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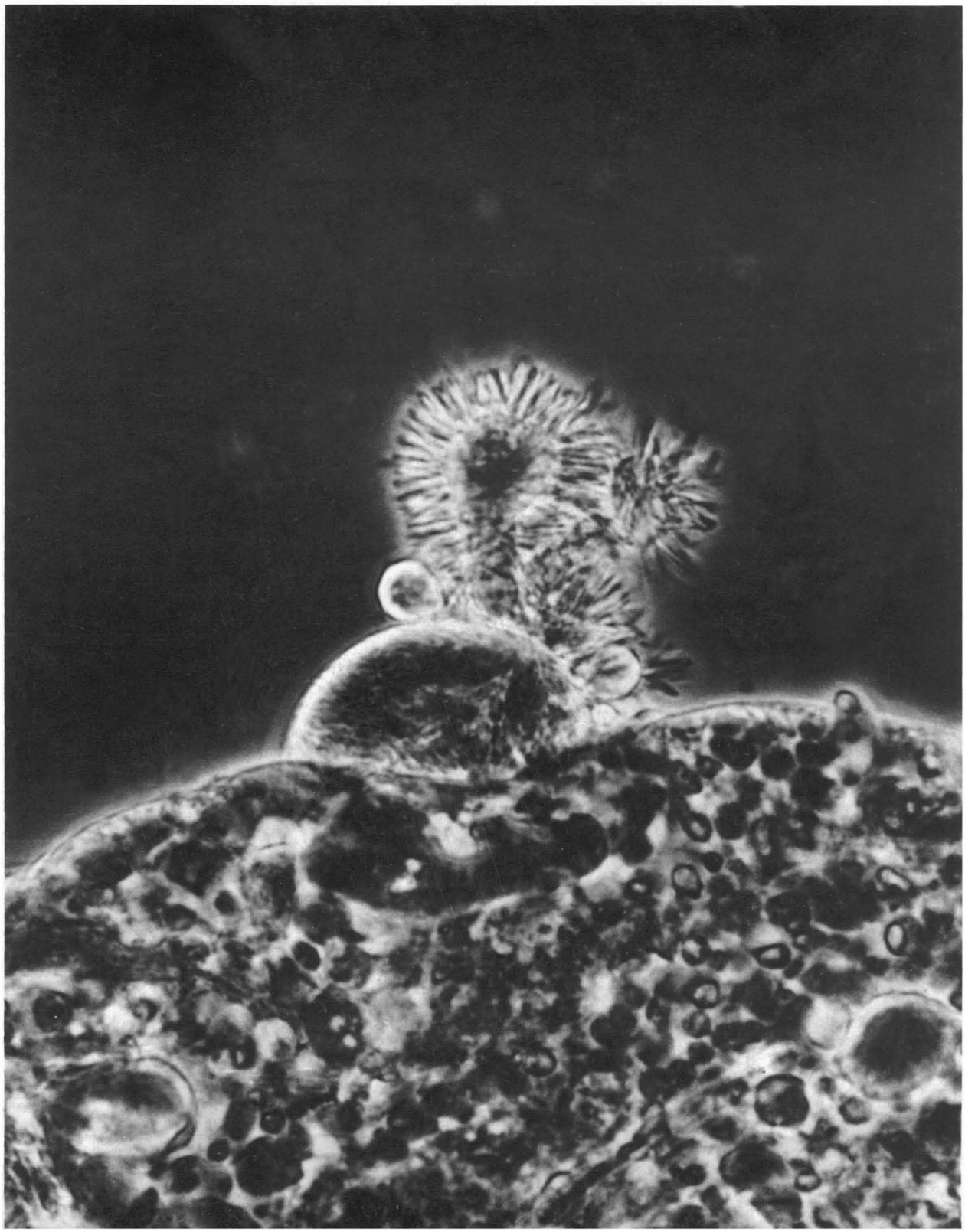
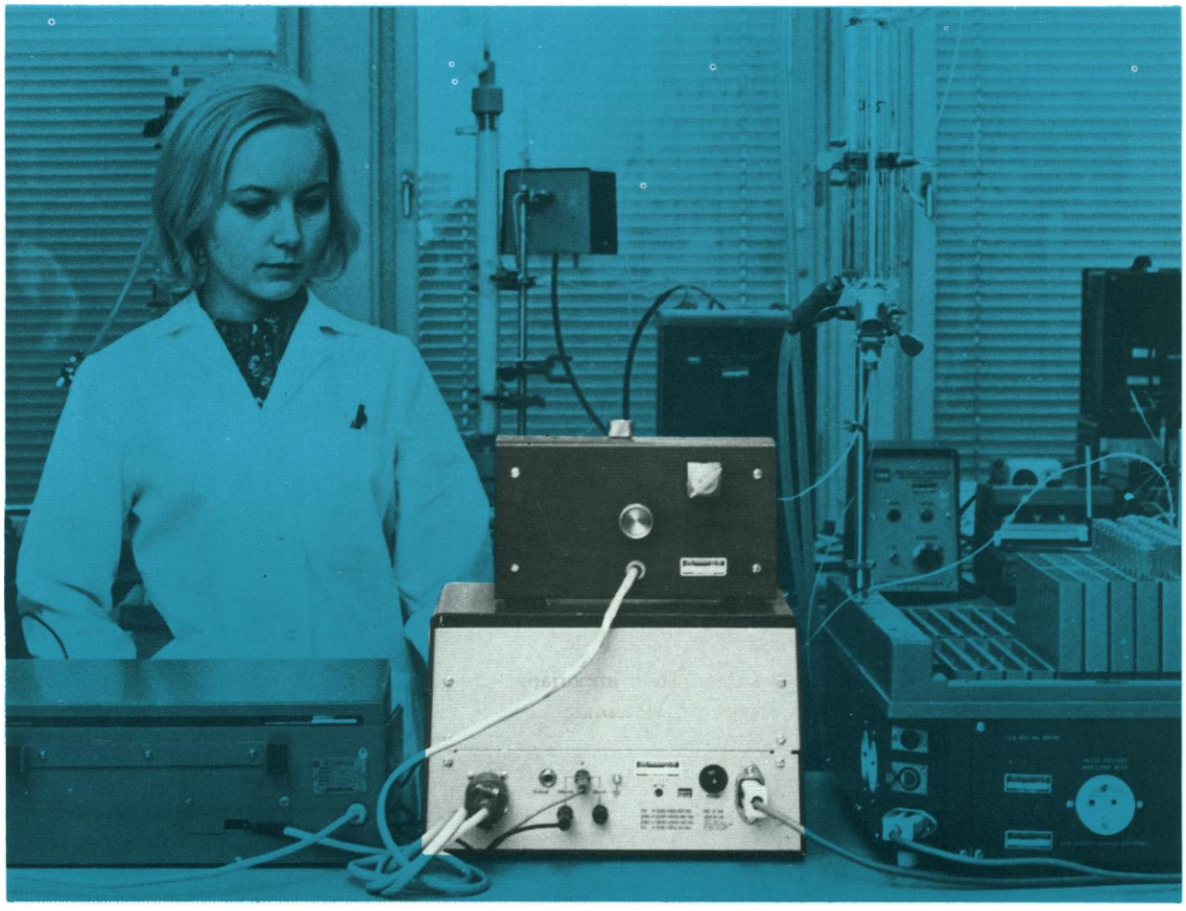
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





