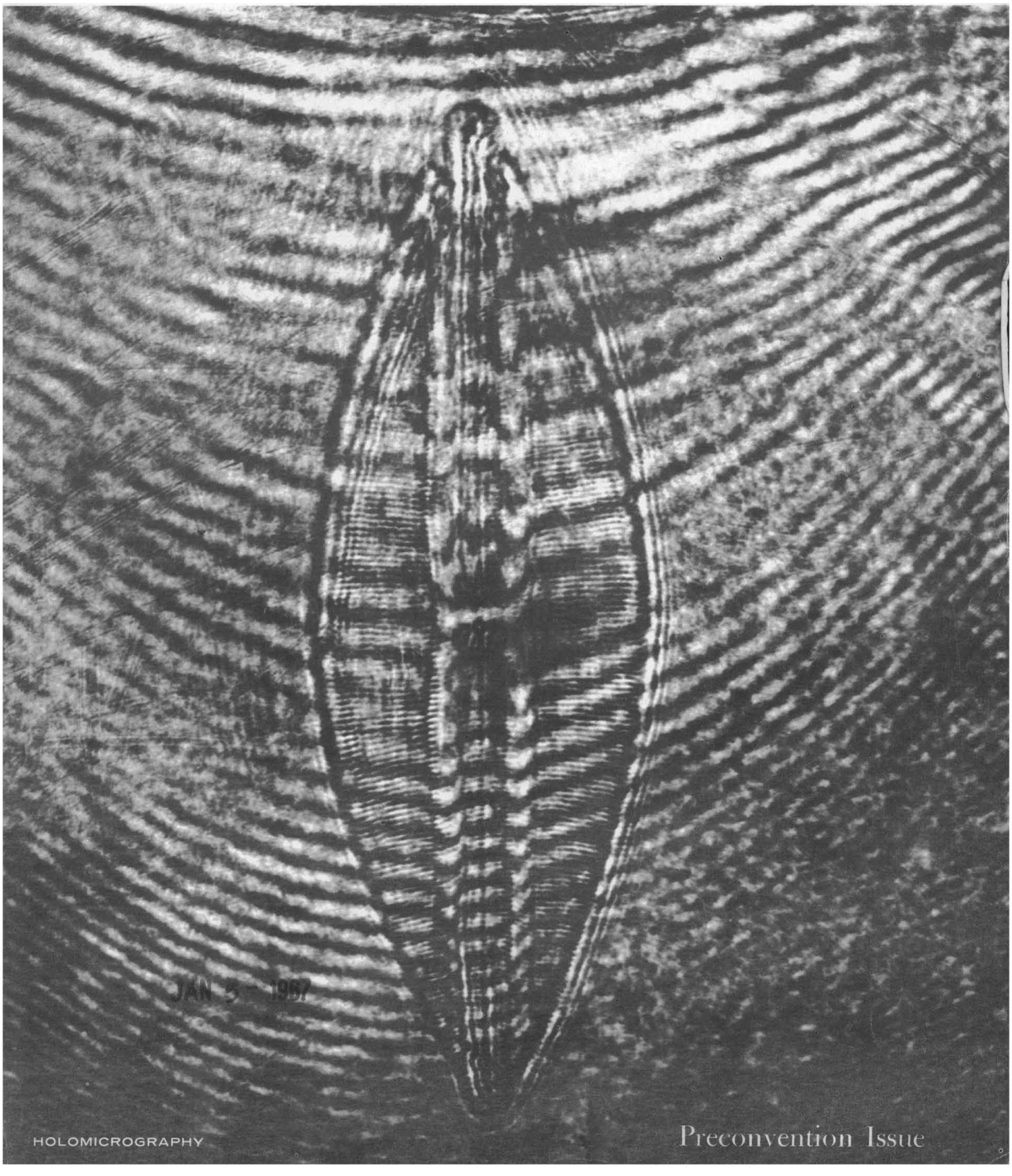
SCIENCE

2 December 1966
Vol. 154, No. 3753

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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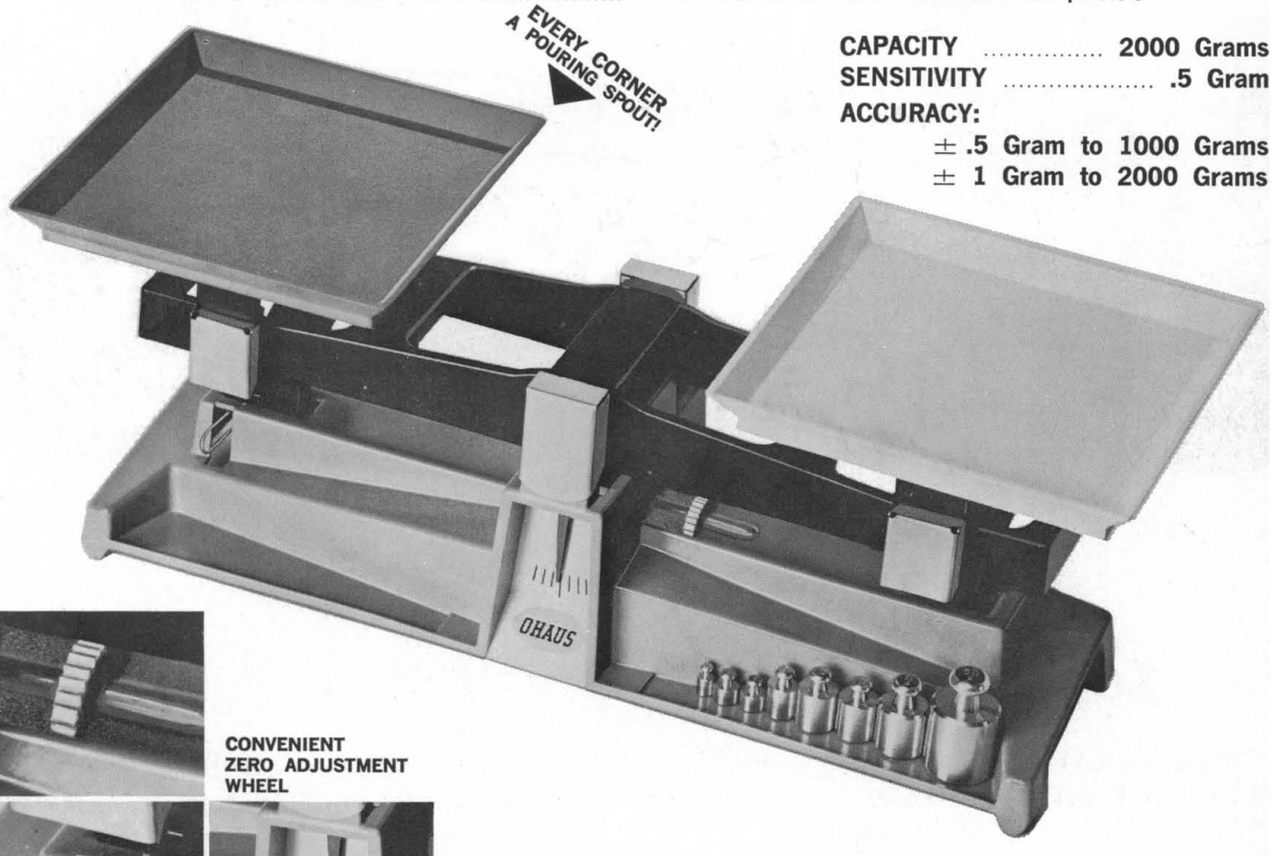

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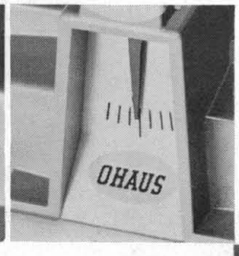

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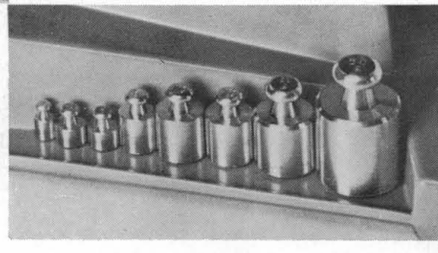

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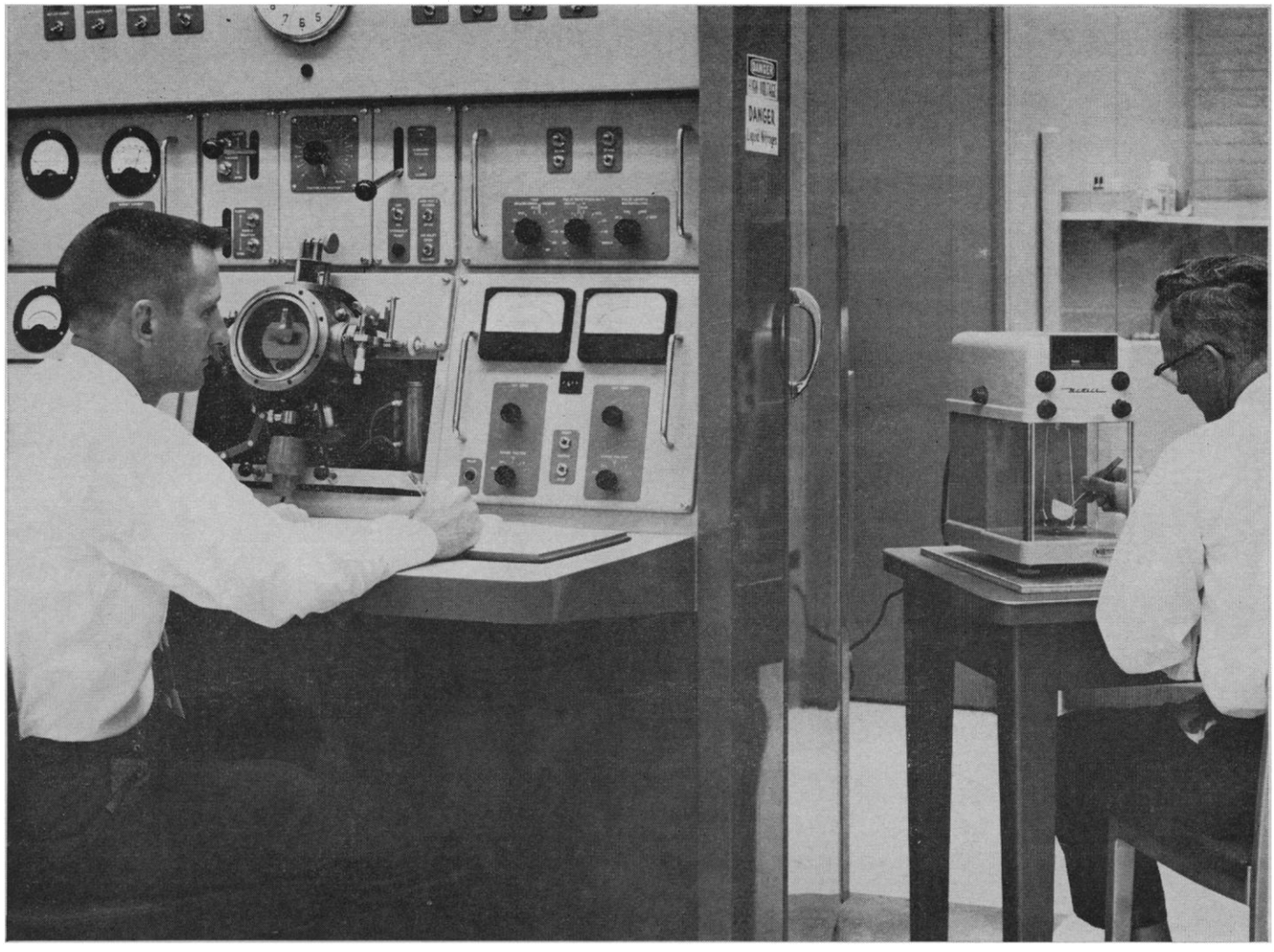

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2 December 1966
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COVER

This diatom was originally recorded as a holomicrogram of a bright-field microscope image which was transformed, after the fact, into interferometric phase-contrast and other types of microscope image. This procedure demonstrates the potential of holography as a means for freezing in time a transient event for subsequent examination by a variety of optical techniques. See page 1195. [Gordon W. Ellis, Dartmouth Medical School, Hanover, New Hampshire]

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edited by Britton Chance, Ronald W. Estabrook, and Takashi Yonetani
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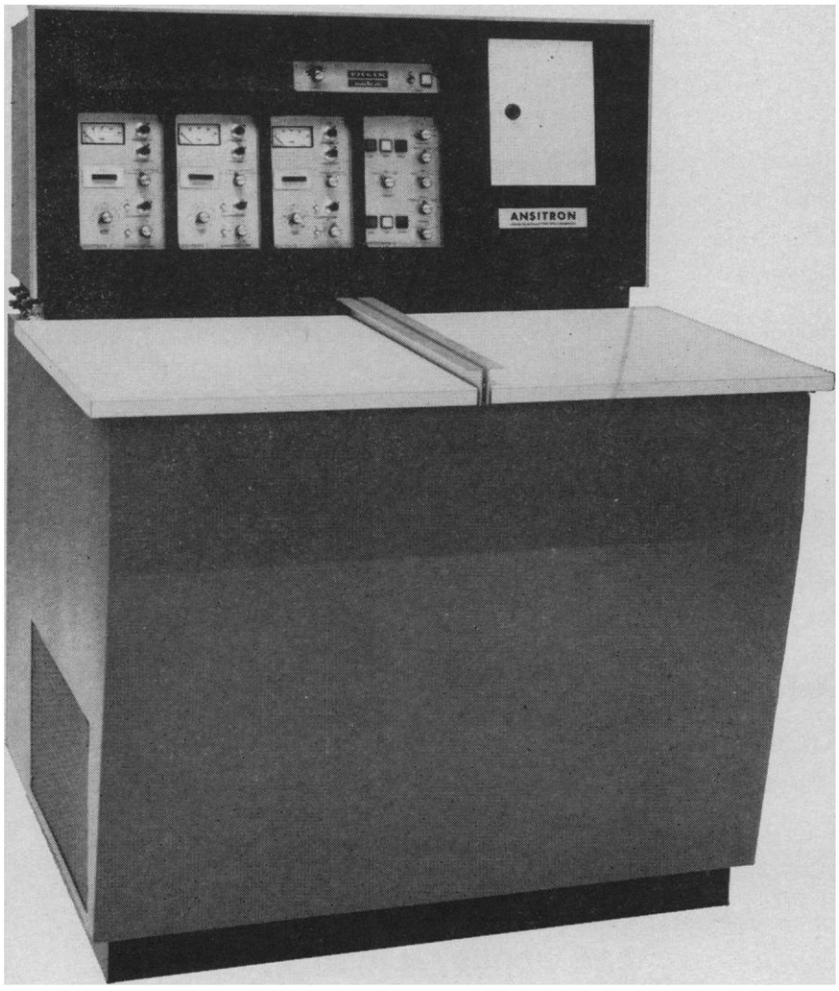

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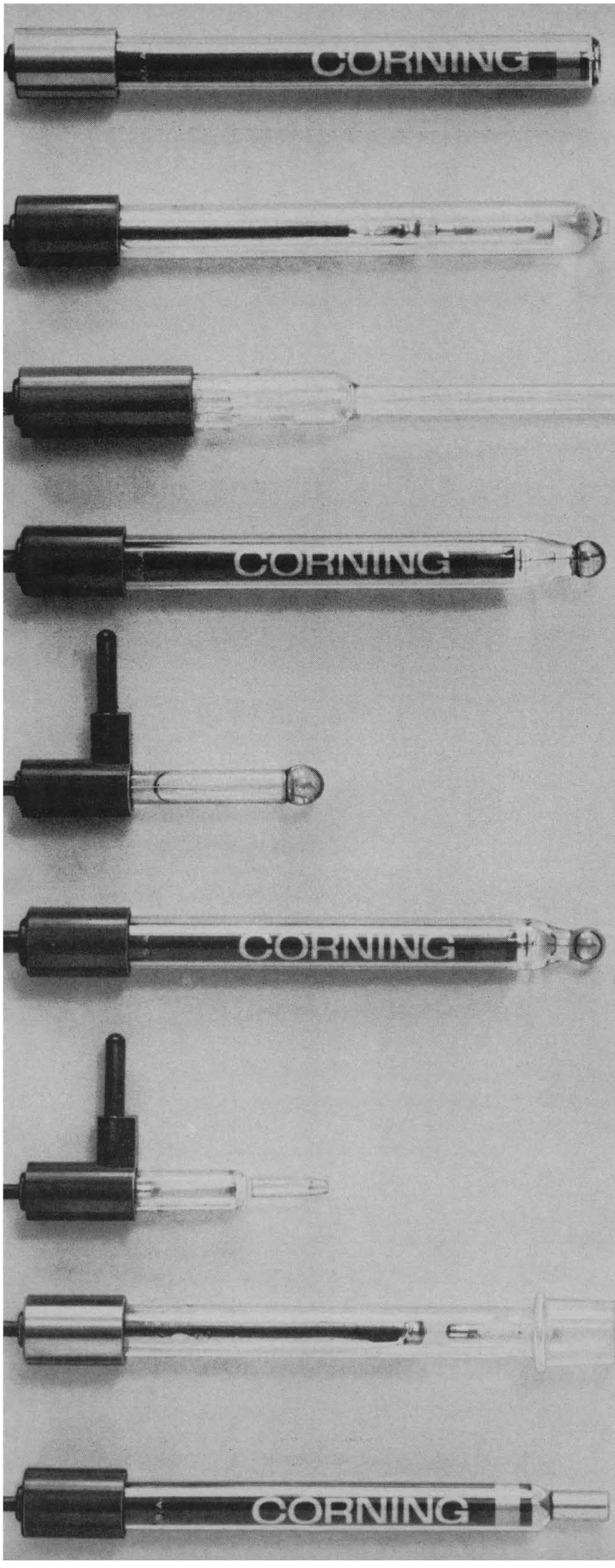

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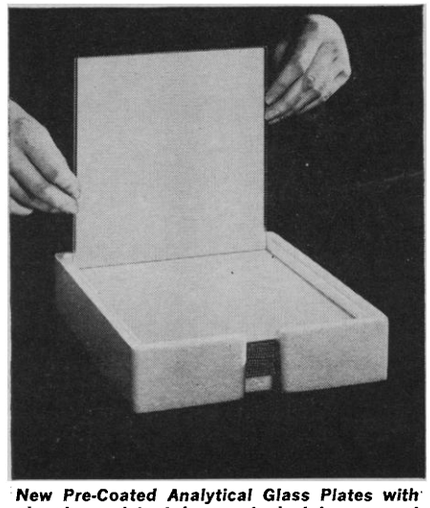

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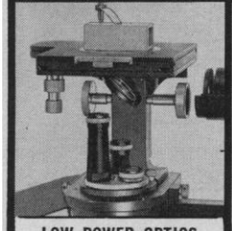

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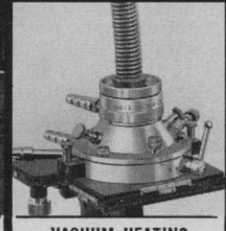

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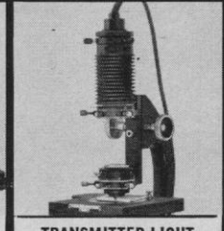

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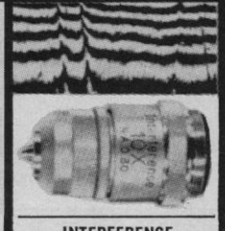