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Rupturing oocyst of the lizard malaria parasite, *Plasmodium mexicanum*, on the stomach wall of a phlebotomine sandfly. Released sporozoites localize in the salivary glands when sandfly is ready for a subsequent blood meal. See page 891. [S. Ayala and D. P. Furman, University of California, Berkeley]

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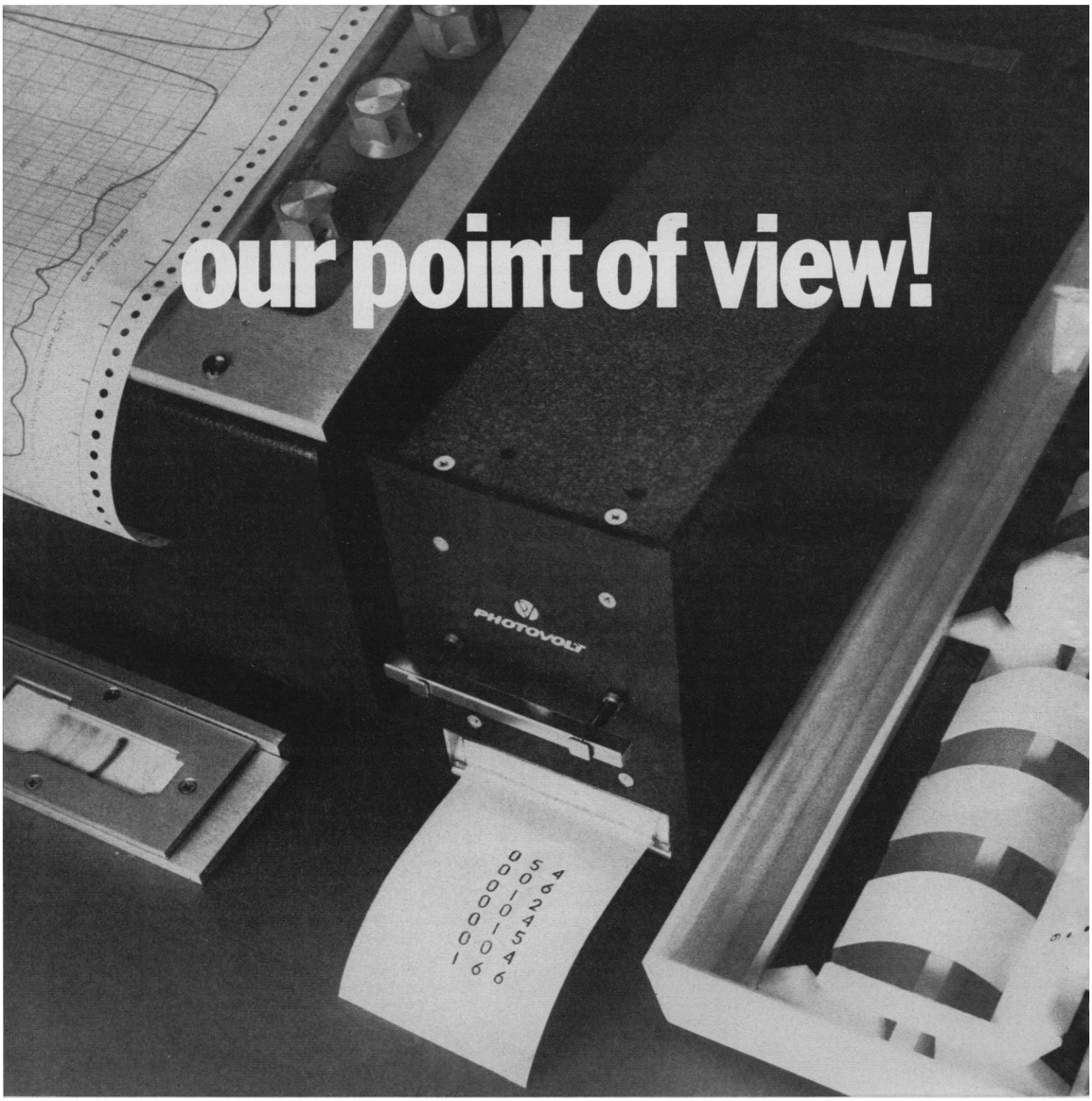

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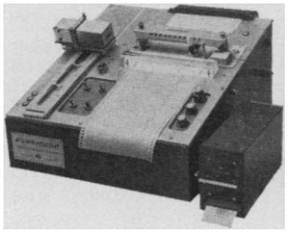

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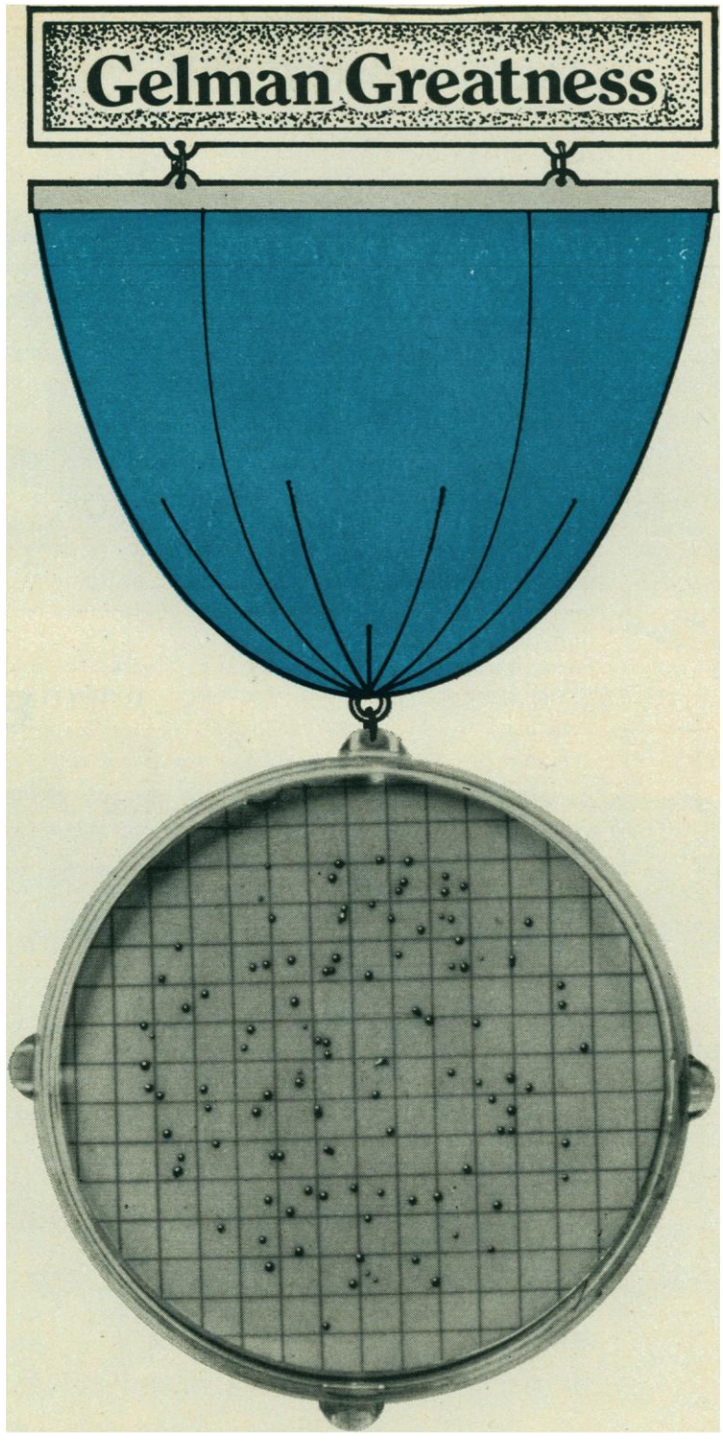

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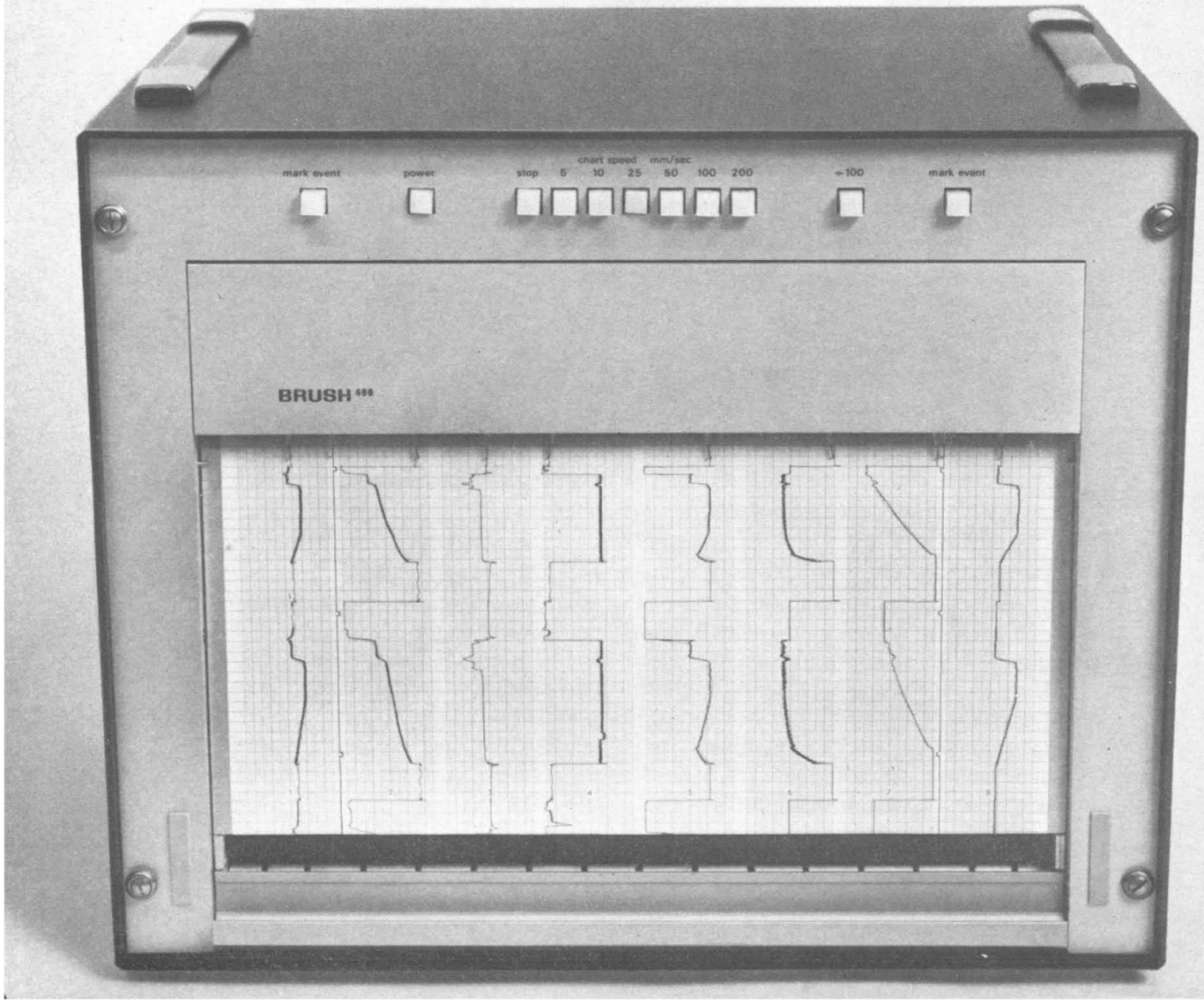