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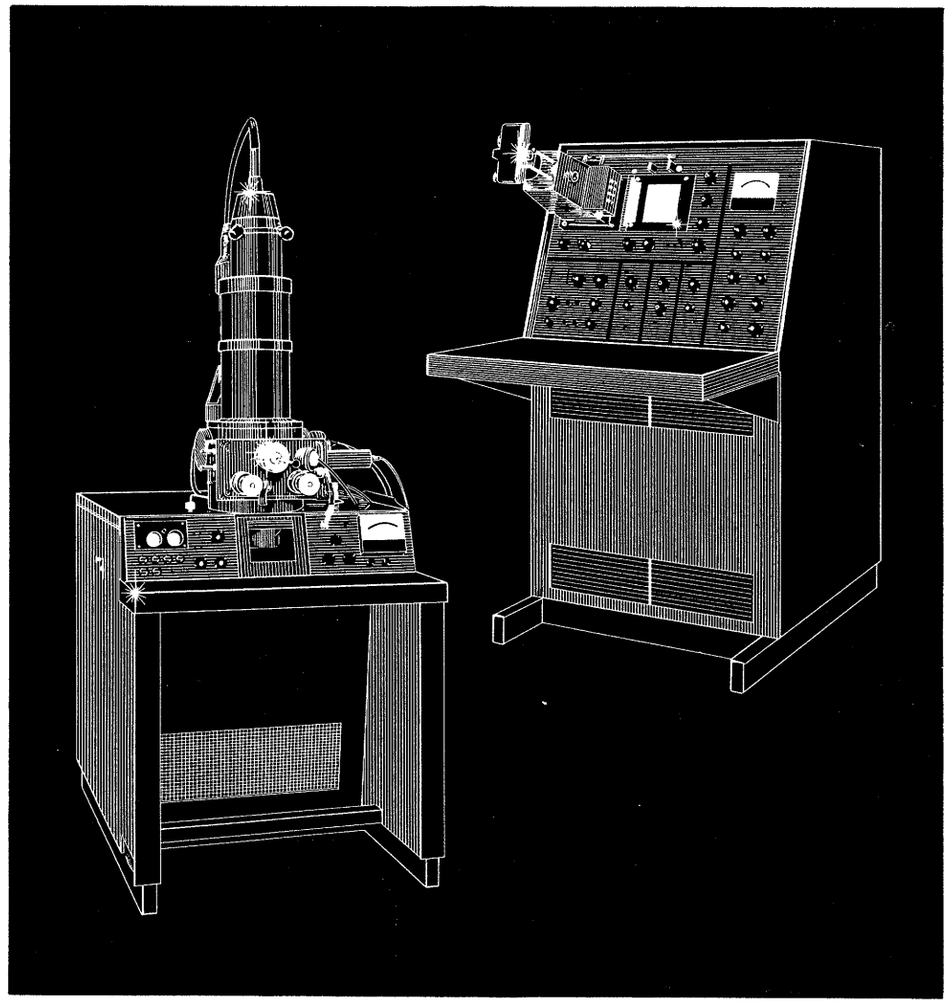

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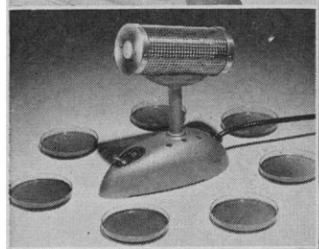

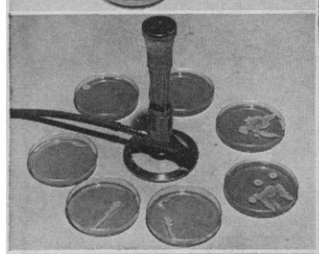

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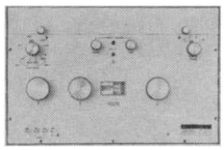
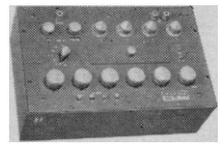
Honeywell Laboratory Standards and Test Instruments are usually specified for their high precision and exceptional reliability. Fine! We're proud of our reputation and we're constantly working for even higher precision and greater reliability. But don't overlook the fact that Honeywell offers one of the *widest selections* of test instruments and lab standards available – in fact, we'd be willing to bet we've got an instrument for just about any application you can name, and as our capability continues to grow, so does our product line. Here's just a small part of it:

Model 2784 Laboratory Potentiometer. This new extended range instrument is twice as accurate as any potentiometer in its



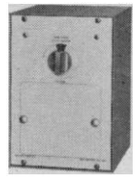
price class; costs half as much as any potentiometer in its accuracy class. Calibrated accuracy – 0.002% at the one volt range. Range – 0 to 11.110 volts, with 5 ppm resolution. Features include multiple guarding, a non-convoluted slide wire, and complete self-checking.

Model 2783 High-Precision Guarded Laboratory Potentiometer. Used for checking and calibration of other potentiometers and accurate measurement or comparison of standard cells, this 6-dial instrument



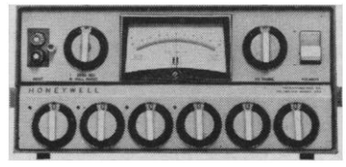
can provide a limit of error of ±0.0003% of reading when corrected in accordance with the optional Honeywell Certificate of Calibration.

Models 2855 and 2856 Voltage Dividers. Primarily for use with the Model 2784 Potentiometer, the 2855



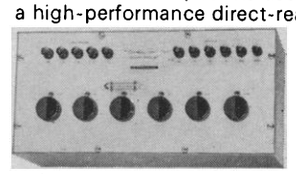
extends the 2784's range to a maximum of 1111.0 volts. Six multipliers (2, 5, 10, 20, 50, 100) are provided. The Model 2856 Voltage Divider employs seven multipliers (2, 5, 10, 20, 50, 100, 200) to extend the 2784's range to 2222.0 volts. Both instruments have a maximum current drain of 1.11 milliamp.

Model 852 Guarded Potentiometric Voltmeter. Completely solid state throughout, the 852 is a high-precision DC measurement device for 0 to 1111.1 volts, with infinite impedance throughout the entire range. All six dials of the K-V divider are overrang-



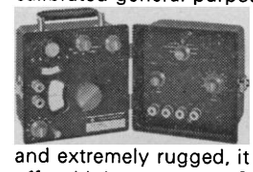
ing, and long-term limit of error is ±0.01% of reading for at least one year.

Model 1407 Universal/Direct Reading Ratio Set. A combination instrument, the 1407 consists of a 6-dial universal ratio set with additional circuitry for its use as a high-performance direct-reading



ratio set. As a universal set, resolution is 1 ppm for any ratio from 1 to 2,000,000, while as a direct set, it compares resistors with ratios of 1:1, 5:1, or 10:1.

Model 2705 Compact Portable Potentiometer. This voltage-calibrated general purpose instrument



is designed for lab, plant, and field service use. Small, lightweight, and extremely rugged, it nonetheless offers high accuracy; ±0.05 of reading.

For complete information on *all* the Honeywell Laboratory Standards and Test Instruments, contact your Honeywell Representative, or, mail the coupon below for fully illustrated literature and price information.

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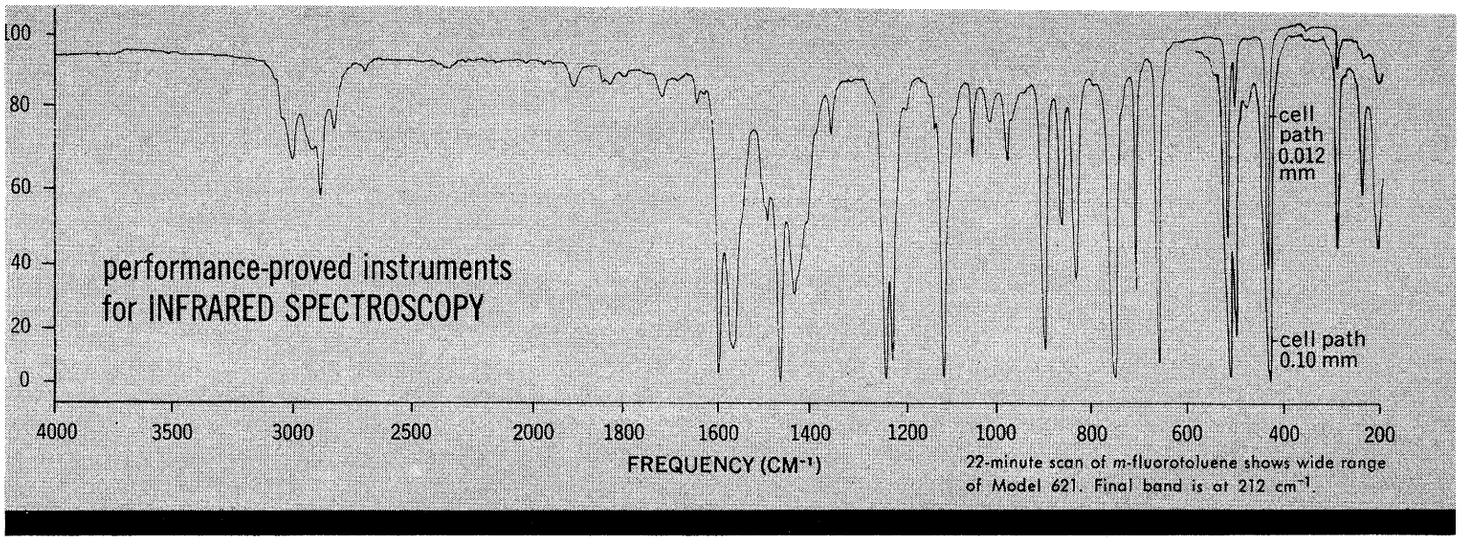


22-minute scan of *m*-fluorotoluene shows wide range of Model 621. Final band is at 212 cm^{-1}.

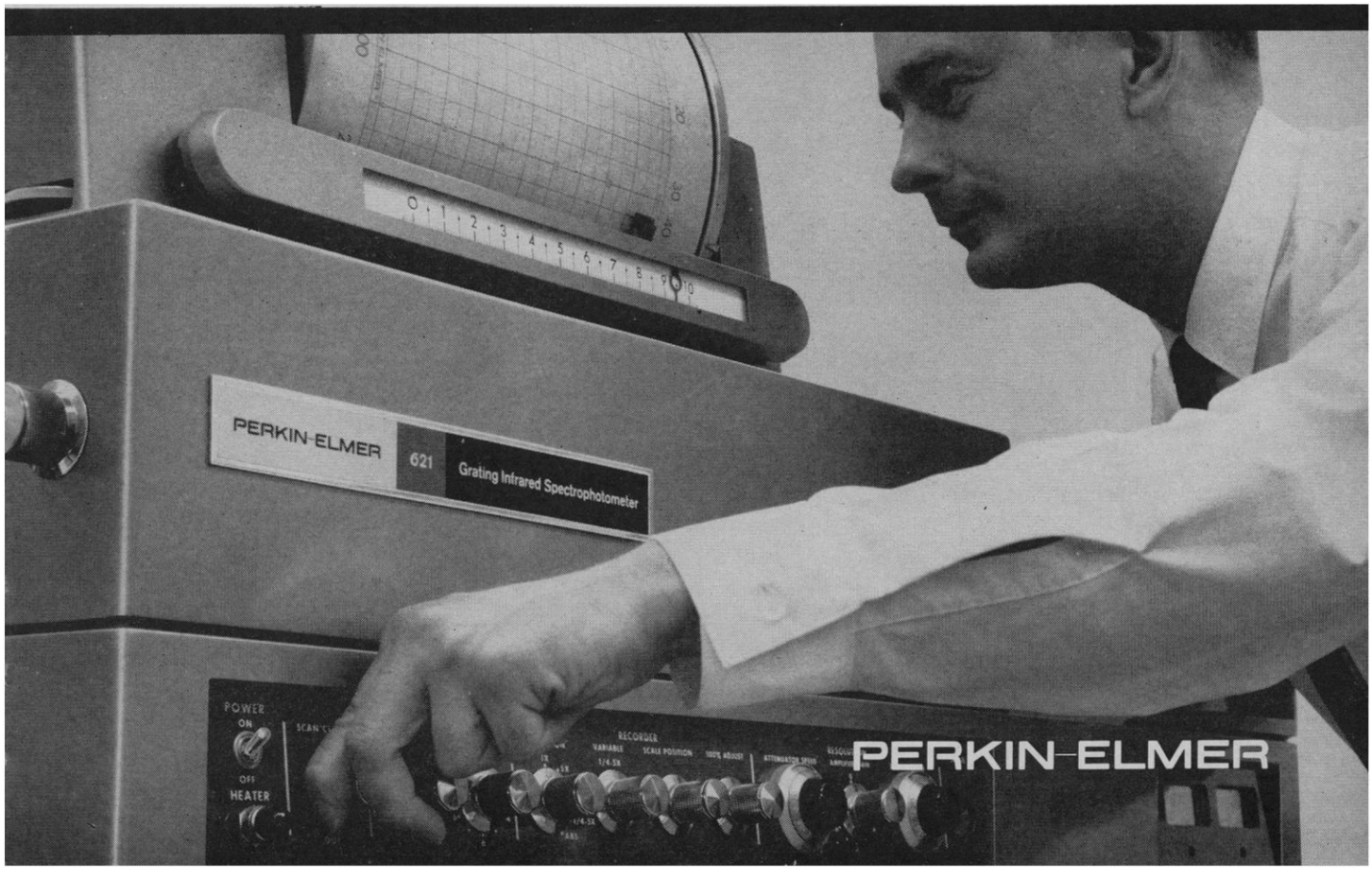
NEW MODEL 621 IR SPECTROPHOTOMETER PROVIDES OPTIMUM ENERGY TRANSFER OVER ENTIRE 4000-200 CM^{-1} RANGE

In the Model 621 Filter-Grating* Infrared Spectrophotometer, Perkin-Elmer — world leader in infrared — has achieved a new level of performance over the instrument's total operating range: from 4000 to 200 cm^{-1}. Fundamental to this additional performance is greater utilization of available energy, even where low energy is classically a problem. To do this, Perkin-Elmer has

- widened the slit opening capability to optimize performance under low energy conditions;
- enlarged the size of the Nernst glower source for greater total energy;
- utilized aspheric (toroidal, paraboloidal) optics for most efficient transfer of energy, and precise imagery—a Perkin-Elmer exclusive feature;
- redesigned the thermocouple detector target for greater sensitivity over the total range;
- maintained Perkin-Elmer's unique, fast f/4.5 optical system, with short paths for efficient and rapid purging.

These features provide an energy bonus and increase the optical precision of the Model 621's system. Thus, they enhance a traditional Perkin-Elmer advantage: the unique capacity to perform microanalysis to an unequalled degree of sensitivity. No matter whether the sample is limited, or the component of quantitative interest is present only as the fractional part of a microgram, Perkin-Elmer's total system is geared to provide a quick, easy and precise determination. For more information, including sample spectra, write to Perkin-Elmer Corporation, 723 Main Avenue, Norwalk, Connecticut.

*U. S. Pat. No. 3,144,498



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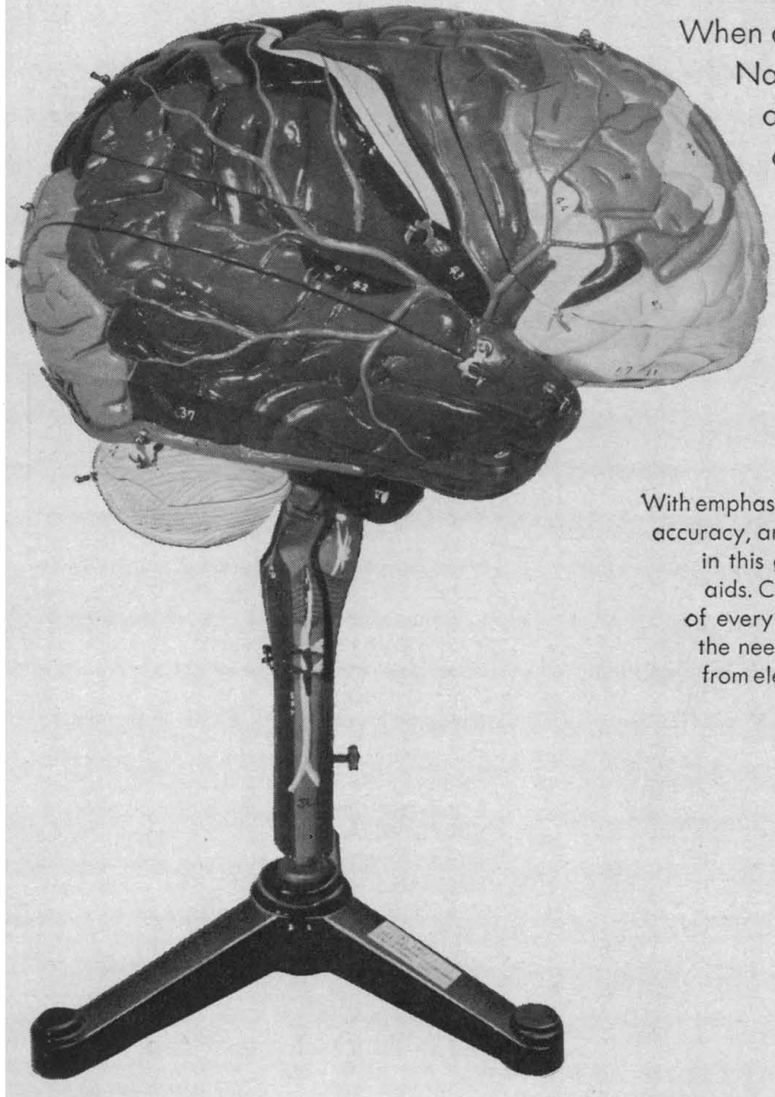

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With emphasis on structural detail, anatomical accuracy, and durable materials, the models in this group are outstanding teaching aids. Clay-Adams offers several models of every major body structure to satisfy the needs of varying educational levels from elementary through medical school.

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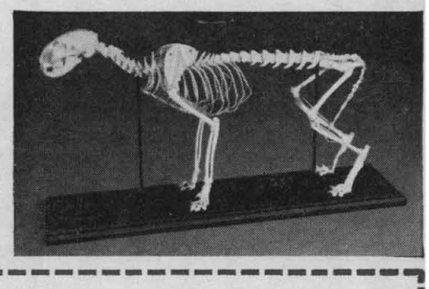
A new addition to the Clay-Adams line, these specially selected specimens are carefully mounted under the supervision of osteologists experienced in the preparation of museum displays to assure anatomical correctness.



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100 μV/cm dual-beam oscilloscope

☐ **Measure stimulus and reaction on the same time base.**

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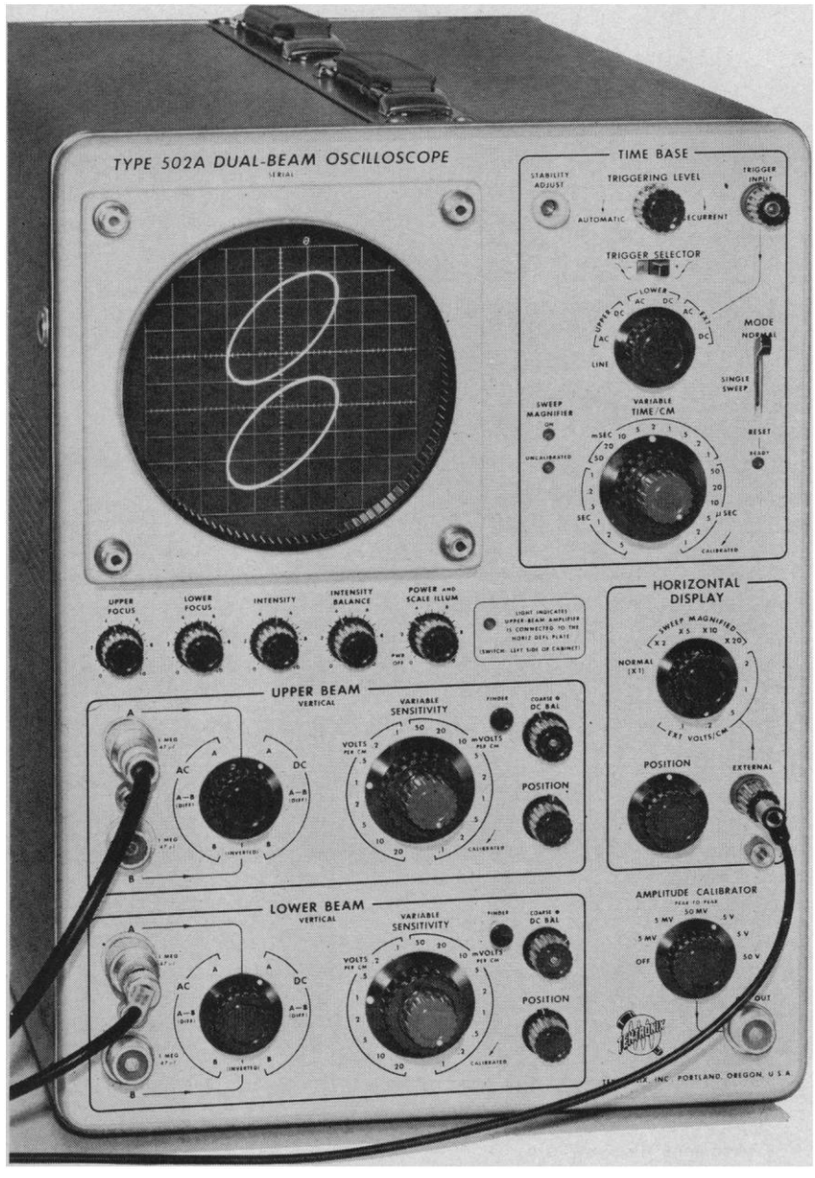

The Type 502A combines the performance capabilities unique to dual-beam oscilloscopes with operational features designed to simplify and speed up your measurements.