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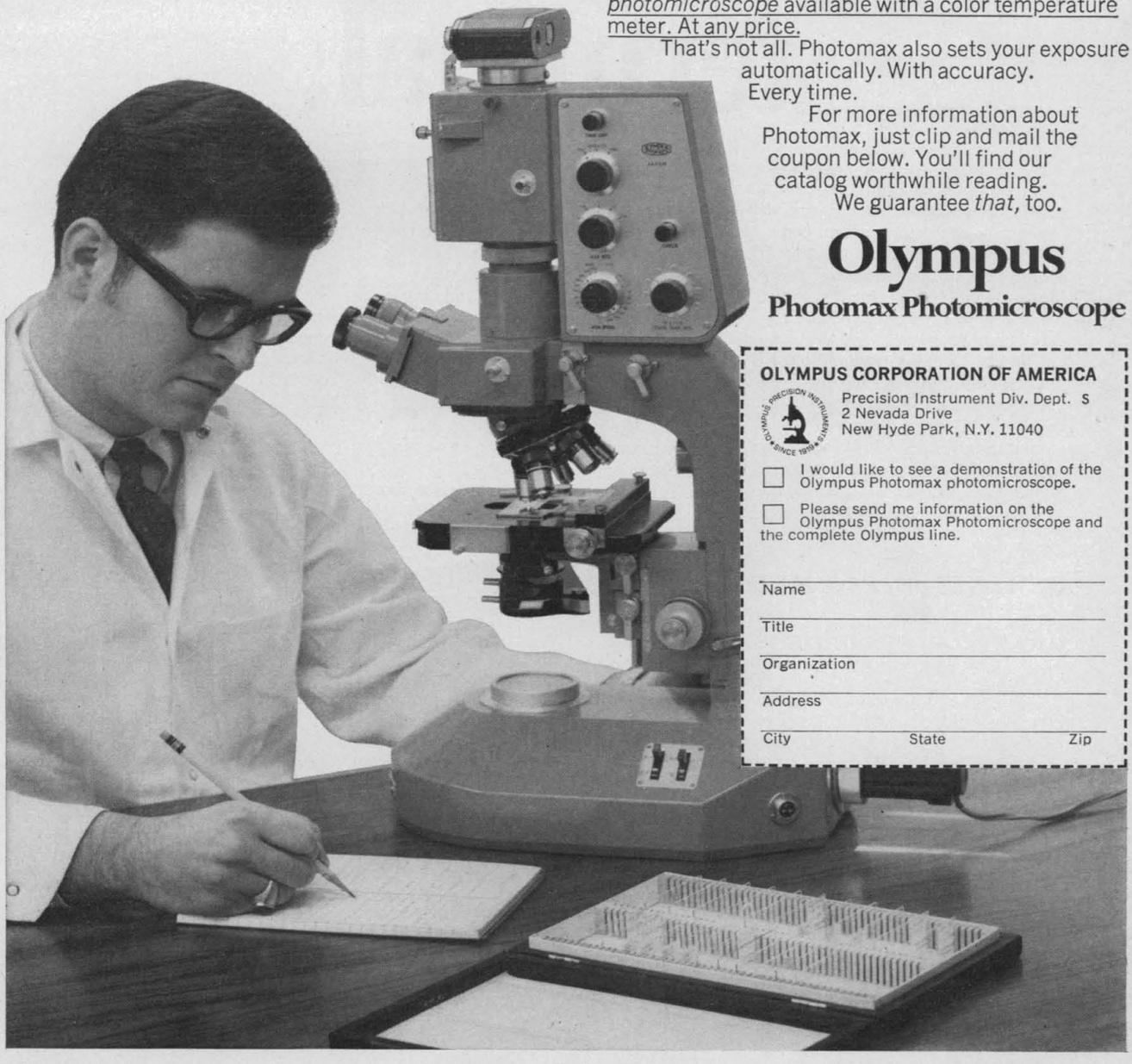