You can examine two waveforms simultaneously by applying input signals to both of the identical vertical amplifiers. You can use each vertical amplifier in a differential display mode to examine the difference between two signals. You can also use the Type 502A as a single-beam X-Y oscilloscope or as a dual-beam X-Y oscilloscope with both traces plotted on the same X scale.

This performance is combined with operating conveniences which include pushbutton beam finders for quick location of off-screen signals, vertical signal outputs, intensity balance for identification of upper and lower beams, single-sweep operation, Z-axis input, variable control of vertical and horizontal deflection factors, electronically-regulated power supplies for stable operation, and other refinements.

performance characteristics include:

Bandwidth from DC to 100 kHz at 100 μV/cm, increasing to DC to 1 MHz from 5 mV/cm to 20 V/cm • Calibrated deflection factors from 100 μV/cm to 20 V/cm in 17 steps; continuously variable between steps, uncalibrated, and to 50 V/cm • Common-mode rejection of at least 50,000:1 from DC to 50 kHz • Phase difference between amplifiers less than 1 degree from DC to 100 kHz • Calibrated sweep rates from 1 μs/cm to 5 s/cm in 21 steps • 2X, 5X, 10X, 20X sweep magnification • Flexible trigger facilities • Amplitude Calibrator • 10 cm by 10 cm display area.

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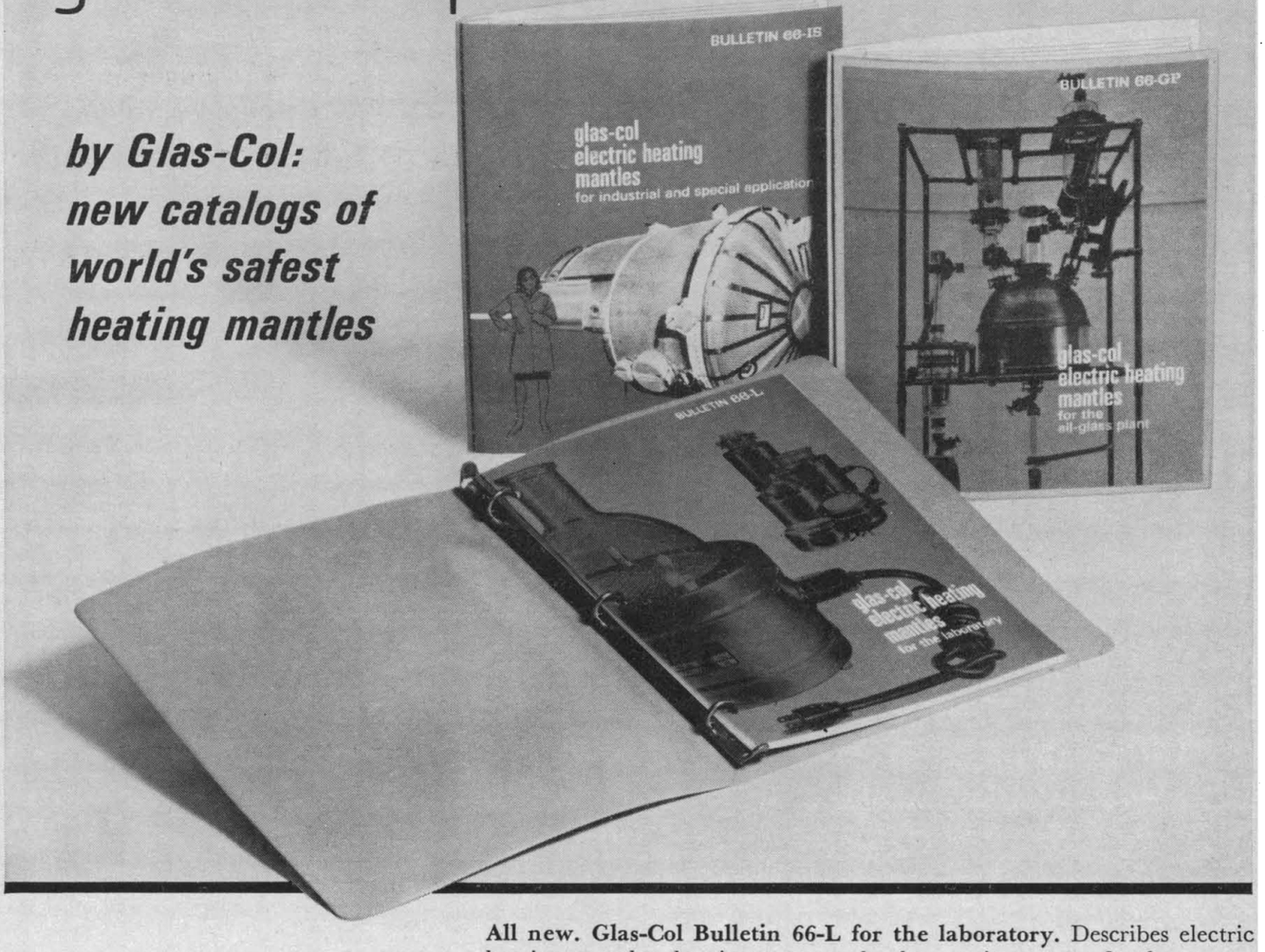

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*Relative to buffer accuracy and assuming proper standardization technique.

- ☐ Absolute Accuracy—at meter, ±5 mv (±0.05 pH) over full scale. At recorder outlet, ±0.6 mv (±0.01 pH).
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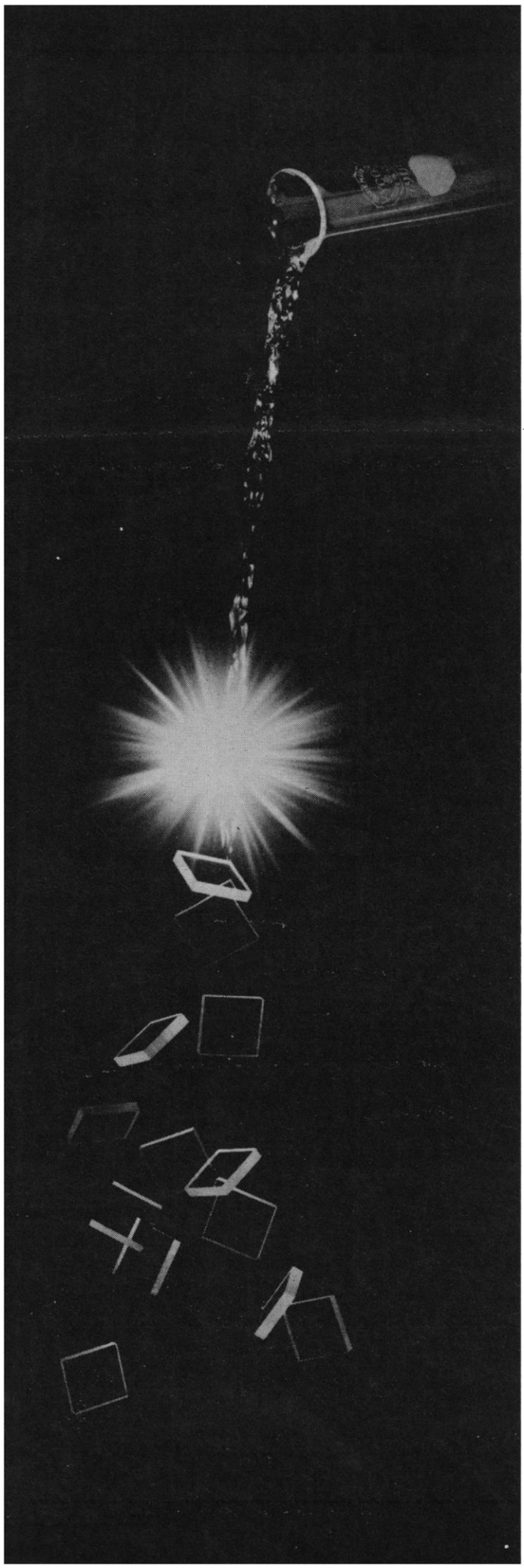


One of a series briefly describing GM's research in depth

Sometimes it takes a light touch to make plastics.

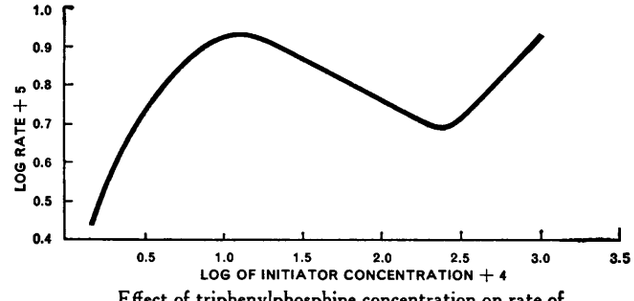
To make a plastic—take a monomer, add an initiator, and then add some energy to kick off the reaction. When it's over, you have polymer molecules—a plastic. The needed energy often comes from heat. But heat can evaporate the monomer before it has a chance to polymerize. Or it can damage a material being plastic coated.

A good alternate energy source is light. Just recently, our chemists discovered an initiator that is particularly effective in forming acrylic polymers on exposure to ultraviolet light.

It's triphenylphosphine. Several other triphenyl compounds are known as effective polymerizing agents at about 200°C. But we've found that these, and the phosphorus derivative, can also initiate *photo*polymerization. And triphenylphosphine is effective at room temperature.

Suppose you want to "pot" a delicate electronic circuit that would be harmed by heat. Take a methacrylate monomer to which our new initiator has been added. Drop the electronics into a bowl of this watery liquid and expose it to ultraviolet light. In a few minutes the circuit is encapsulated in a clear, solid plastic that is potentially very stable. (Many initiators leave a residue in the polymer that hastens its degradation. Triphenylphosphine doesn't.)

The suggested explanation of how and why all this happens gets into molecular complex formations and electron exchanges. Detailed discussion is available on request. It's all part of our continuing search for a better way.



Effect of triphenylphosphine concentration on rate of polymerization of methyl methacrylate.

General Motors Research Laboratories
Warren, Michigan 48090

MARK OF EXCELLENCE

What every Ph.D. should know about cage sanitation:

Anything less than a spotlessly clean cage can cause a fatal infection to an experimental animal during his post-operative recovery period and negate all your test results.

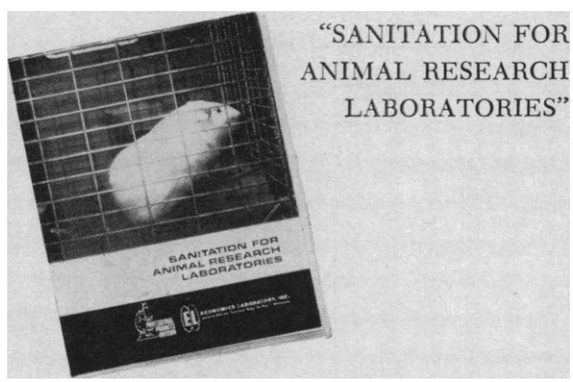
One major cause of unsanitary machine-washed cages is *overfoaming* in the machine, caused by the reaction of the detergent with the high protein soil loads resulting from the animal's feed and waste matter. This overfoaming cuts pump and wash pressure in the machine, thereby preventing it from doing its sanitation job.

But now, a new Economics Laboratory defoaming agent built into two detergents *completely eliminates foam,* enabling *you* to eliminate this major cause of unsanitary conditions. It's called EL F-58, and it may mean the difference between success and failure in your next experimental operation. It is now available in two powerful detergents, EVENT and SPEARHEAD, both of which contain polyphosphate to hold soils in suspension for their complete removal during the final rinse.

The first, EVENT, is recommended for non-aluminum, non-galvanized metal or plastic cages. It is a highly alkaline, non-chlorinated detergent for removing high organic soil loads and is recommended whenever heavy duty cleaning is required.

The second, SPEARHEAD, is recommended for aluminum and galvanized metal cages and racks. Equally effective in hard and soft water, it contains a unique combination of metal corrosion inhibitors. It, too, completely eliminates foaming where organic soil loads are encountered.

For more comprehensive information on cage sanitation, return the coupon below *today* for your *free* copy of this new, up-to-the-minute manual,



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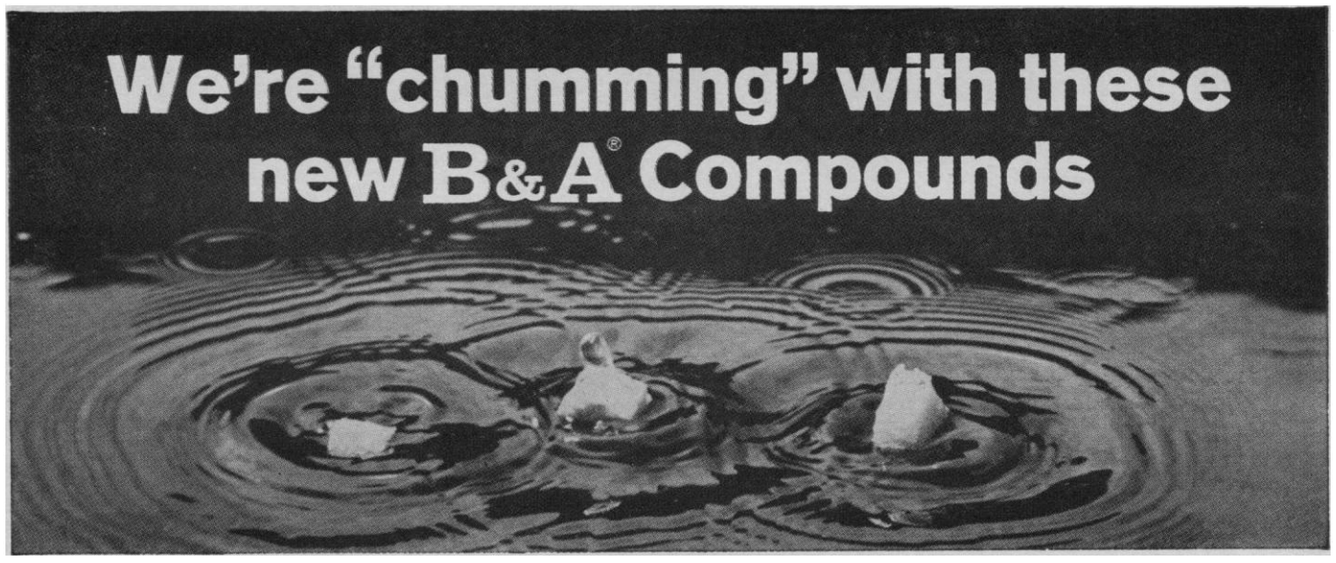
We're "chumming" with these new B&A® Compounds



chum (chŭm), *n.* (Origin obscure) Chopped fish, or bait, thrown overboard to draw fish.

chum, *v. i.* To fish with the aid of chum.

We're using these new compounds as "chum" to see if we can arouse any interest from you. Some of the products that we advertised in earlier "fishing trip" ads proved so useful to readers that we're now supplying them in pilot and production quantities.

Monochloroacetyl Chloride: $CH_2ClCOCl$
Dichloroacetyl Chloride: $CHCl_2COCl$
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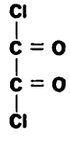
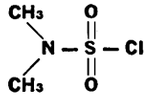
Convenient intermediates for introducing the corresponding chloroacetyl group in a variety of organic syntheses.

Oxalyl Chloride



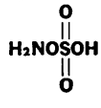
Synthesis of acid chlorides. Condensation reagent with $AlCl_3$ for ethers of aromatic hydrocarbons to form open diketones.

N,N-Dimethyl Sulfamyl Chloride



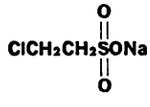
Reacts with amines, sodium alcoholates, sodium phenates, etc. to give the corresponding amides and esters.

Hydroxylamine-O-Sulfonic Acid



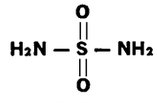
Reacts with organic amines to form hydrazines.

Sodium 2-Chloroethane Sulfonate



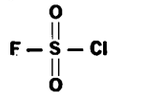
For introducing the sulfoethyl group in organic synthesis.

Sulfamide



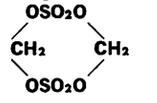
Similar to urea in many of its reactions, except it is more acidic and can act as a dibasic acid.

Sulfuryl Chlorofluoride



Gives selective reactivity between SO_2F_2 & SO_2Cl_2. Reacts with phenol or substituted phenols forming the corresponding aryl fluorosulfonates.

Methylene Sulfate

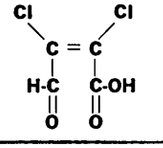


Reacts with alcohols & glycols to give formals; with tertiary amines such as pyridine, quinoline & dimethylaniline compounds of a type analogous to betaine results.

Sulfur Trioxide Pyridine Complex
Sulfur Trioxide Trimethylamine Complex
Sulfur Trioxide Triethylamine Complex

Specialty sulfating and sulfamating agents.

Mucochloric Acid



This compound and its derivatives exhibit bactericidal, fungicidal and insecticidal properties.

Thioacetamide, Tech.
CH_3CSNH_2

Highly reactive with organic halides, aldehydes, nitriles, acid chlorides, etc.

If any of these makes your mouth water, don't hesitate to write for more information. B&A Fine Chemicals, Allied Chemical Corporation.