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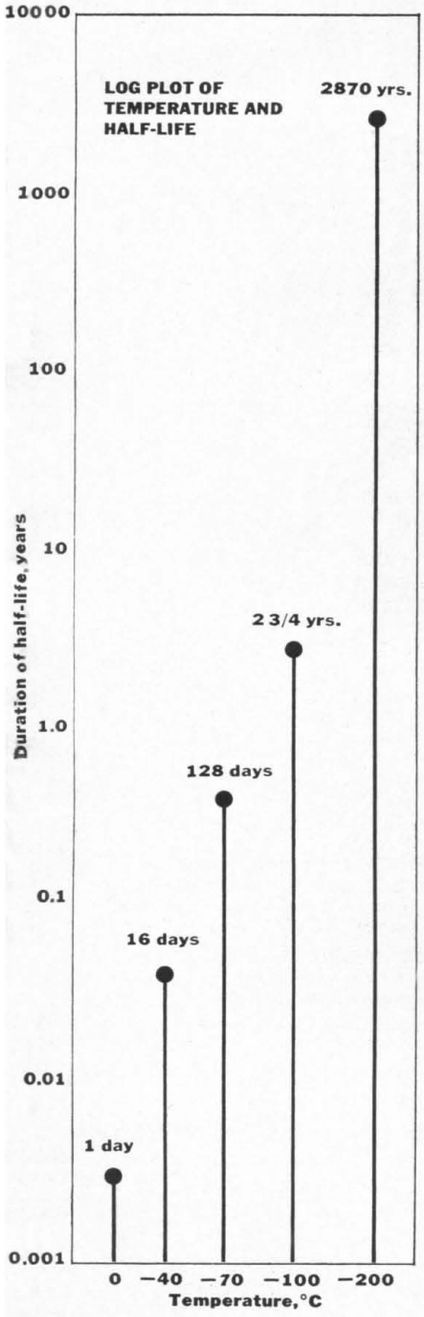
How cryogenic storage can be a lifesaver for the bioscientist

The gradual erosion of a biological property that is being maintained as a preservative measure in the frozen state at a temperature of −70°C or higher is an occurrence with which workers in the biosciences inevitably become familiar. Often marvels of ingenuity are exercised in preparing a system for the potentially dangerous phase transition. The bioscientist is able to show that, as the temperature of the basically aqueous medium is lowered, enzyme activity, membrane integrity, or cellular morphology has survived the excursion from +15°C to −70°C and back. The system, perhaps with the addition of a protective additive, has presumably been well prepared not only for a passage to and from the solid state but also for a storage period in that state. Yet, if the return to +15°C is delayed for weeks, or months or years, these or other desirable and essential properties may be irretrievably lost. What has happened? Why?



The precise mechanisms by which entities of biological origin undergo degradation with time in a frozen environment have not been delineated in terms of their chemistry. The nonfunctioning enzyme system, the infertile sperm cell, the hemolyzed erythrocyte, and other biological disasters nevertheless attest to their reality. Clearly, as the cryobiologists probe the basics of their field, one can expect definition of reactions of great interest, conceivably of wholly new concepts in chemistry. There are portents, perhaps, in Wang's dimerization of 1,3 dimethyl thymine in frozen environments, a photoreaction that proceeds at a negligible rate in the liquid state.

At present known only by their workings, a loss of activity or other form of biological integrity, these degradative reactions are temperature dependent, and it is on this relationship that the success or failure of a frozen storage operation may depend For over a century we have known that a decline in temperature of 10°C decreases the reaction velocity by approximately 1/2 or 2/3, but those of you who remember your problems in chemical kinetics will recall the awe-inspiring influence of temperature on the specific reaction rate as expressed by Arrhenius:

$$K = A\,e^{-\Delta E/RT}$$

The effect of temperature on K, the specific reaction rate, is exerted exponentially through the Boltzmann factor. If the storage temperature used permits significant biological decay, that is to say, an undesirably high degradative reaction velocity, one can slow the process effectively. How effectively can be seen in almost any text of physical chemistry. Daniels, for example, cites a first-order reaction in which the half-life is increased by a factor approaching 10,000 as the temperature is lowered from −75°C to −100°C. Such considerations are necessarily important when materials of biological origin, many of which are intrinsically unstable, are to be stabilized for indefinitely prolonged periods at reduced temperatures. Remember, too, that the frequency factor, A, diminishes with decreasing temperature.

Among the procedures by which the scientist may capitalize on the relationships inherent in the Arrhenius equation to provide maximum stability to systems of biological interest, the use of cryogenic fluids in appropriate storage equipment offers a relatively simple solution. Liquid nitrogen, abundantly available, is a boiling liquid, −196°C, at atmospheric pressure. An idea of its potential effectiveness as a refrigerating agent can be seen from the diagram below. Here we postulate a reaction with a half-life of one day at 0°C and a reduction of reaction rate by one half for each 10°C decline in temperature.

REFERENCES:

Daniels, F.: Outlines of Physical Chemistry, New York, John Wiley & Sons, Inc., 1948, p. 367.

Wang, S. Y.: Photochemical Reactions in Frozen Solutions. Nature *190*:690-4, 1961.

See also: Wang, S.Y.: Photochemical Reactions of Nucleic Acid Components in Frozen Solutions. Fed. Proc. *24*(2) Part III:S-71-9, Mar.-Apr., 1965.