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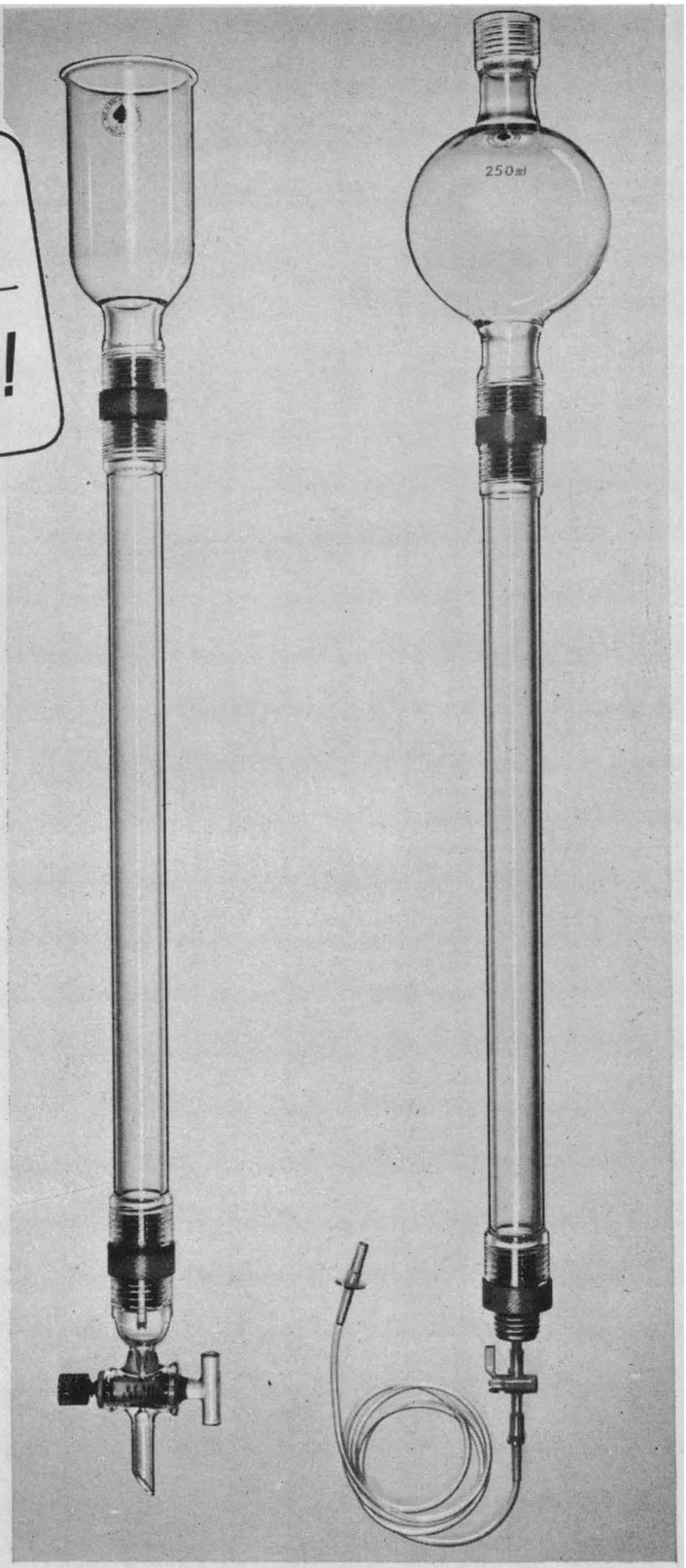

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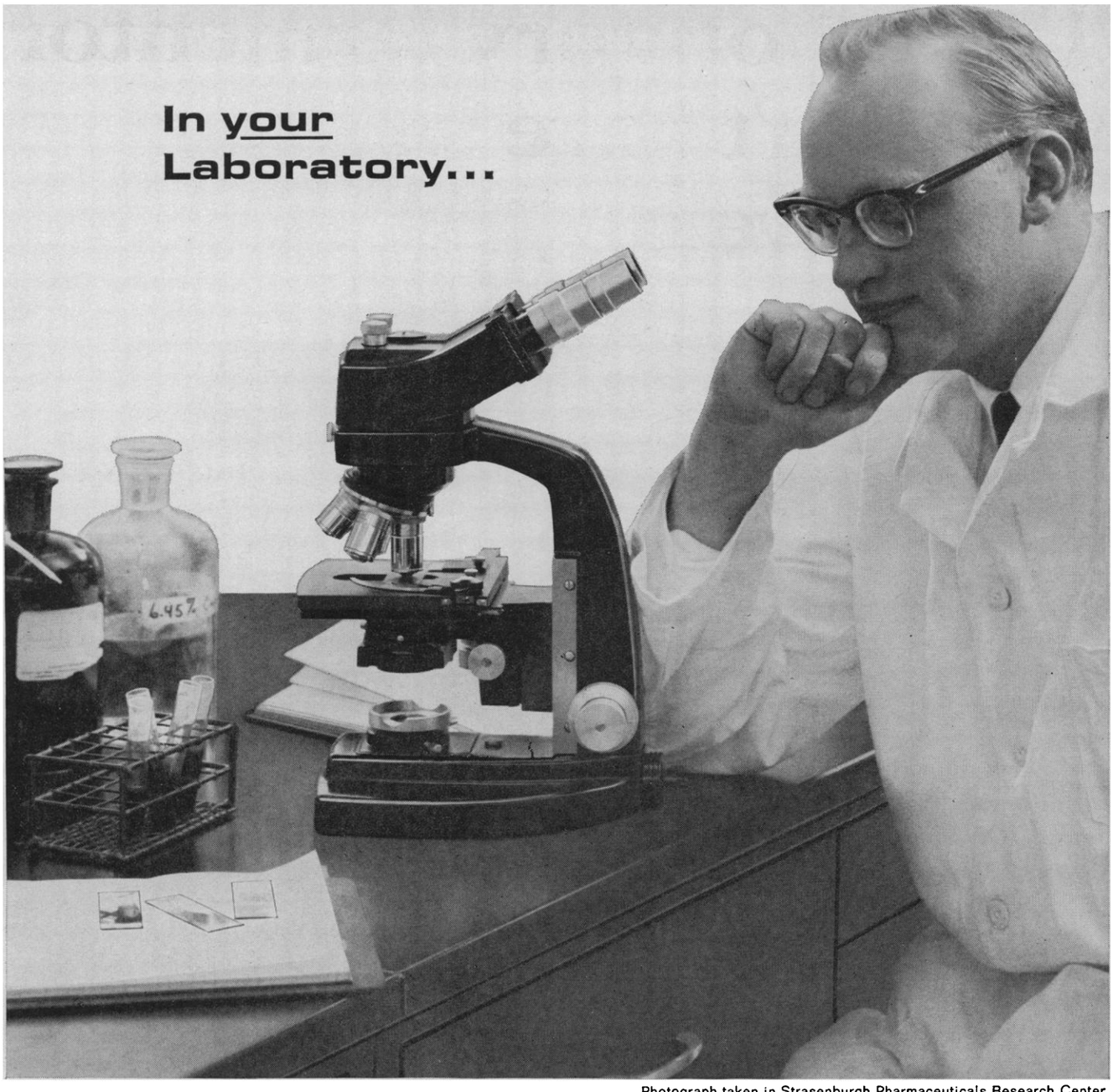

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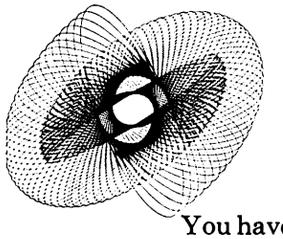

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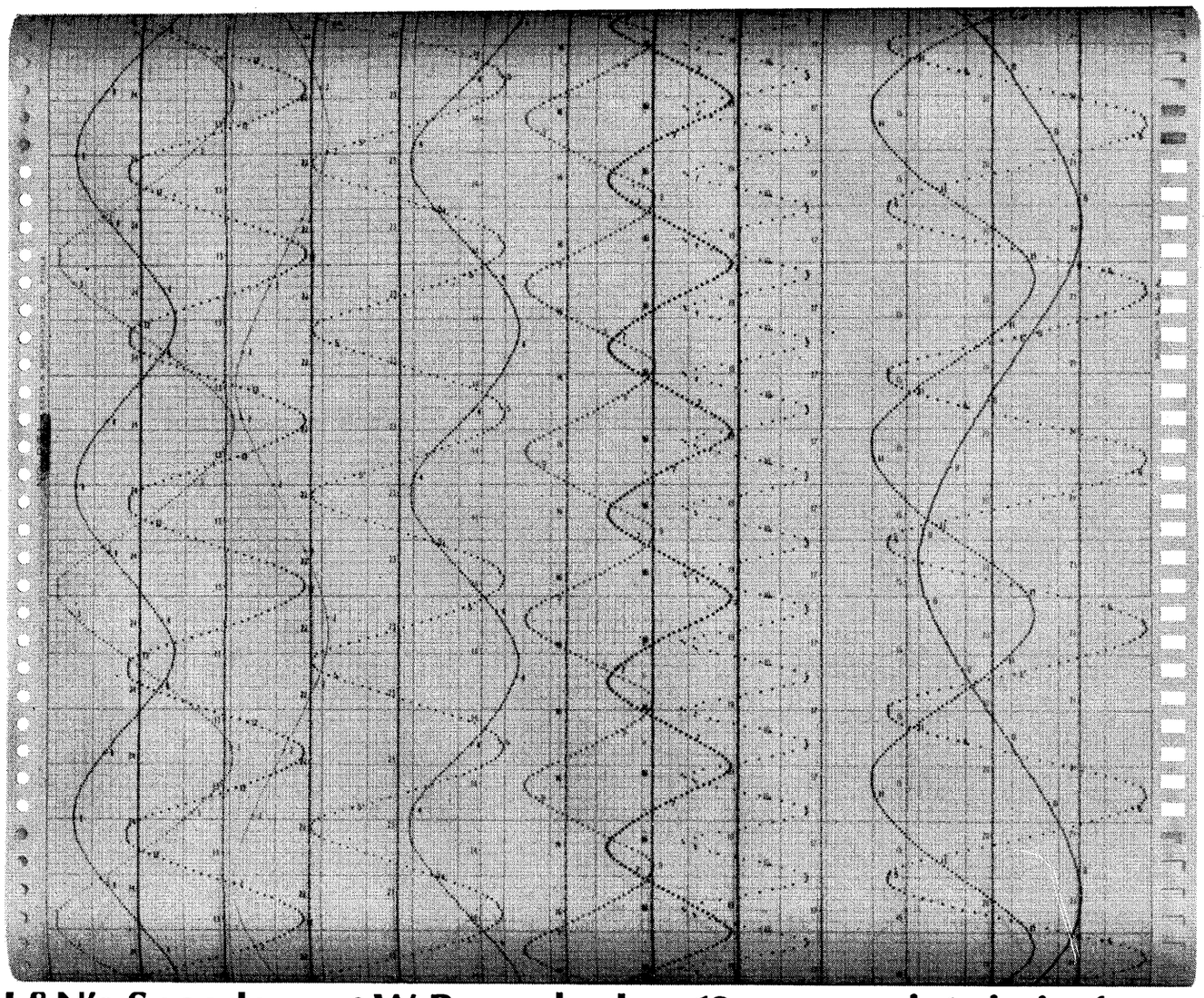

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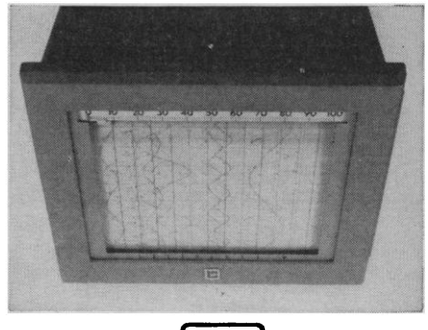

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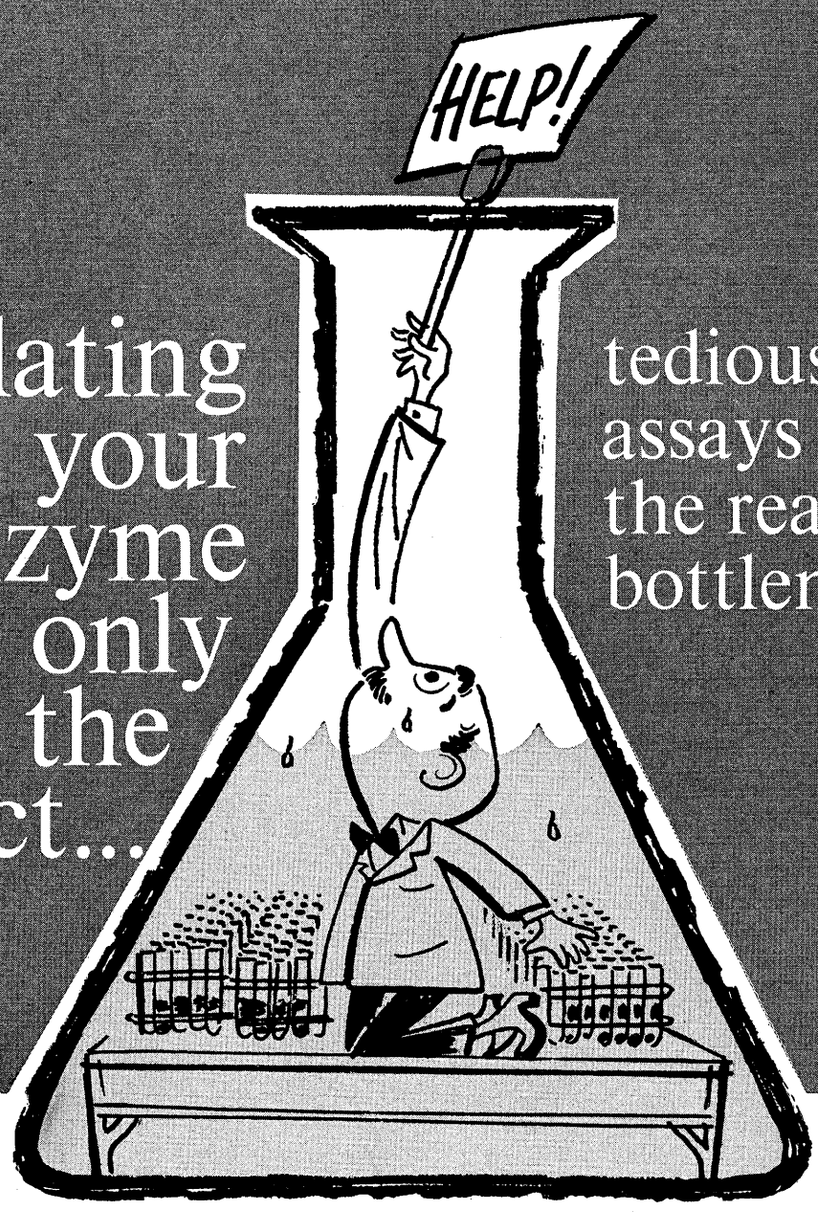

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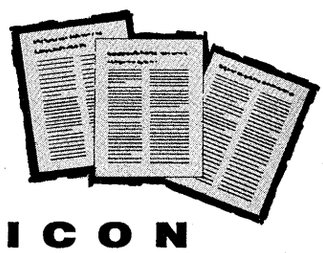

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Spin Labels for Biomolecules

EXAMPLE: "Tagged" molecules by chemical reaction with stable spin systems.

Most materials of biological and chemical interest do not contain an unpaired electron spin (in their ground states) and are not useful for EPR studies. Many of these materials can be studied with EPR methods by either oxidizing or reducing them. Recently, a more general method has been developed by McConnell *et al*,[1,2,3] who have "tagged" molecules by chemical reaction with stable spin systems, somewhat in analogy to customary fluorescence labeling. All tagging or labeling methods are useful in determining the mere presence or absence of the tagged compound. In addition, spin labeling offers several intrinsic advantages over other methods: The EPR technique has very high sensitivity; the spin label provides a microprobe for examination of the local environment; and the motion of the tagged species affects the observed spectrum.

As an example, the reversible change of Bovine Serum Albumin (BSA) as the pH is lowered was studied by spin labeling methods. The molecule BSA was reacted chemically with a spin label, which in this case was a stable nitroxide molecule similar to that shown in Figure 1. In a pure solution of the spin label, three sharp well resolved hyperfine lines are observed, arising from coupling to the nitrogen nucleus (I=1). The lines are sharp because rapid motion in solution averaged the anisotropic hyperfine interactions. The spectrum of spin labeled BSA is shown in Figure 2. McConnell *et al* have shown that this spectrum arises from spin labels bound in two different environments of the BSA molecule, one site where considerable motion of the nitroxide radical is permitted giving rise to 3 narrow lines, and one site where the spin label is more tightly bound to the BSA molecule and an anisotropically broadened spectrum is obtained. Here the spin label presumably is bound to a region of restricted access in the BSA molecule.

As the pH is lowered, the BSA molecule is uncoiled in such a manner that the broad anisotropic portion of the spectrum arising from the tightly bound spin labels decreases in intensity. At the same time the intensity of the 3 narrow hyperfine lines arising from more freely moving spin labels increases. Figure 3 shows the pH dependency for the process, which is envisaged as an opening up of the protein BSA.

Spin labels are currently being considered for other applications such as kinetic rate determinations and study of the environments close to reaction sites, e.g. enzymes.

1. Stone, Buckman, Nordio, McConnell, Proc. Nat'l. Acad. Sci. 54, 1010, (1965);
2. Griffith and McConnell, Proc. Nat'l. Acad. Sci. 55, 8, (1966);
3. Lawrence, Berliner and McConnell, Proc. Nat'l. Acad. Sci. 55, 708, (1966).

Fig. 1

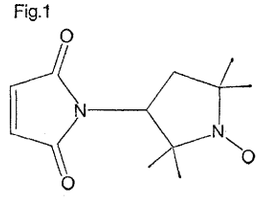


Fig. 2

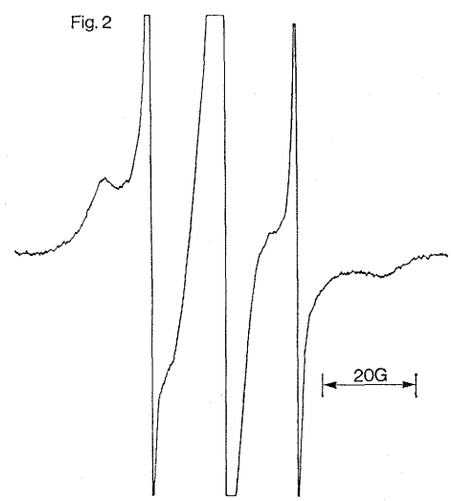
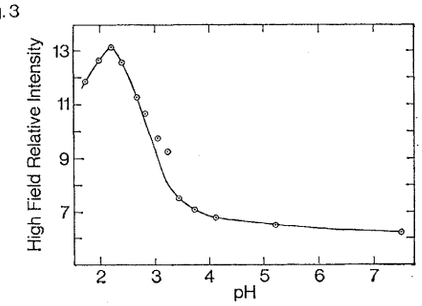


Fig. 3



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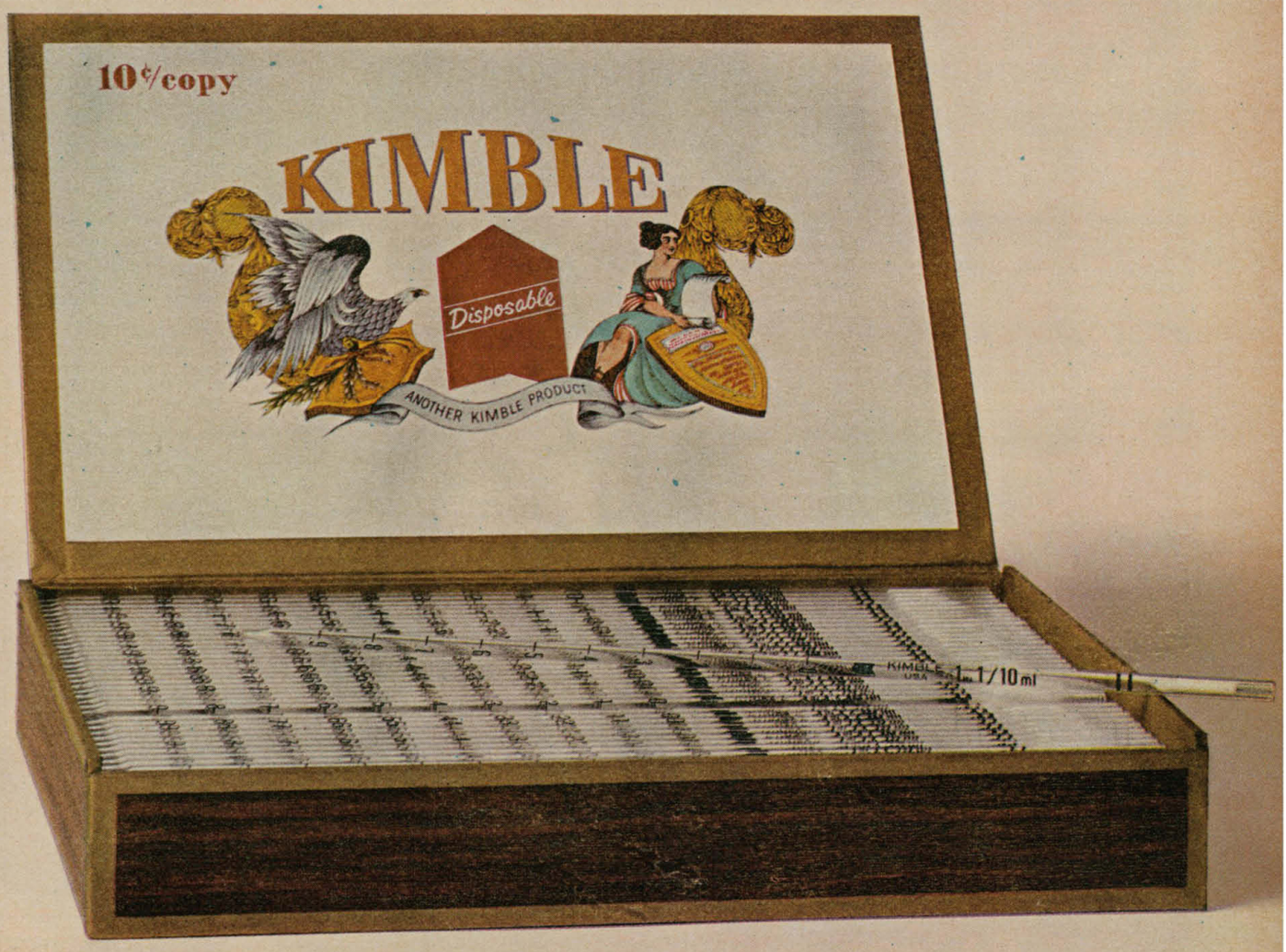

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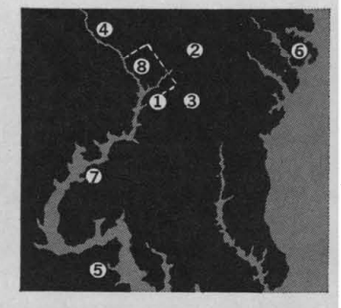

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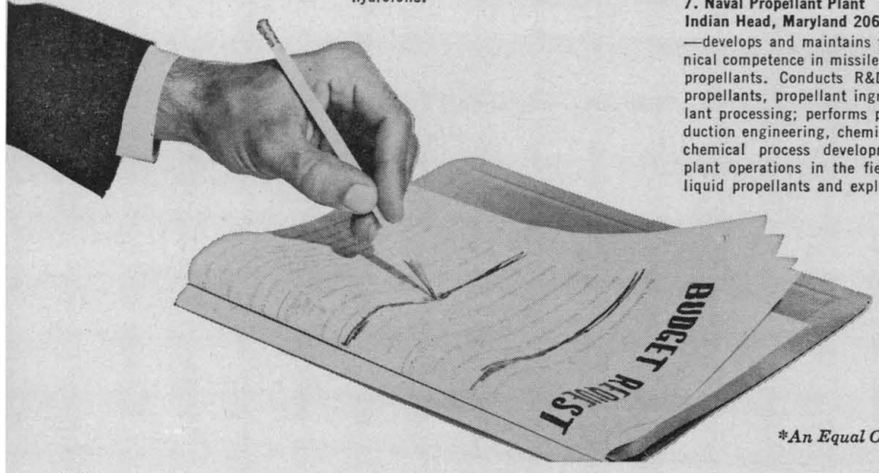

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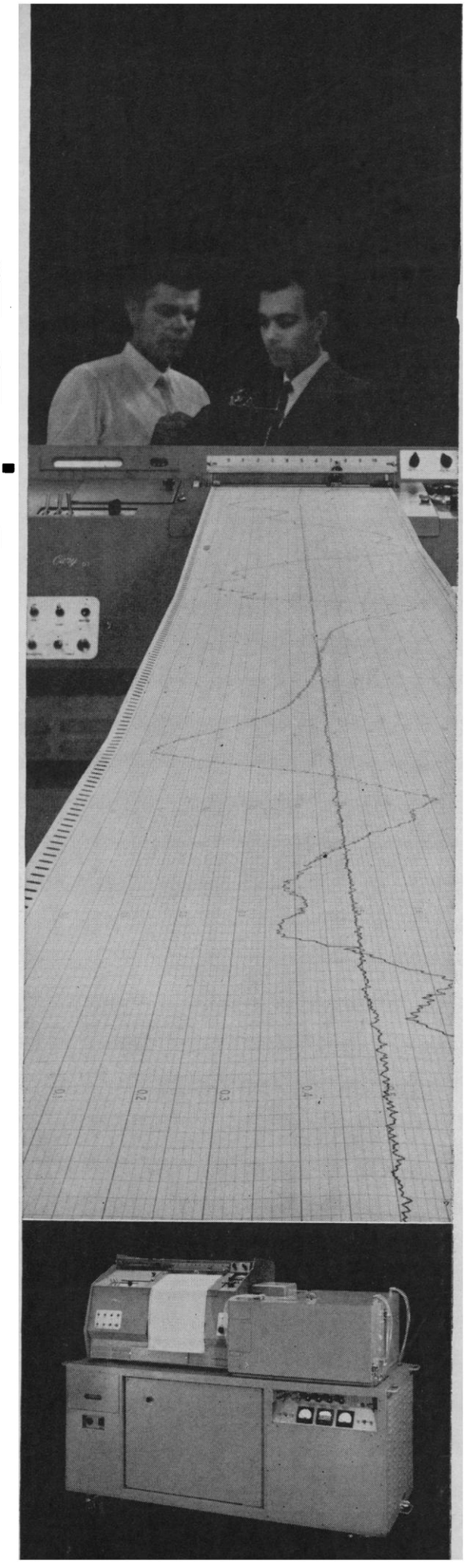

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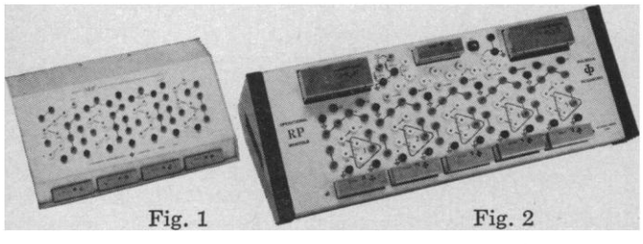

Fig. 1 Fig. 2

It takes but a few weeks of active use to recover the modest cost of either the MP (4 amplifiers, plus power supply, $390) or the RP (5 amplifiers, plus power supply, $495.), and you will probably notice certain extra-economic bonuses: superior circuit performance, sunnier dispositions, and greater freedom of invention, to name three. In time, you may find yourself using manifolds for semi-permanent circuits that must be built to otherwise-impossible schedules. They *are* neat enough, they compete very favorably with one-shot "custom" chassis-punching and wiring, and RP is easily rack-mountable.

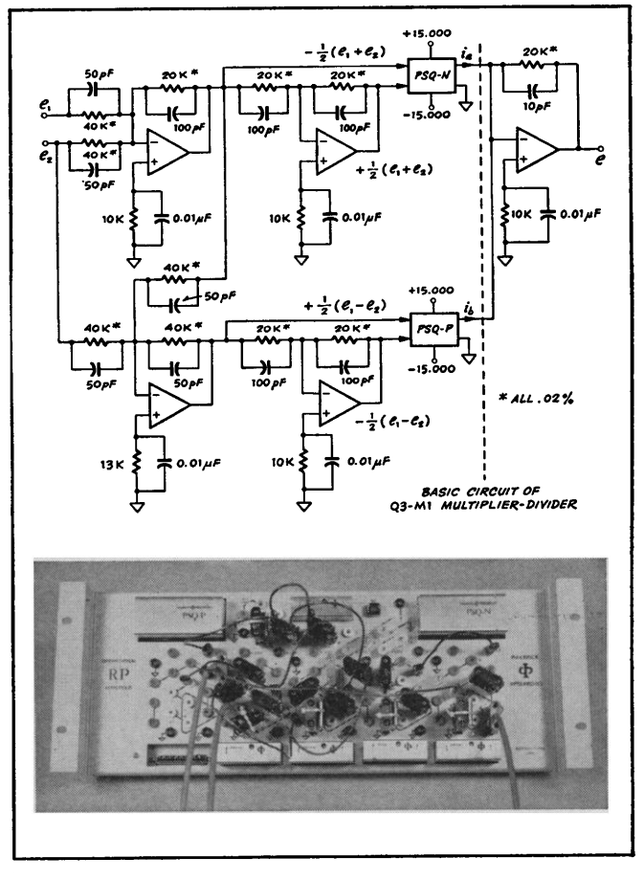

Fig. 3

As for speed and convenience, we should be content to rest our case on the schematic and photograph of Figure 3. This 5-amplifier multiplier was "constructed" in just 27 minutes, starting with the schematic. To make the test perfectly fair, we ran it in the laboratory of a customer, only 15 minutes after he first saw the RP, and with no rehearsals. We didn't help him, except to run through the instructions once, and hand him one of our standard kits of plug-in components and jumper-leads . . . informally known, by the way, as our "Bag of Worms."

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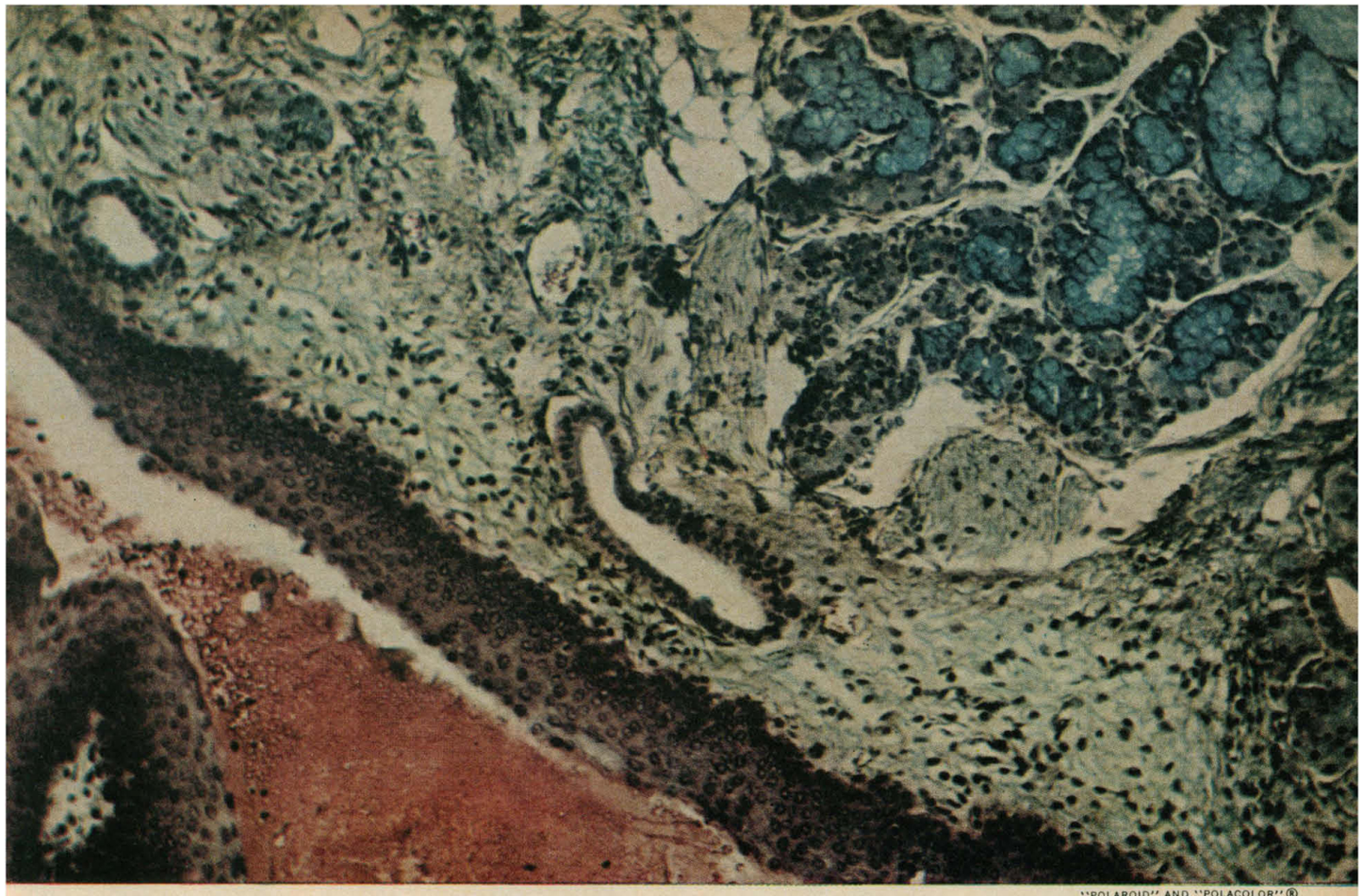

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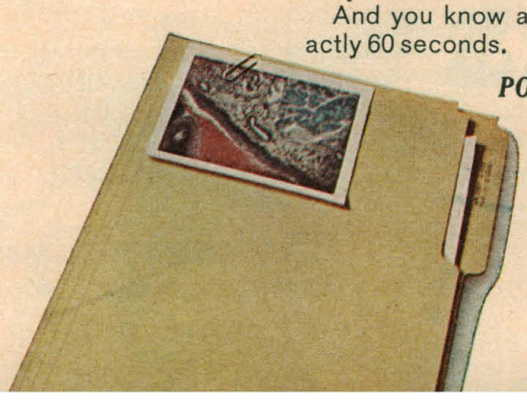

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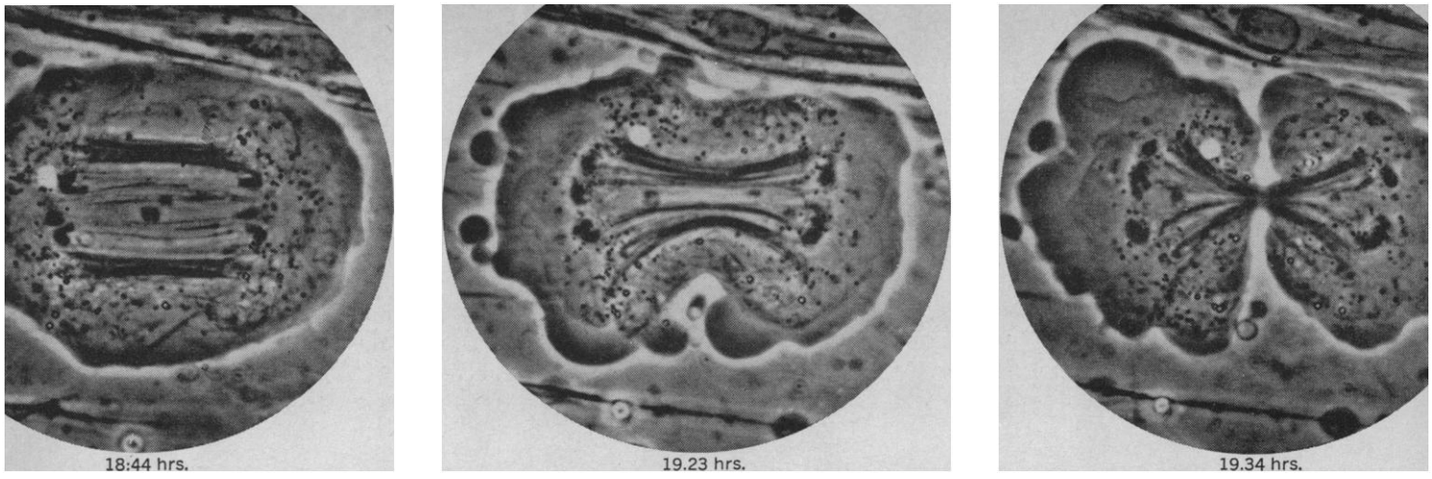

Anaphase: bivalents of homologous chromosome pairs moving to opposite poles during spermatogenesis in Pales ferruginea (Tipulidae).

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Isaac Newton R.I.P.

I, too, would like to comment on the dates of Newton's birth and death (Letters, 16 Sept. and 21 Oct.). Crew has noted the inscription in Westminster Abbey giving the date of Newton's death as 20 March 1726, Old Style (as Julian dating is called). While he is correct in stating that the year should be 1727, the day of the month should also be changed to 31 March, because of the jump of 11 days which was made when the British Empire switched to the Gregorian calendar in 1752—2 September was immediately followed by 14 September.

As Barr states, Newton's Old Style birthdate was 25 December 1642. However, it was only in the 18th century that the gap between Julian and Gregorian dates was 11 days. In the 17th century, the gap was only 10 days. Thus, Newton's New Style birthdate should be 4 January 1643.

When Russia switched to the Gregorian calendar in the 20th century, the gap was 13 days.

ELLEN THRO

4939 Lee Avenue,
Downers Grove, Illinois 60515

A View of the Whole Forest

I agree with Carter's analysis ("Wilderness Act: Great Smoky plan debated," 1 July, p. 39) that park administrations seem to measure success "more by the number of visitors . . . than by the quality of stewardship." This unfortunate preoccupation with numbers has roots in external apathy as well as in empire building. In the defense of natural areas, scientists could provide eloquent alternatives to visitor counts.

A park naturalist's time is indeed taken up by "the shepherding of park visitors." However, the interpretive programs reach visitors who may be unversed in biology, geology, or conservation, but who are still capable of influencing congressmen who might be considering proposals for pork-barrel dams and roads.

Yes, ". . . the job of park naturalist has lost most of its appeal for men with an urge to do scientific research." Although the first park interpreters were university teachers, park work cannot attract the senior molecular biologists and physiologists of today. However, many graduate programs require some marine biology. Wouldn't a season devoted to exploring a terrestrial biota in a park be rewarding also? A graduate-student ranger-naturalist can serve the public whose taxes may be educating him, while he views the whole forest before permanently roosting on a specialized limb.

Seasonal naturalist experience has convinced me that improvements are needed on both sides. The Park Service should hire receptionists to free naturalists for some field work. The academic community should show more interest when their natural heritage is at stake. Scientific breakthrough: today or tomorrow; natural area preservation: now or never.

WILLIAM A. CALDER, JR.

Route 1, Box 218,
Durham, North Carolina 27705

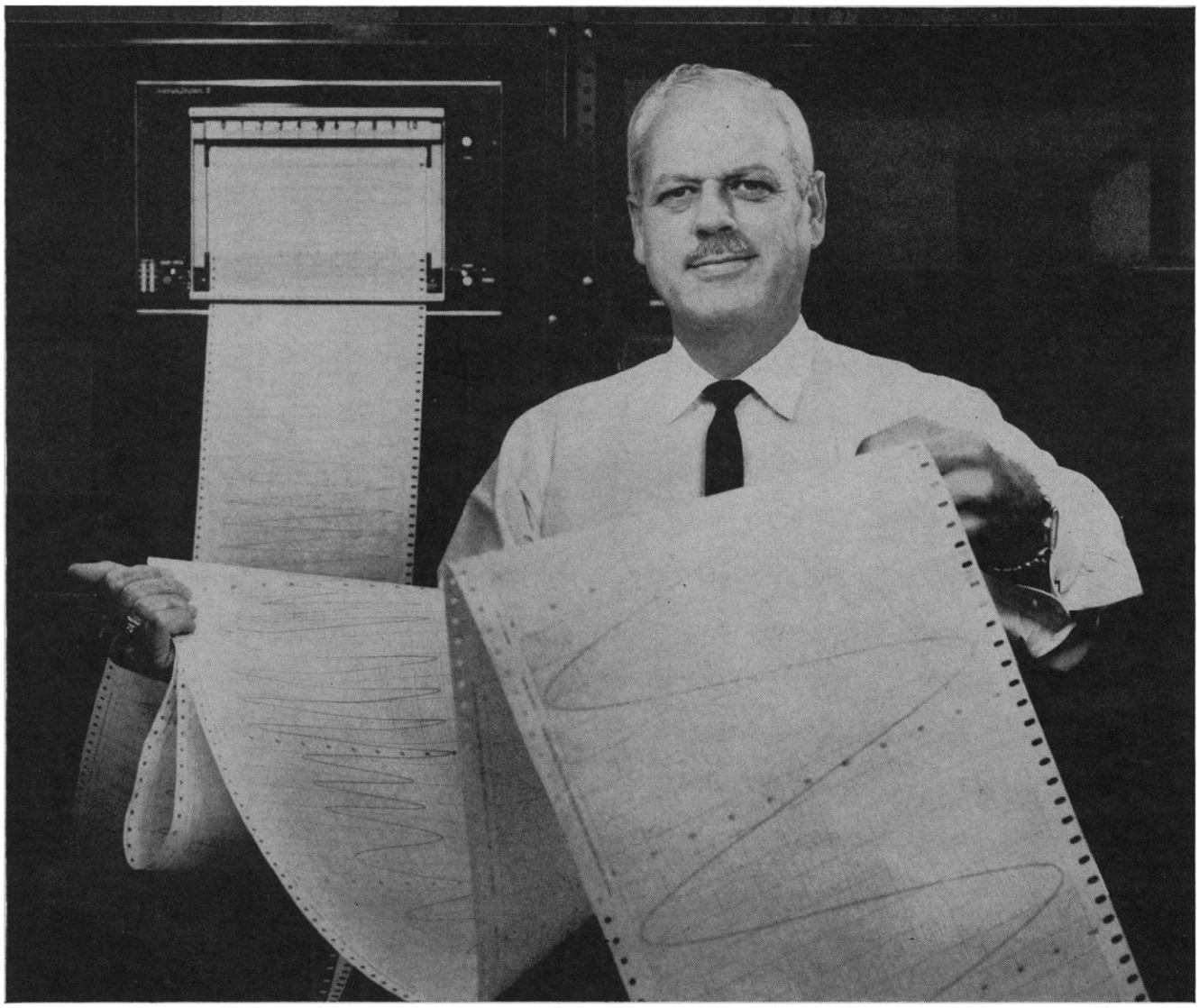
A 1953 Sighting

Hynek's letter (21 Oct.) makes me feel better. As a fishery biologist, I have almost felt ashamed that I, too, among other scientists, have seen a "flying saucer." In the fall of 1953 in the eastern panhandle of West Virginia, it was there on the horizon, about a mile away—looked 20 to 30 feet (6 to 9 m) in diameter—glistening in the crystal-clear sunny afternoon. It moved vertically from an on-the-horizon position, then to the left, to the right, and finally descended to the horizon. Then with phenomenal speed it took off to the right on a high sweeping curve out of sight. In my car with me were two other fishery biologists, who saw what I saw and we all agreed it was the "flying saucer" often described in the press that year, and probably what a doctor in that part of West Virginia had been reporting. I suggested we report it, but one of my assistants felt it might be classified as "fishy" since it was from three fishery biologists! One of the viewers was a former P-38 pilot.