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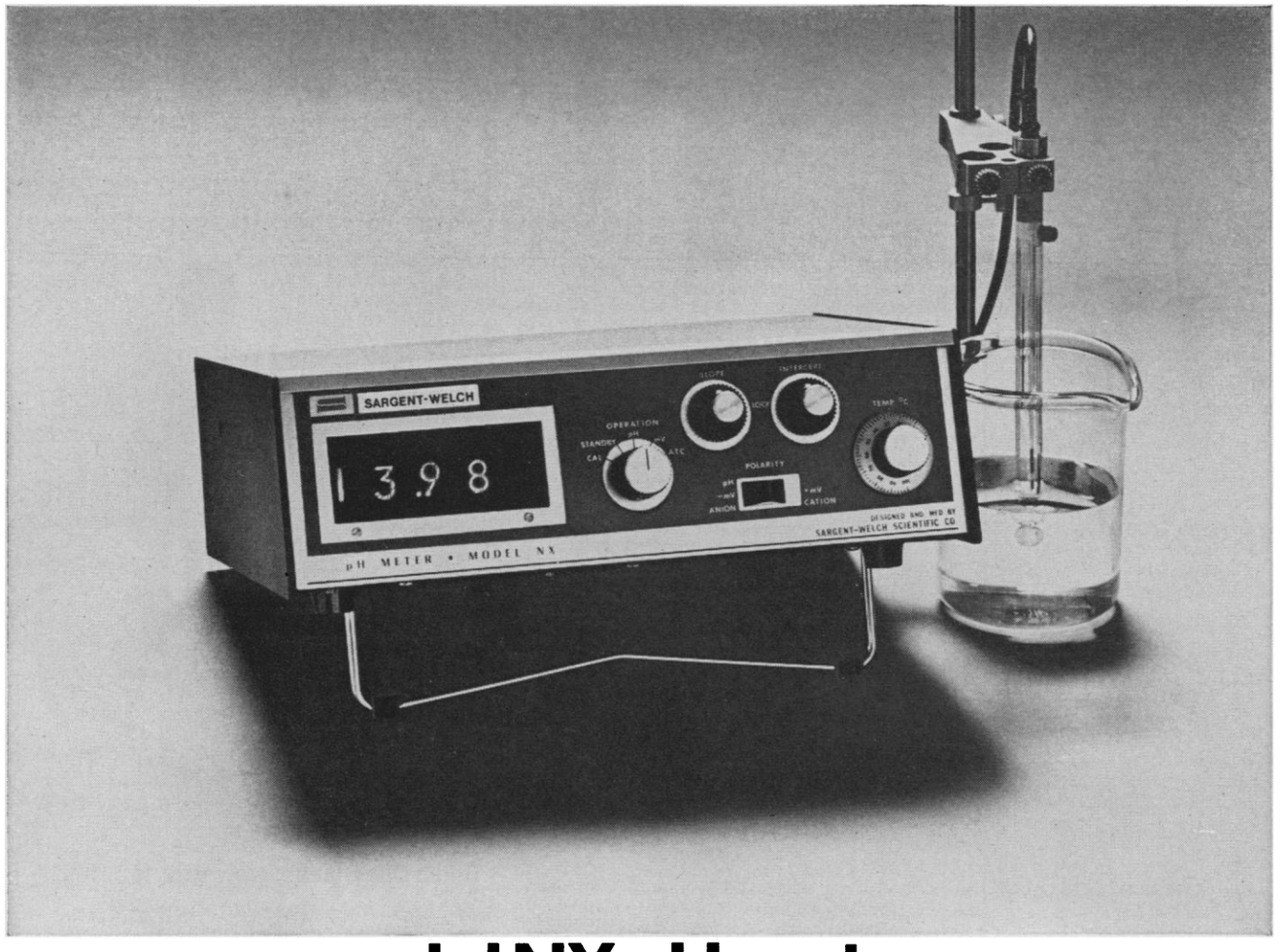