The result of a scientist's reluctance to report such sightings is that these incidents remain merely conversational comment at parties. Now I feel relieved that Hynek has given the scientific observer freedom to talk about those crazy flying machines.

E. A. SEAMAN

American Fisheries Society,
15th and New York Avenue, NW,
Washington, D.C. 20005



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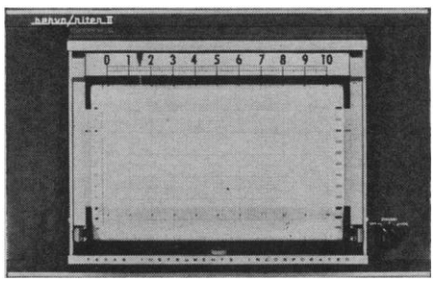

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Interpretations of DNA

A letter from Van Rensselaer Potter (8 July) has criticized my statement ("The biological nature of man" 22 Apr., p. 472) that "nothing that has so far been learned about DNA has helped significantly to understand the nature of man or of any other whole organism." His objections are that, in general, molecular biology has contributed to such understanding and that, specifically, its contributions include knowledge of feedback in individuals and in evolution and explanation of teleological aspects of organisms.

On the first point, I referred solely to DNA, not to molecular biology in general, which under various names is older than evolutionary biology and centuries older than DNA studies. Potter does not refer to DNA and his remarks are therefore not relevant to the statement he criticizes. On the second point, although the term "feedback" is fairly recent jargon, the concept was quite well understood more than a century ago; for instance, by Claude Bernard with respect to individuals and by Charles Darwin in the study of populations. That was before DNA was known; and it is the involvement of DNA in those feedbacks which is not yet adequately comprehended.

I completely agree with Potter that molecular biology has already contributed to the understanding of organisms and that DNA studies will add greatly to that understanding. I am glad he has made that point.

GEORGE GAYLORD SIMPSON
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Cambridge, Massachusetts 02138

Calcium and Fluoride Absorption

Armeit (Letters, 30 Sept.) expressed some doubt about the validity of my proposal (Letters, 17 June) to investigate the influence of the fluoride content of fish flour on the teeth of children, by citing a sentence from my original paper on this subject [*J. Pediat.* **65**, 782 (1964)] regarding the influence of calcium on fluoride absorption. In that paper, I discussed in detail human studies showing that fluoride in bone meal becomes partially unavailable in the presence of increased amounts of calcium.

However, the important point is that fish flour is rich in fluoride (169 to 272 parts per million) and that despite its increased levels of calcium (5.2 to 6.5 percent), a substantial amount of fluoride could be absorbed to affect the teeth at the quantities of 10 to 20 grams of fish flour commonly consumed by young children daily. It was on this basis that I recommended undertaking studies regarding the effect of fluoride present in fish flour on dental caries and mottled enamel development in children. In this connection, it should be noted that the low prevalence of caries and the severity of mottled enamel development seen among children in a recent study [*Arch. Oral Biol.* **5**, 125 (1961)] were attributed to a large extent to the daily high consumption of small fish eaten with the bones which contain increased levels of both fluoride and calcium.

D. M. HADJIMARKOS
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University of Oregon Dental School,
Portland 97201

Carrel: An Earlier Laureate

In a review of the many accomplishments of Charles Huggins, one of the 1966 Nobel laureates in medicine or physiology, it is incorrectly stated (News and Comment, 21 Oct., p. 362) that "only one other surgeon—Emil Theodor Kocher—has ever received a Nobel prize (1909)." In fact, the first Nobel prize in medicine that came to America was awarded to Alexis Carrel of the Rockefeller Institute in 1912 for "advances in suturing blood vessels and organ transplantation." Although Carrel made several contributions in other biological fields, particularly while applying tissue culture methods developed by R. G. Harrison in 1907, international acclaim followed his demonstration of the feasibility of suturing blood vessels, dramatically carried out in the successful treatment of melena neonatorum by blood transfusion in a premature infant, son of a New York physician, in whom Carrel anastomosed the father's radial artery to the popliteal vein of the infant. [H. O. Mosenthal, *J. Amer. Med. Ass.* **54**, 1613 (1910)].

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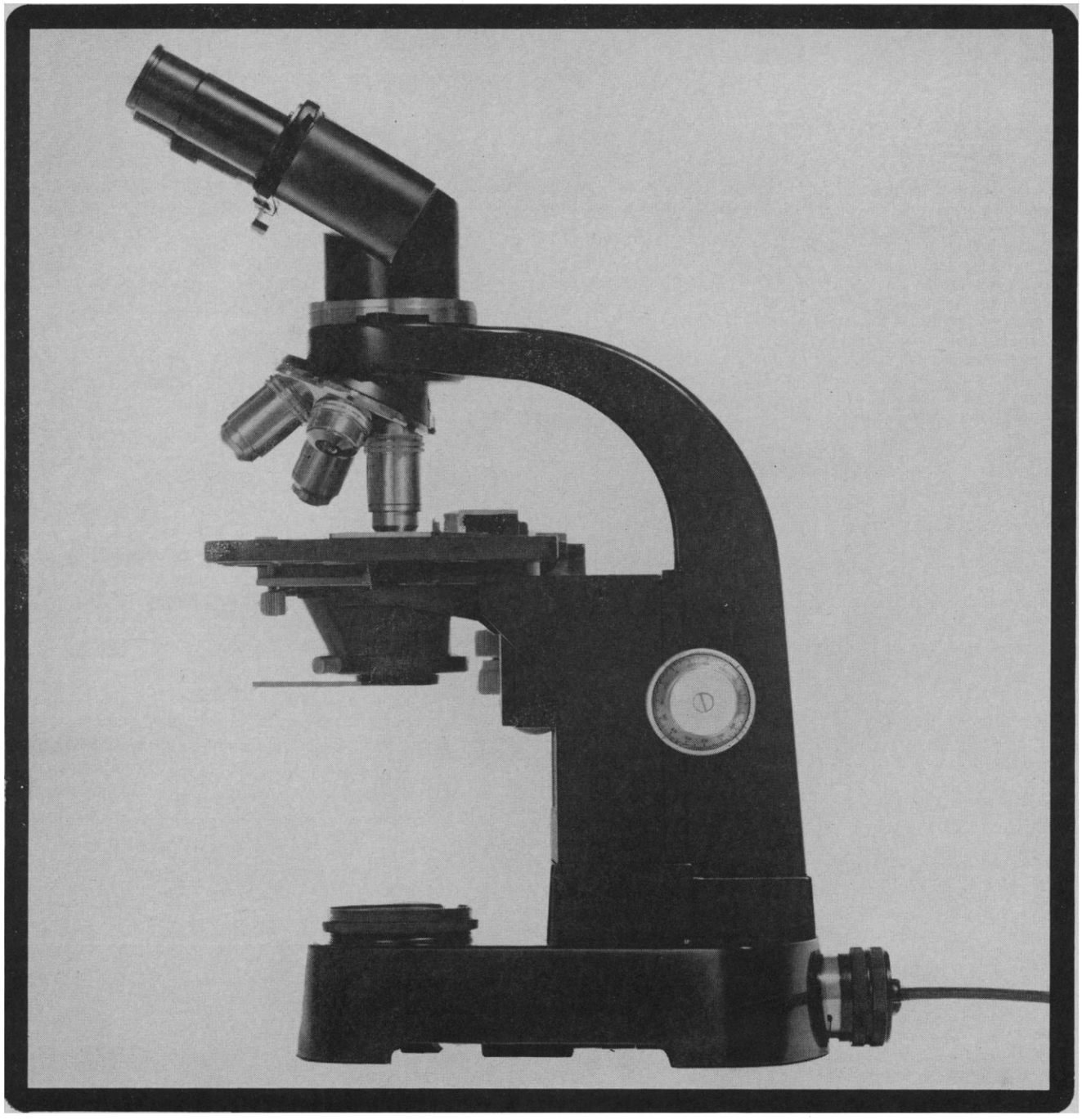

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2 December 1966, Volume 154, Number 3753 **SCIENCE**

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Project Hindsight*

The United States Department of Defense is the largest customer of many of the major companies engaged in advanced science and technology. The Department has an $80-billion inventory of weapons systems and equipment. This inventory is continually being upgraded. In some instances succeeding generations of weapons systems have achieved a cost effectiveness greater by an order of magnitude than that of their predecessors.

In order to understand factors contributing to successful management of its research and development programs, DOD is conducting a retrospective study of the science and technology used in weapons systems. This effort, known as Project Hindsight, has been under way for 2½ years. About 20 proven weapons systems have been analyzed. Typically a team of five to ten expert scientists and engineers dissects the system into its subsystems and components and identifies contributions from recent science and technology important to improved cost or effectiveness. Such a contribution is called an Event. A typical Event is the development of a titanium-aluminum-vanadium alloy used in compressor blades of the turbo-fan engines in the C-141 transport aircraft (and in many civilian planes). The high and uniform strength-to-weight ratio and corrosion and erosion resistance, the notch toughness, and the creep resistance of this alloy substantially increase the performance and life of jet engines.

Once the Event has been recognized, its history is traced. It has been possible to identify the individuals who were principal contributors, their organizations, and the dates and circumstances under which the work was done. For the 20 systems, the principal contributors have included 1025 people. The Events were performed by about 300 organizations, sometimes jointly. All together, some 638 Events have been analyzed. Eight percent of the Events are categorized as science; 92 percent, as technology.

Of the science Events, the majority were applied research clearly oriented toward a DOD need. Most of the remainder were applied research with a commercial objective. Only two science Events were identified as arising from basic academic research. These were the early development of the shock tube, at Cornell University, and a project in statistical sampling, at Wayne University. Nine percent of all the Events, mostly in applied research and technology, were performed by universities.

About 90 percent of the federal funds for university research is furnished by mission-oriented agencies including the Department of Defense. Some of the conclusions from Project Hindsight are of relevance to such agencies. Some of the conclusions are these:

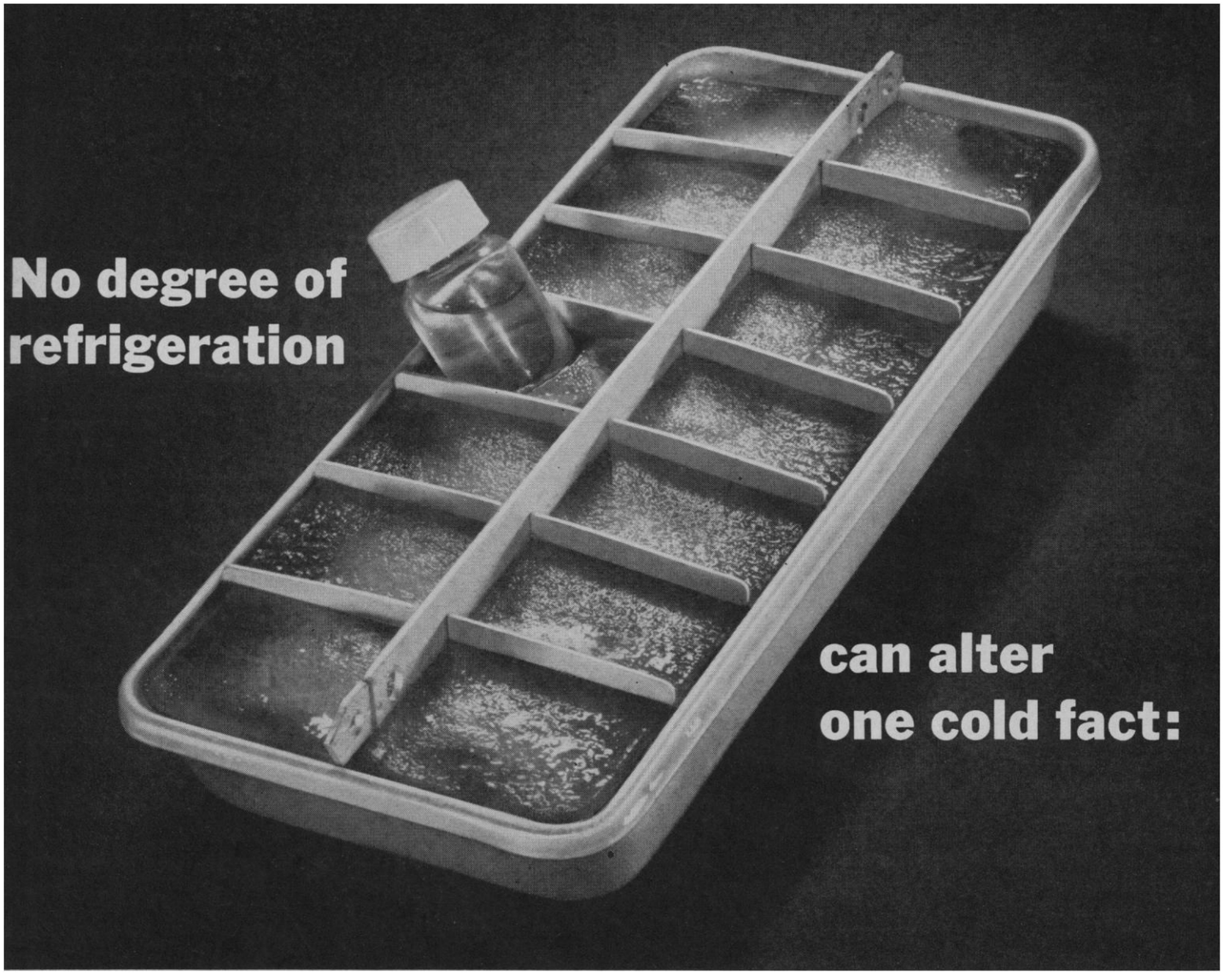
1) Contributions from recent (post-1945) undirected science to the systems studied appear to have been small.

2) The length of time to utilization of scientific findings is decreased when the scientist is working in areas related to the problems of his sponsor.

3) The efficient production of timely knowledge useful to a mission-oriented agency is most readily achieved when that agency funds and manages its own research programs.

Because of its unprecedented nature and impressive scope Project Hindsight is likely to be influential. The report implicitly raises questions concerning government support of academic research which university scientists will do well to consider.—PHILIP H. ABELSON

* Available from the Clearinghouse for Federal Scientific and Technical Information, 5285 Port Royal Road, Springfield, Virginia 22151.



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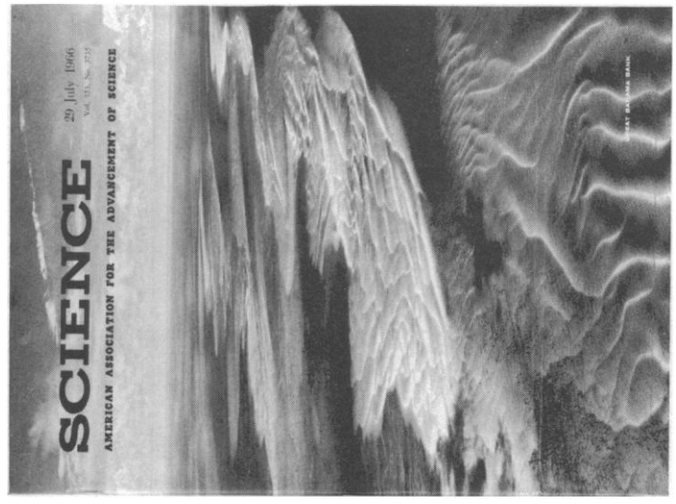

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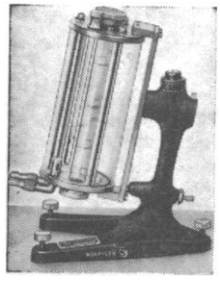

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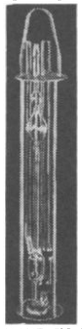

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Vice-Presidential Address of Section Q. Craig Sipe (George Peabody College for Teachers) will preside. Dinosaurs and dodo birds in higher education, Clarence Boeck (University of Minnesota; vice president of Section Q).

Teacher Education for the Eighties. Symposium, joint session of Section Q and the National Association for Research in Science Teaching. Arranged by Craig Sipe, who will also preside. Preparing the science teacher for the elementary school of 1980, Willard Jacobson (Columbia University). Preparing secondary school science teachers for 1980, James A. Rutledge (University of Nebraska).

AAAS Commission on Science Education (Q1)

Panel. Science—A Process Approach, and Experimental Program in Science for Grades Kindergarten through 6. Program sponsored by the Commission. Arranged by John R. Mayor and Arthur H. Livermore (AAAS). John R. Mayor will preside. Panel members: Edwin B. Kurtz, Jr. (AAAS), Arthur H. Livermore (AAAS), Daniel M. Rochowiak (Oliver Cromwell School, Baltimore, Maryland), and Henry Walbesser (AAAS).

Technical and Vocational Education. Symposium, arranged by George B. Brain (Washington State University), who will also preside. Speakers: Grant Venn (U.S. Office of Education), David Bushnell (U.S. Office of Education), and Gordon McCloskey (Washington State University).

American Educational Research Association (Q2)

The Association has arranged a joint session with Section Q (29 Dec.).

American Nature Study Society (Q3)

The ANSS program will be found in the coordinated programs of the Science Teaching Societies. See Q13.

Central Association of Science and Mathematics Teachers (Q4)

The program for CASMT will be found in the coordinated programs of the Science Teaching Societies. See Q13.

Commission on Education in Agriculture and Natural Resources (Q5)

The Commission has arranged a joint session with Section Q (27 Dec.).

Commission on Undergraduate Education in the Biological Sciences (Q6)

The Commission has arranged a joint session with Section Q (27 Dec.).

Cooperative Committee on the Teaching of Science and Mathematics (Q7)

Wednesday 28 December

Some Conjectures with Regard to the Future of Science Education. Symposium. Robert L. Silber (American Chemical Society) will preside. Speakers: Richard L. Shetler (General Learning Corp., Washington, D.C.) and I. A. Warheit (International Business Machines Corp., San Jose, California).

Educational Policies Commission (Q8)

Tuesday 27 December

Education and the Spirit of Science. Program of the Commission, cosponsored by the National Science Teachers Association. Arranged by James E. Russell (National Education Association) and Robert H. Carleton (NSTA). James E. Russell will preside. Speakers: I. I. Rabi (Columbia University), Isaac Asimov (science writer, Newton, Massachusetts), and J. Darrell Barnard (New York University).

National Association for Research in Science Teaching (Q9)

NARST has arranged a joint session with Section Q (29 Dec.).

National Association of Biology Teachers (Q10)

The NABT program will be found in the coordinated programs of the Science Teaching Societies. See Q13.

National Science Teachers Association (Q11)

The NSTA program will be found in the coordinated programs of the Science Teaching Societies. See Q13.

Pennsylvania Science Teachers Association (Q12)

On Thursday, 29 December, the Association will hold its Annual Business Meeting.

Science Teaching Societies Affiliated with AAAS (Q13)

The following is the coordinated program of: American Nature Study Society (Q3), Central Association of Science and Mathematics Teachers (Q4), National Association for Research in Science Teaching (Q9), National Association of Biology Teachers (Q10), and National Science Teachers Association (Q11), in chronological sequence.

Monday 26 December

NSTA Session I. New Approaches in The Laboratory for College Physical Science. Program cosponsored by The Central Association of Science and Mathematics Teachers. Arranged by Albert F. Eiss (NSTA). Conrad E. Ronneberg (Denison University) will preside. Physical science laboratory programs need new approaches, James H. Mathewson (San Diego State College). Laboratory projects in physical science for general education, Conrad Ronneberg. Laboratory projects in physics for science and engineering students, John G. King (Massachusetts Institute of Technology).

ANSS Board of Directors Meeting.

Tuesday 27 December

ANSS Session I. Nature Study and Conservation. Howard E. Weaver (University of Illinois) will preside. Broadened ecological perspectives for understanding man and nature, Sanford S. Farness (Michigan State University). Why wilderness and how biologists can help save it, M. Rupert Cutler (The Wilderness Society, Washington, D.C.). Natural areas: their management and use, Charles H. W. Foster (The Nature Conservancy, Washington, D.C.). Nature study and conservation education programs, Matthew J. Brennan (Pin-

chot Institute for Studies in Conservation, Milford, Pennsylvania). Conservation of conservation materials, Carl S. Johnson (Ohio State University).

NABT. Contributed Papers. Arranged by Philip Fordyce (Florida State University), who will also preside. Six papers will be presented.

All Science Teaching Societies. After BSCS, What? Arranged by Jay Barton II (CUEBS, Washington, D.C.), who will also preside. Introduction: Possible directions for the biology program of the future, William V. Mayer (BSCS). Organizing principle 1; intellectual history, Garland E. Allen (Harvard). Organizing principle 2; social relevance, Sherwood L. Washburn (University of California, Berkeley). Organizing principle 3; quantitative rigor, Wayne Thornburg (Dartmouth).

Joint Mixer of ANSS, CASMT, NABT, NARST, and NSTA. Planned by the Arlington Science Teachers Association. Phoebe Knipling (supervisor of Science, Arlington County Schools) is chairman.

ANSS Board of Directors Meeting.

Wednesday 28 December

ANSS Session II. Frontiers for Nature Study. John A. Gustafson (State University of New York, Cortland) will preside. New horizons in outdoor education through Title III, Kingsley L. Greene (Outdoor Education Project, Lima, Pennsylvania). Outdoor education for rural disadvantaged, Robert L. Vogl (Northern Illinois University). Are naturalists neglecting nature?, Paul E. Goff (Toledo, Ohio, Metropolitan Park District). School site development: site planning; site development; curriculum enrichment; and community use, William B. Stapp (University of Michigan).

NSTA Session II. Science Education and Children. Program cosponsored by the CASMT. Arranged by Albert F. Eiss. Harold E. Tannenbaum (Hunter College) will preside. Introducing children to science, Mrs. Deanna Brummett (elementary teacher, Webster Groves, Missouri). Widening vistas: inservice education, David Butts (University of Texas). Innovation in science education for elementary teachers, Archie L. Lacey (Hunter College).

NABT Luncheon and Address. William K. Stephenson (Earlham College) will preside. Presentation of NABST Presidential Award, Andrew S. Macalaster (Macalaster Scientific Corpora-

tion) to Arnold B. Grobman (retiring president, NABT; Rutgers). Behavioral technology and social change, Francis Mechner (Institute of Behavioral Technology, Pleasantville, New York.).

ANSS Annual Luncheon. Douglas E. Wade (Northern Illinois University) will be master of ceremonies. Presidential address: ANSS—present and future, Howard E. Weaver (University of Illinois). Presentation of the Eva L. Gordon Award in Nature Literature.

Thursday 29 December

All Science Teaching Societies. Joint General Session. Human Ecology. Arranged by Jay Barton II (CUEBS, Washington, D.C.). Jack B. Bresler (Tufts University) will preside. A definition of human ecology, Stanley A. Cain (Assistant Secretary of the Interior). Human ecology in the classroom, Jack B. Bresler. Panel: Paul Baker (Pennsylvania State University) and John Paul Scott (Bowling Green State University).

ANSS Session III. Nature Study Approaches Basic to Science Curricula and Programs. H. Seymour Fowler (Pennsylvania State University) will preside. Using slides to stimulate observing and recording, John W. Brainerd (Springfield College). Engendering a sense of wonder, Stanley B. Mulaik (University of Utah). Exploring winter aspects, Richard B. Fischer (Cornell University). Meeting some problems of outdoor education, Ruth W. Kearns (East Hill School, Camillus, New York).

NSTA Session III. The Physical Sciences in Oceanography. Program cosponsored by the CASMT. Arranged by Albert F. Eiss. Victor J. Linnenbom (U.S. Naval Research Laboratory) will preside. Geophysics, Brackett Hersey (Office of Naval Research). Geochemistry, John Lyman (U.S. Department of the Interior). Fueling of the air-sea system, Michael Garstang (Florida State University).

Joint Committee Meeting to Plan the 1967 Meeting.

ANSS Board Meeting.

Joint Field Trip of ANSS and NABY. Arranged by ANSS and Association of Interpretive Naturalists. Exploring and interpreting some urban ecology in the Washington, D.C., area.

Field Trip of NSTA. Field trip to Goddard Space Flight Center, Greenbelt, Maryland.

Information and Communication (T)

Tuesday 27 December

The Place of Information Retrieval and Scientific Communication in the Education of the Scientist, Part I. Symposium, program of Section T, cosponsored by Section Q–Education. Arranged by Eugene Garfield (Institute for Scientific Information, Philadelphia, Pennsylvania), who will also preside. Scientists and literature resources, Andrew Lasslo (University of Tennessee Medical Units). How can patent literature be made more useful, John Bardeen (University of Illinois). The pedagogical politics of educating scientists, Frederick L. Goodman (University of Michigan). Sweetness and light, Daniel Gore (Ashville-Biltmore College). Training in scientific thinking through the teaching of scientific writing, F. Peter Woodford (Rockefeller University).

Part II. Panel discussion: comments and critiques on papers presented in Part I. Eugene Garfield will preside. Panel members: Sanborn C. Brown (Massachusetts Institute of Technology), Leonard Ornstein (Mount Sinai Hospital, New York, New York), Richard R. Overman (University of Tennessee Medical Units), Halvor N. Christensen (University of Michigan Medical School), John T. Edsall (Harvard), William A. Fowler (California Institute of Technology), Alvin M. Weinberg (Oak Ridge National Laboratory), and John Pinzelik (Purdue).

Wednesday 28 December

Society and Information Resources. Interdisciplinary symposium, arranged by Robert A. Harte (American Society of Biological Chemists, Bethesda, Maryland). C. E. Sunderlin (National Academy of Sciences) will preside. Information as a social catalyst, Louis Levin (National Science Foundation). Dynamics of information exchange: scientists in communication, William D. Garvey (Johns Hopkins University). The federal viewpoint, John Sherrod (U.S. Atomic Energy Commission). The international viewpoint, Harrison Brown (National Academy of Sciences).

Thursday 29 December

Luncheon and Address. Phyllis V. Parkins (BioSciences Information Service, *Biological Abstracts*) will preside. Introductory remarks by Edward G. Sherburne, Jr. (Science Service). Isaac Asimov (Boston University School of

Medicine) will speak on escape to reality.

The Technical Writer and Society. Symposium, joint program of Section T and the Society of Technical Writers and Publishers. Arranged by Isaac D. Welt (American University), who will also preside. Science writing—the communication of concepts, Irlene R. Stephens (City University of New York). Readability—an essential element of communication, Paul W. Howerton (American University). Technical writing and the copyright problem, Bella L. Linden (Linden and Deutsch, Manhattan). Spot science news and the spirit of science, Chauncey D. Leake (University of California Medical School, San Francisco).

Vice-Presidential Address of Section T. Phyllis V. Parkins (secretary of Section T) will preside. Toward a national information system for the life sciences, William C. Steere (New York Botanical Garden).

Business Meeting. William C. Steere will preside.

National Association of Science Writers (T1)

Tuesday 27 December

Business meeting and reception by Invitation.

Statistics (U)

Monday 26 December

Experimental Design in Education. Symposium, joint program of Sections U and Q–Education. Arranged by Rosedith Sitgreaves (Columbia University). Morris B. Ullman (Bureau of the Budget) will preside. A design to assess the effect of given information on judges' ratings, Benjamin Rosner (Educational Testing Service, Princeton, New Jersey). Designs for measuring change over time, Richard H. Lindeman (Columbia University). Some problems in designs for educational research, William W. Farquar (Michigan State University).

Tuesday 27 December

Experimental Design in Epidemiology. Symposium joint program of Sections U and N–Medical Sciences. Arranged by Rosedith Sitgreaves. Lila M. Elveback (Mayo Clinic) will preside. Mouse population experiments with ectromelia (a favorite Topley-Wilson design), Lauritz R. Christensen (Berg Institute, New York University). The

iatrotropic stimulus and clinical spectrum of a disease: a source of constant bias in epidemiologic comparisons, Alvan R. Feinstein (Yale University School of Medicine). A model for Dengue hemorrhagic fever (a Ph.D. thesis with Colin White), Diana Fisher (Yale).

Thursday 29 December

Vice-Presidential Session. W. J. Youden (George Washington University) will preside. R. A. Fisher: A memorial address by Jerzy Neyman (University of California, Berkeley; past vice president for Section U). A few footnotes by William G. Cochran (Harvard; vice president for Section U).

Friday 30 December

Experimental Design in Agriculture. Symposium, joint session of Sections U and O–Agriculture. Arranged by Rosedith Sitgreaves. Fred Schultz (U.S. Department of Agriculture, Beltsville, Maryland) will preside.

American Statistical Association (U1)

Cosponsor of Section U's entire program. The American Statistical Association (Washington Statistical Society Chapter) and Section U will jointly sponsor a luncheon and address on 29 December at 12:30 p.m. at the Presidential Arms, 1320 G Street, NW. W. Edwards Deming will preside, and Churchill Eisenhart (NBS, Gaithersburg), past chairman of Section U, will speak on "Antecedents of modern experimental design."

Biometric Society, Eastern North American Region (U2)

Thursday 29 December

Over-exploited Animal Populations, Part I. Symposium, joint program of the Biometric Society, ENAR, and Sections F–Zoological Sciences and U, cosponsored by the American Fisheries Society. Arranged by Douglas S. Robson (Cornell). Walter F. Crissey (Bureau of Sport Fisheries and Wildlife, Laurel, Maryland) will preside. Population dynamics of Antarctic baleen whales, Douglas G. Chapman (University of Washington). Effect of hunting mortality in North American ducks, Aelred D. Geis (Bureau of Sport Fisheries and Wildlife, Laurel, Maryland). Responses of seal populations

to exploitation, Ian A. McLaren (Dalhousie University). Social behavior in relation to exploitation of California sea lion and northern fur seal, Richard S. Peterson (University of California, Santa Cruz).

Over-exploited Animal Populations, Part II. John L. McHugh (Bureau of Commercial Fisheries, Washington, D.C.) will preside. Sustainable yield from the Georges Bank haddock stock, Marvin D. Grosslein (Bureau of Commercial Fisheries, Woods Hole, Massachusetts). Effects of over-exploitation in the sockeye salmon of the Skenna River, Peter A. Larkin (University of British Columbia). The effect of fishing on the Pacific sardine, Garth I. Murphy (University of Hawaii). Exploitation status of tunas in the central Pacific, Brian J. Rothschild (Bureau of Commercial Fisheries, Honolulu, Hawaii). Fishery dynamics and present status of the yellowfin tuna population of the eastern Pacific Ocean, Milner B. Schaefer (University of California, San Diego). Species succession and fishery exploitation in the Great Lakes, Stanford H. Smith (Bureau of Commercial Fisheries, Ann Arbor, Michigan).

Institute of Mathematical Statistics (U3)

The Institute is a cosponsor of all sessions of Section U.

Science in General

The following are programs of organizations not affiliated with any single section.

Academy Conference (X1)

Tuesday 27 December

Breakfast Meeting of the Executive Committee.

Business Meeting of the Academy Conference. James A. Rutledge (president, Academy Conference) will preside. Topics: Reports of officers, reports of committees, discussion of Academy programs and problems, and election of officers.

Public Understanding of Science. James A. Rutledge will preside. The role of state and local Academies of Science in the public understanding of science, E. G. Sherburne, Jr. (Science Service, Washington, D.C.). Discussants: Henry Eyring (University of

Utah), John H. Melvin (Ohio Academy of Science), and J. Teague Self (University of Oklahoma).

Publications and Academies of Science. Program of the Academy Conference, cosponsored by Section T–Information and Communication. V. Elving Anderson (president elect, Academy Conference) will preside. The role of Academies of Science in the field of scientific publications, Robert E. Gordon (University of Notre Dame). Discussants: Gordon H. Bixler (editor, *Chemical and Engineering News*, American Chemical Society, Washington, D.C.), R. Hobart Ellis, Jr. (editor, *Physics Today*, American Institute of Physics, New York City), and Sylvia W. Rosen (Minnesota Academy of Science, Minneapolis).

Academy Conference Dinner and Presidential Address. Karlem Riess (past president, Academy Conference) will preside. Presentation of Distinguished Service Awards by Clinton L. Baker (Southwestern College, Memphis). The requisities of a strong academy, James A. Rutledge.

Wednesday 28 December

American Junior Academy of Science Program I. Robert C. Fite (Oklahoma State University) will preside. Sawdust effects on filth, Lyn Grandt (LaGrove High School, Farina, Illinois). Chlorioallantoic studies, Letantia Jankowski (Immaculate Conception High School, Lodi, New Jersey). Developing a method for determining temperatures in a planetary nebula, Carol Anne Farlow (James Madison High School, Vienna, Virginia). Influence of riboflavin on the effects of 3-amino-1,2,4-triazole on *Schizosaccharomyces octosporus*, Ann Cosgrove (Norman High School, Norman, Oklahoma). The effects of thiouracil on the thyroid gland of the albino mouse, Patricia Patridge (Mason City, Iowa). Fossils, the story of ancient life, Larry Lundardi (Notre Dame High School, Niles, Illinois). Photosynthetic gas exchanger in a closed ecosystem for space, Thomas Paul Starch (Marist High School, Bayonne, New Jersey). Determination of the structural change involved in learning in planarians through the application of retrograde amnesia, Jack Gaughan, Jr. (Homer L. Ferguson High School, Newport News, Virginia). An algebraic ring of F-sequence and determinant solutions to simultaneous equations in the system, Ken A. Dill (Putnam City High School, Oklahoma City, Oklahoma).

American Junior Academy of Science

Program II. Wilmer W. Tanner (Brigham Young University) will preside. The research, design, and development of the ARC-jet engine and its application, Gary Hudson (St. Bernard's High School, St. Paul, Minnesota). A comparison of methods of interpretation, Don Barry (Cedar Rapids, Iowa).

Scientific Research Society of America (X2)

Thursday 29 December

Joint Luncheon of the Society of the Sigma Xi and the Scientific Research Society of America.

Annual Address of the Scientific Research Society of America and Award of the William Procter Prize. Chauncey Starr will preside. Speaker: Elmer W. Engstrom (Radio Corporation of America). Award of William Procter Prize by Chauncey Starr.

18th Annual Convention of the Scientific Research Society of America. Chauncey Starr will preside.

Scientists' Institute for Public Information (X3)

The Institute's Committee on the Biological and Social Apsects of Race is a joint sponsor of the symposium, The Utility of the Construct of Race (30 Dec.). See General Sessions.

Sigma Delta Epsilon (X4)

Monday 26 December

Coffee Hour (4 p.m.) for all women in science.

Tuesday 27 December

Member Research on Cancer and Infectious Disease. Symposium arranged by a committee: Agnes Hansen (University of Minnesota, chairman; Barbara Roth (Burroughs Wellcome & Company, Tuckahoe, New York); Eltora M. Schroeder (U.S. Department of Agriculture, Beltsville, Maryland). Irene C. Diller (Institute for Cancer Research, Philadelphia, Pennsylvania) will preside and present the first paper, The infectious nature of cancer. Bacterial implications of cancer, Eleanor Alexander-Jackson (College of Physicians and Surgeons, Columbia University). Viruses and cancer, Bernice E. Eddy (National Institutes of Health). Mechanisms of chemical carcinogenesis,

Helen M. Dyer (National Science Foundation). Environmental factors influencing radiation-induced genetical damage to the cell, Anna R. Whiting (Oak Ridge National Laboratory). Chemotherapy based on differential enzyme inhibition, Barbara Roth (Burroughs Wellcome & Company). A new experimental animal for medical research—the miniature pig, Almut E. Dettmers (University of Minnesota).

Wednesday 28 December

Luncheon for all women in science. Eltora M. Schroeder (president, Sigma Delta Epsilon) will preside. What is a hortorium?, Margaret H. Stone (L. H. Bailey Hortorium, Cornell University).

Society of the Sigma Xi (X5)

Thursday 29 December

7th Annual Convention of the Society of the Sigma Xi, Part I. Farrington Daniels (University of Wisconsin, Madison) will preside.

Joint Annual Address of the Society of the Sigma Xi and the United Chapters of Phi Beta Kappa. H. Bentley Glass (member, AAAS Board of Directors) will preside. Science, a wellspring of our discontent, Walter Orr Roberts (National Center for Atmospheric Research, Boulder, Colorado).

United Chapters of Phi Beta Kappa (X6)

The program consists of the joint address of Phi Beta Kappa and Sigma Xi (29 Dec.).

Washington Academy of Sciences (X7)

Tuesday 27 December

Special Invited Lecture. John K. Taylor (president, Washington Academy of Sciences) will preside. The ever-widening gap, P. M. S. Blackett (president, The Royal Society, London, England).

Wildlife Society (X8)

Friday 30 December

Wildlife Resources in a Changing World. Symposium, joint program of Section F–Zoological Science and the Wildlife Society. Arranged by John L. Buckley (U.S. Department of the Interior). For details, see Section F.

Forthcoming Events

December

26–31. **American Assoc. for the Advancement of Science**, annual, Washington, D.C. (R. L. Taylor, AAAS, 1515 Massachusetts Ave., NW, Washington, D.C. 20005)

In addition to the 20 sections of the Association and five AAAS committees, the following organizations have arranged sessions at the AAAS annual meeting 26–31 December in Washington, D.C.

Mathematics

American Mathematical Soc. (E. Pitcher, Lehigh Univ., Bethlehem, Pa.)

Association for Computing Machinery (D. Leiti, Heliodyne Corp., Rosslyn, Va.)

National Council of Teachers of Mathematics (J. Gates, 1201 16 St., NW, Washington, D.C.)

Society for Industrial and Applied Mathematics (J. H. Griesmer, I.B.M., T. J. Watson Research Center, Yorktown Heights, N.Y.)

Physics

American Astronautical Soc. (S. F. Singer, Univ. of Miami, Coral Gables, Fla.)

American Meteorological Soc. (J. E. Masterson, Natl. Center for Atmospheric Research, Greenbelt, Md.)

Harvard Project Physics (F. J. Rutherford, Harvard Univ., Cambridge, Mass.)

Chemistry

American Assoc. of Clinical Chemists (R. S. Melville, Natl. Inst. of General Medical Sciences, NIH, Bethesda, Md.)

Geology and Geography

Association of American Geographers, Middle Atlantic Div. (D. J. Patton, Carnegie Inst. of Washington, Washington, D.C.)

National Geographic Soc. (R. Gray, The Society, Washington, D.C.)

National Speleological Soc. (W. B. White, Pennsylvania State Univ., University Park)

Zoological Sciences

American Fisheries Soc. (R. F. Hutton, The Society, Washington, D.C.)

American Soc. of Zoologists (L. E. DeLanney, Ithaca College, Ithaca, N.Y.)

Animal Behavior Soc. (E. M. Banks, Univ. of Illinois, Urbana)

Herpetologists' League (J. E. Huheey, Dept. of Chemistry, Univ. of Maryland, College Park)

Society of Systematic Zoology (R. P. Higgins, Wake Forest College, Winston-Salem, N.C.)

Zoological and Botanical Sciences

American Soc. of Naturalists (R. D. Hotchkiss, Rockefeller Univ., New York, N.Y.)

Association of Southeastern Biologists (E. Quarterman, Vanderbilt Univ., Nashville, Tenn.)

Beta Beta Beta Biological Soc. (Mrs. F. G. Brooks, Box 515 Ansonia Sta., New York, N.Y.)

Ecological Soc. of America (C. D. Monk, Laboratory of Radiation Biology, Bldg. 772-G, Aiken, S.C.)

Society for the Study of Evolution (E. C. Olson, Univ. of Chicago, Chicago, Ill.)

Psychology

American Speech and Hearing Assoc. (E. D. Schubert, Stanford Univ., Palo Alto, Calif.)

Social and Economic Sciences

American Economic Assoc. (H. F. Williamson, Northwestern Univ., Evanston, Ill.)

American Political Science Assoc. (G. M. Lyons, Natl. Acad. of Sciences, Washington, D.C.)

American Soc. of Criminology (D. E. J. MacNamara, City Univ. of New York, New York)

American Sociological Assoc. (J. A. Beegle, Michigan State Univ., East Lansing)

Metric Assoc. (R. P. Fischelis, College of Pharmacy, Ohio Northern Univ., Ada)

National Inst. of Social and Behavioral Science (D. P. Ray, The Institute, Washington, D.C.)

Society for the Scientific Study of Religion (H. L. Silverman, Seton Hall Univ., South Orange, N.J.)

History and Philosophy of Science

History of Science Soc. (B. S. Finn, Museum of History and Technology, Smithsonian Inst., Washington, D.C.)

Science Courses for Baccalaureate Education Project (V. L. Parsegian, Rensselaer Polytechnic Inst., Troy, N.Y.)

Society for General Systems Research (R. F. Ericson, George Washington Univ., Washington, D.C.)

Society for the History of Technology (R. Sanders, Industrial College of the Armed Forces, Washington, D. C.)

Medical Sciences

Alpha Epsilon Delta (M. L. Moore, The Society, Bronxville, N.Y.)

American Acad. of Psychoanalysis (E. A. Weinstein, Washington School of Psychiatry, Washington, D.C.)

American Assoc. of Bioanalysts (M. M. Cohen, 165-25 Hillside Ave., Jamaica, N.Y.)

American Physiological Soc. (F. Halberg, Univ. of Minnesota, Minneapolis)

American Psychiatric Assoc. (J. O. Cole, Natl. Inst. of Mental Health, NIH, Bethesda, Md.)

Education

AAAS Commission on Science Education (J. R. Mayor, AAAS, Washington, D.C.)

American Nature Study Soc. (D. E. Wade, 106 Depot St., Oregon, Ill.)

Cooperative Committee (E. Will, State College of New York, Oneonta)

Educational Policies Commission (J. E. Russell, The Commission, Natl. Education Assoc., Washington, D.C.)

National Assoc. of Biology Teachers (W. Stephenson, Earlham College, Richmond, Ind.)

National Science Teachers Assoc. (A. F. Eiss, NSTA, Washington, D.C.)

Pennsylvania Science Teachers Assoc. (D. Ulmer, Lock Haven State College, Lock Haven, Pa.)

Science Teaching Soc. Coordinated Program (A. F. Eiss, Natl. Science Teachers Assoc., Washington, D.C.)

Information and Communication

National Assoc. of Science Writers (L. Zahn, Hill and Knowlton, Inc., 150 E. 42 St., New York, N.Y.)

Society of Technical Writers and Publishers (I. D. Welt, School of Government, American Univ., Washington, D.C.)

Biometric Soc. ENAR (D. S. Robson, Dept. of Plant Breeding, Cornell Univ., Ithaca, N.Y.)

Science in General

Academy Conference (K. Reiss, Tulane Univ., New Orleans, La.)

Scientific Research Soc. of America (D. B. Prentice, The Society, 51 Prospect St., New Haven, Conn.)

Society of the Signa Xi (T. T. Holme, 51 Prospect St., New Haven, Conn.)

Washington Acad. of Sciences (J. K. Taylor, The Academy, Washington, D.C.)

Wildlife Soc. (J. L. Buckley, U.S. Dept. of the Interior, Washington, D.C.)

27–30. American **Astronomical** Soc., 123rd mtg., University of California, Los Angeles, (G. C. McVittie, The Society, Univ. of Illinois Observatory, Urbana)

28–30. **Econometric** Soc., winter mtg., San Francisco, Calif. (Box 1264, Yale Station, New Haven, Conn.)

January

2–6. **Endoctrinology**, 3rd Asia and Oceania congr., Manila, Philippines. (L. S. Villadolid, Dept. of Medicine, College of Medicine, Univ. of the Philippines, Herran, Manila)

3–7. **Chemistry**, 4th Caribbean symp., Univ. of the West Indies, Mona, Kingston, Jamaica. (W. R. Chan, Chemistry Dept., Univ. of the West Indies, Mona, Kingston 7)

4–5. Society for **General Microbiology**, 48th general mtg., London, England. (The Society, c/o Soc. for Visiting Scientists, 19 Albermarle St., London W.1)

4–7. National Soc. of Professional **Engineers**, winter mtg., San Juan, P.R. (The Society, 2029 K St., NW, Washington, D.C. 20006)

4–7. **Solid State Physics**, conf., Manchester, England. (Inst. of Physics and the Physical Soc., 47 Belgrave Sq., London S.W.1)

5–6. **Rheology and Texture of Foodstuffs**, symp., London, England. (P. Sherman, Unilever Research Laboratory, Welwyn, Herts., England)

9–10. **Industrial Research**, 2nd natl. conf., Purdue Univ., West Lafayette, Ind. (W. E. Spaulding, Krannert Graduate School of Industrial Administration, Purdue Univ., West Lafayette)

9–11. Electrical and Electronic **Measurement and Test Instruments**, conf., Ottawa, Ontario, Canada. ("EEMTIC '67," Box 6015, Postal Station J, Ottawa 13)

9–14. American **Library** Assoc., mtg., New Orleans, La. (D. H. Clift, The As-

sociation, 50 E. Huron St., Chicago, Ill. 66011)

9–18. **Spectroscopy,** intern. conf., Bombay, India. (Organizing Committee, Spectroscopy Div., Atomic Energy Establishment, 414 A Cadell Rd., Bombay 28)

10–12. **Reliability,** annual symp., Inst. of Electrical and Electronics Engineers, Washington, D.C. (IEEE, 345 E. 47 St., New York 10017)

10–13. Physics of **Quiescent Plasmas,** conf., Rome, Italy. (Quiescent Plasmas, Laboratorio Gas Ionizzati, EURATOM-C.N.E.N., C. P. 65, Frascati, Rome, Italy)

11–13. **Surface Chemistry,** 3rd Scandinavian symp., Fredensborg, Denmark. (Nordforsk, Ørnevej 30, Copenhagen NV)

12–14. Evaluation of Agents Used in Prevention of **Oral Diseases,** conf., New York Acad. of Sciences, New York. (J. Hein, Forsythe Dental Center, 140 Fenway, Boston, Mass. 02215)

13–14. **Orthopaedic Research** Soc., mtg., San Francisco, Calif. (R. A. Calandruccio, 869 Madison Ave., Memphis, Tenn.)

13–14. American Soc. for **Surgery of the Hand,** San Francisco, Calif. (R. M. Curtis, 2947 St. Paul St., Baltimore, Md. 21218)

14–19. American Acad. of **Orthopedic Surgeons.** San Francisco, Calif. (J. K. Hart, 29 E. Madison St., Chicago, Ill. 60602)

16–18. **Compressed Gas** Assoc., annual mtg., New York, N.Y. (The Association, 500 Fifth Ave., New York 10036)

16–20. **Australian and New Zealand** Assoc. for the Advancement of Science, 39th congr., Melbourne, Australia. (W. W. Fee, The Association, Dept. of Chemistry, Univ. of Melbourne, Parkville, N.2, Australia)

16–20. **Highway Research** Board, NAS–NRC, 46th annual mtg., Washington, D.C. (E. W. Harris, 2101 Constitution Ave., NW, Washington, D.C. 20418)

16–21. Atomic, Molecular, and Solid State **Physics,** symp., Gainesville, Fla. (P.-O. Löwdin, Quantum Theory Project, Nuclear Sciences Bldg., Univ. of Florida, Gainesville 32601)

16–21. Recent Advances in **Tropical Ecology,** symp., Varanasi, India. (R. Misra, Intern. Soc. for Tropical Ecology, Dept. of Botany, Banaras Hindu Univ., Varanasi 5)

16–27. Low Energy **Nuclear Physics,** intern. seminar, Dacca, Pakistan. (A. M. Harunar Rashid, Atomic Energy Center, P.O.B. 164 RAMNA, Dacca)

16–31. **Ocean Science,** 5th Pan Indian congr., Bangkok, Thailand. (P. Cheosakul, Natl. Research Council, Bangkhen, Bangkok)

17–18. **Engineering** Socs. and Their **Literature Programs,** symp., Engineers Joint Council, New York. (EJC, 345 E. 47 St., New York 10017)

17–18. **Simulation** in Medicine and Biology, symp., Central and Midwestern States Simulation Council, Mayo Clinic, Rochester, Minn. (J. B. Bassingthwaighte, Dept. of Physiology, Mayo Clinic, Rochester 55902)

18–20. **Oil and Water,** symp., Brighton, England. (Inst. of Petroleum, 61 New Cavendish St., London W.1)

18–21. **Conformation of Biopolymers,**

intern. symp., Madras, India. (C. Ramakrishnan, Centre of Advanced Study in Biophysics, Univ. of Madras, A.C. College Bldgs., Madras 25)

18–22. **Parasitology**, 1st Latin American congr., Santiago, Chile. (R. Donckaster, Dept. of Parasitology, Univ. of Chile, Santiago)

20–21. **Blood**, 15th symp., Wayne State Univ., Detroit, Mich. (W. H. Seegers, Dept. of Physiology, Wayne State Univ. School of Medicine, Detroit 48207)

20–2. International College of **Surgeons**, 3rd Caribbean surgical congr. and cruise. (S. E. Henwood, 1516 Lake Shore Dr., Chicago, Ill. 60610)

22–3. **Electron Microscopy**, workshop, Northeastern Univ., Boston, Mass. (M. D. Maser, Millard Fillmore Hospital, 3 Gates Circle, Buffalo, N.Y. 14209)

23–24. **Avionics**, symp., Montreal, Canada. (Secretary, Canadian Aeronautics and Space Inst., 77 Metcalfe St., Ottawa 4, Ontario, Canada)

23–24. **Coupled Reactor Kinetics**, natl. mtg., Texas A&M Univ., College Station. (C. G. Chezem, Dept. of Nuclear Engineering, Texas A&M Univ., College Station 77843)

23–25. **Aerospace Science**, 5th mtg., American Inst. of Aeronautics and Astronautics, New York, N.Y. (Manager of Public Information, AIAA, 1290 Sixth Ave., New York 10019)

23–25. Society of **Thoracic Surgeons**, mtg., Kansas City, Mo. (F. X. Byron, The Society, City of Hope Medical Center, 1500 E. Duarte Rd., Duarte, Calif. 91010)

23–27. **Relativistic Astrophysics**, symp., New York, N.Y. (A. G. W. Cameron, Belfer Graduate School of Science, Yeshiva Univ., New York 10033)

24–27. **Comparative Pharmacology**, intern. symp., Natl. Inst. of Health, Bethesda, Md. (G. J. Cosmides, Room 5B29, Bldg. 31, NIH, Bethesda 20014)

25–27. American **Crystallographic** Assoc., mtg., Georgia Inst. of Technology, Atlanta. (W. L. Kehl, Gulf Research and Development Co., P.O. Drawer 2038, Pittsburgh, Pa. 15230)

25–27. American **Mathematical** Soc., 73rd annual mtg., Houston, Tex. (The Society, P.O. Box 6248, Providence, R.I. 02904)

25–28. American **Group Psychotherapy** Assoc., New York, N.Y. (Mrs. M. Schiff, 1790 Broadway, New York 10019)

26–28. **Mathematical** Assoc. of America, 50th annual mtg., Houston, Tex. (H. L. Alder, Univ. of California, Davis)

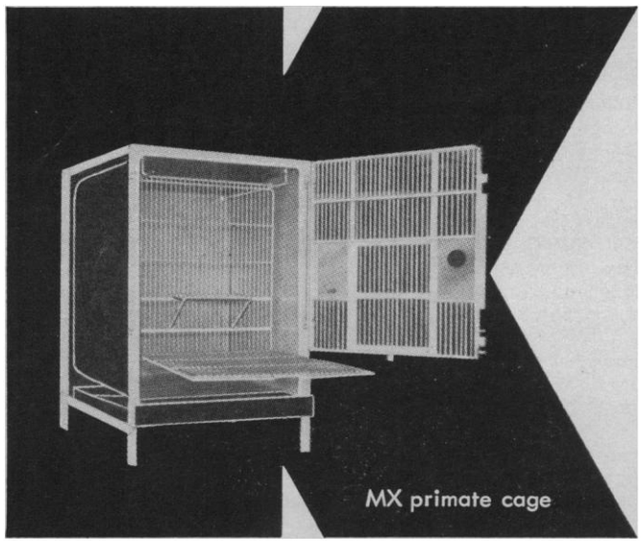
28–30. **Radiology**, southern conf., Point Clear, Ala. (M. Eskridge, P.O. Box, 4097, Mobile, Ala.)

28–1. American Acad. of **Allergy**, Phoenix, Ariz. (J. O. Kelley, 756 N. Milwaukee St., Milwaukee, Wis. 53202)

29. **Mössbauer Effect Methodology**, 3rd annual symp., New York, N.Y. (P. A. McNulty, New England Nuclear Corp., 575 Albany St., Boston, Mass. 02118)

29–3. **Power**, mtg., Power Group, Inst. of Electrical and Electronics Engineers, New York, N.Y. (E. C. Day, IEEE, 345 E. 47 St., New York 10017)

30. American Soc. of **Heating, Refrigerating, and Air Conditioning Engineers**, semi-annual mtg., Detroit, Mich. (Miss J. I. Szabo, 345 E. 47 St., New York 10017)



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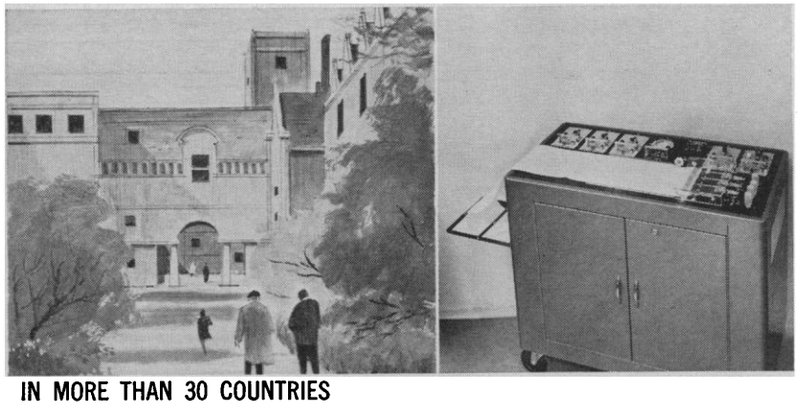

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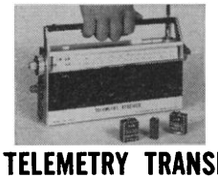

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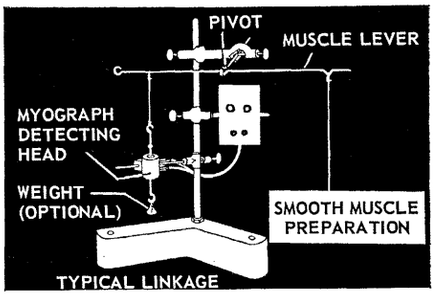

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NEW BOOKS

(Continued from page 1161)

Wiley, New York, 1966. 417 pp. Illus. $12.95.

Chemical Equilibrium. Allen J. Bard. Harper and Row, New York, 1966. 216 pp. Illus. $7.50. Harper's Chemistry Series.

Chemistry Calculations: With a Focus on Algebraic Principles. Alexander Vavoulis. Holden-Day, San Francisco, 1966. 152 pp. Illus. Paper, $2.50; cloth, $4.95.

The Chemistry of Organic Sulfur Compounds. vol. 2. Norman Kharasch and Cal Y. Meyers, Eds. Pergamon, New York, 1966. 473 pp. Illus. $21. There are 14 papers.

Climatic Atlas of the United States. Stephen Sargent Visher. Harvard Univ. Press, Cambridge, Mass., 1966. 415 pp. Illus. $12.50.

Complexes of the Rare Earths. Shyama P. Sinha. Pergamon, New York, 1966. 213 pp. Illus. $7.50.

Differential and Difference Equations. Louis Brand. Wiley, New York, 1966. 716 pp. Illus. $11.95.

Differential Space, Quantum Systems, and Prediction. Norbert Wiener, Armand Siegel, Bayard Rankin, and William Ted Martin. M.I.T. Press, Cambridge, Mass., 1966. 188 pp. Illus. $7.50.

The Dynamics of the Upper Ocean. O. M. Phillips. Cambridge Univ. Press, New York, 1966. 269 pp. Illus. $11.50. Cambridge Monographs on Mechanics and Applied Mathematics.

Electronic Structure of Molecules. Raymond Daudel. Translated from the French (Paris, 1962). Pergamon, New York, 1966. 241 pp. Illus. $8.

Elementary Electronics. D. Hywel White. Harper and Row, New York, 1966. 184 pp. Illus. $9.50. Harper's Physics Series.

Elementary Methods in the Analytic Theory of Numbers. A. O. Gel'fond and Yu. V. Linnik. Translated from the Russian edition (Moscow, 1962) by D. E. Brown. I. N. Sneddon, Translation Ed. Pergamon, New York, 1966. 244 pp. Illus. $9.80. International Series of Monographs in Pure and Applied Mathematics, vol. 92.

Freezing and Thawing of Concrete—Mechanisms and Control. William A. Cordon. American Concrete Inst., Detroit; Iowa State Univ. Press, Ames, 1966. 111 pp. Illus. $4.50.

Fundamentals of Electronics. vol. 1. George E. Owen and P. W. Keaton. Harper and Row, New York, 1966. 351 pp. Illus. $14. Harper's Physics Series.

Handbook of Compressed Gases. Prepared by the Compressed Gas Association. Reinhold, New York, 1966. 414 pp. Illus. $20.

Handbook of Specific Losses in Flow Systems. Robert P. Benedict and Nicola A. Carlucci. Plenum Press, New York, 1966. 203 pp. Illus. $12.50.

Infrared Spectra of Polymers in the Medium and Long Wavelength Regions. Dieter O. Hummel. Interscience (Wiley), New York, 1966. 215 pp. Illus. $12.

Instrumentation for High Speed Plasma Flow. A. E. Fuhs. Published for Advisory Group for Aerospace Research and Development, NATO. Gordon and Breach, New York, 1966. 196 pp. Illus. $19.50.

Integral Equations and Their Applications. vol. 1. W. Pogorzelski. Translated from the Polish edition (Warsaw, 1953–1960). PWN-Polish Scientific Publishers, Warsaw; Pergamon, New York, 1966. 732 pp. Illus. $18.50.

International Meteorological Tables. S. Letestu, Ed. World Meteorological Organization, Geneva, 1966. Unpaged.

Interpretation of Mass Spectra: An Introduction. F. W. McLafferty. Benjamin, New York, 1966. 247 pp. Illus. $9.

Interval Analysis. Ramon E. Moore. Prentice-Hall, Englewood Cliffs, N.J., 1966. 159 pp. Illus. $9. Prentice-Hall Series in Automatic Computation.

Introduction to Analytic Functions. Wilfred Kaplan. Addison-Wesley, Reading, Mass., 1966. 222 pp. Illus. $7.95. Addison-Wesley Series in Mathematics.

Introduction to Electrical Discharges in Gases. Sanborn C. Brown. Wiley, New York, 1966. 296 pp. Illus. $9.95. Wiley Series in Plasma Physics.

An Introduction to Equilibrium Thermodynamics. Robert P. Bauman. Prentice-Hall, Englewood Cliffs, N.J., 1966. 128 pp. Illus. Paper, $1.95; cloth, $5.50. Foundations of Modern Chemistry Series.

Introduction to Linear Programming, with Applications. William R. Smythe, Jr., and Lynwood A. Johnson. Prentice-Hall, Englewood Cliffs, N.J., 1966. 231 pp. Illus. $10.

Logic and Algorithms: With Applications to the Computer and Information Sciences. Robert R. Korfhage. Wiley, New York, 1966. 206 pp. Illus. $7.95.

Magnetoelectric Devices: Transducers, Transformers, and Machines. Gordon R. Slemon. Wiley, New York, 1966. 556 pp. Illus. $11.50.

Materials of High Vacuum Technology. vol. 1, *Metals and Metalloids*. Werner Espe. Deutscher Verlag der Wissenschaften, Berlin; Pergamon, New York, 1966. 924 pp. Illus. $45.

Networks and Systems. Peter H. O'N. Roe. Addison-Wesley, Reading, Mass., 1966. 350 pp. Illus. $12.50. Addison-Wesley Series in Electrical Engineering.

Numerical Solutions of Nonlinear Differential Equations. Proceedings of a symposium (Madison, Wis.), May 1966. Conducted by the Mathematics Research Center, U.S. Army. Donald Greenspan, Ed. Wiley, New York, 1966. 357 pp. Illus. $7.75. There are 14 papers and 24 abstracts.

Organic Nomenclature: A Programmed Introduction. James G. Traynham. Prentice-Hall, Englewood Cliffs, N.J., 1966. 143 pp. Illus. Paper, $1.95.

Organic Photochemistry. Robert O. Kan. McGraw-Hill, New York, 1966. 303 pp. Illus. $12.50. McGraw-Hill Series in Advanced Chemistry.

Photographic Systems for Engineers. F. M. Brown, H. J. Hall, and J. Kosar, Eds. Soc. of Photographic Scientists and Engineers, Washington, D.C., 1966. 227 pp. Illus. Paper, $5. Based on papers presented at seminars held in 1959 and 1966 by the New York Chapter of the Society.

Progress in Ceramic Science. vol. 4. J. E. Burke, Ed. Pergamon, New York, 1966. 287 pp. Illus. $14. Five papers.

Progress in Nuclear Magnetic Resonance Spectroscopy. vol. 1. J. W. Emsley, J. Feeney, and L. H. Sutcliffe. Pergamon,