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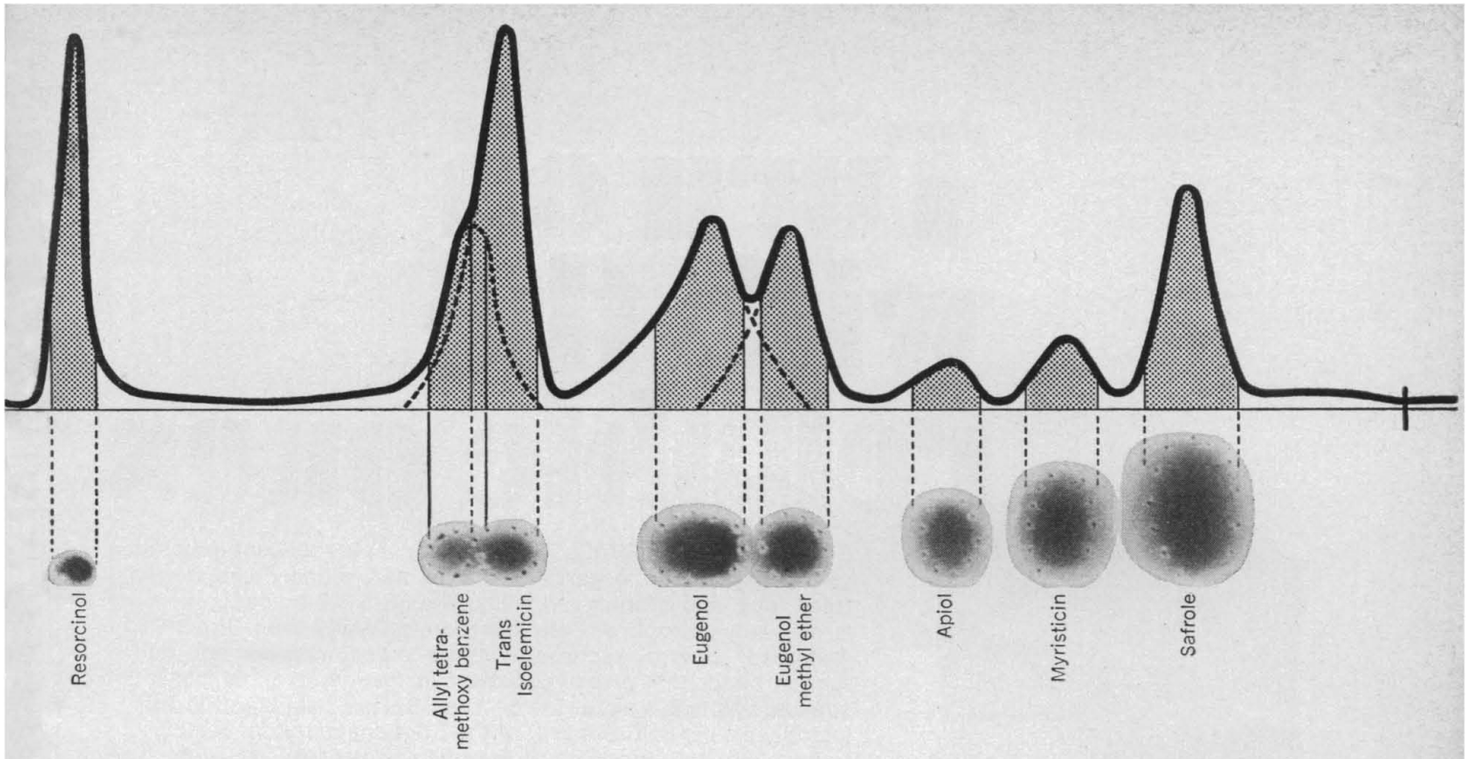

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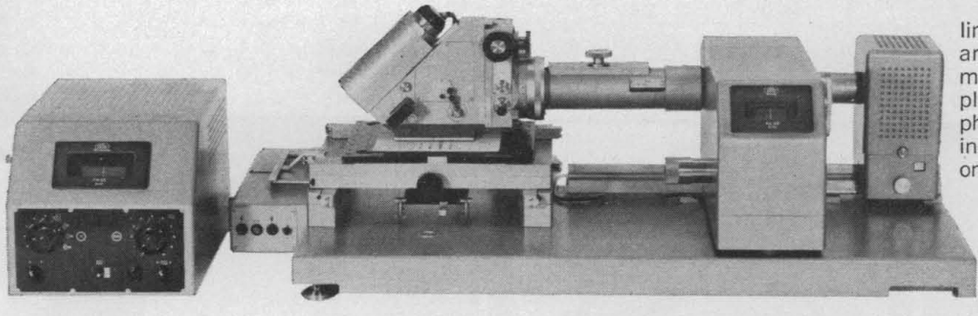

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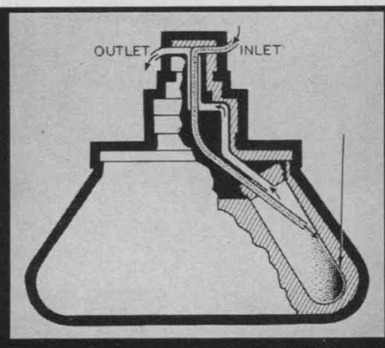

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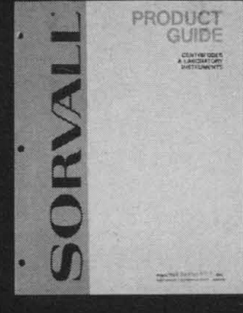

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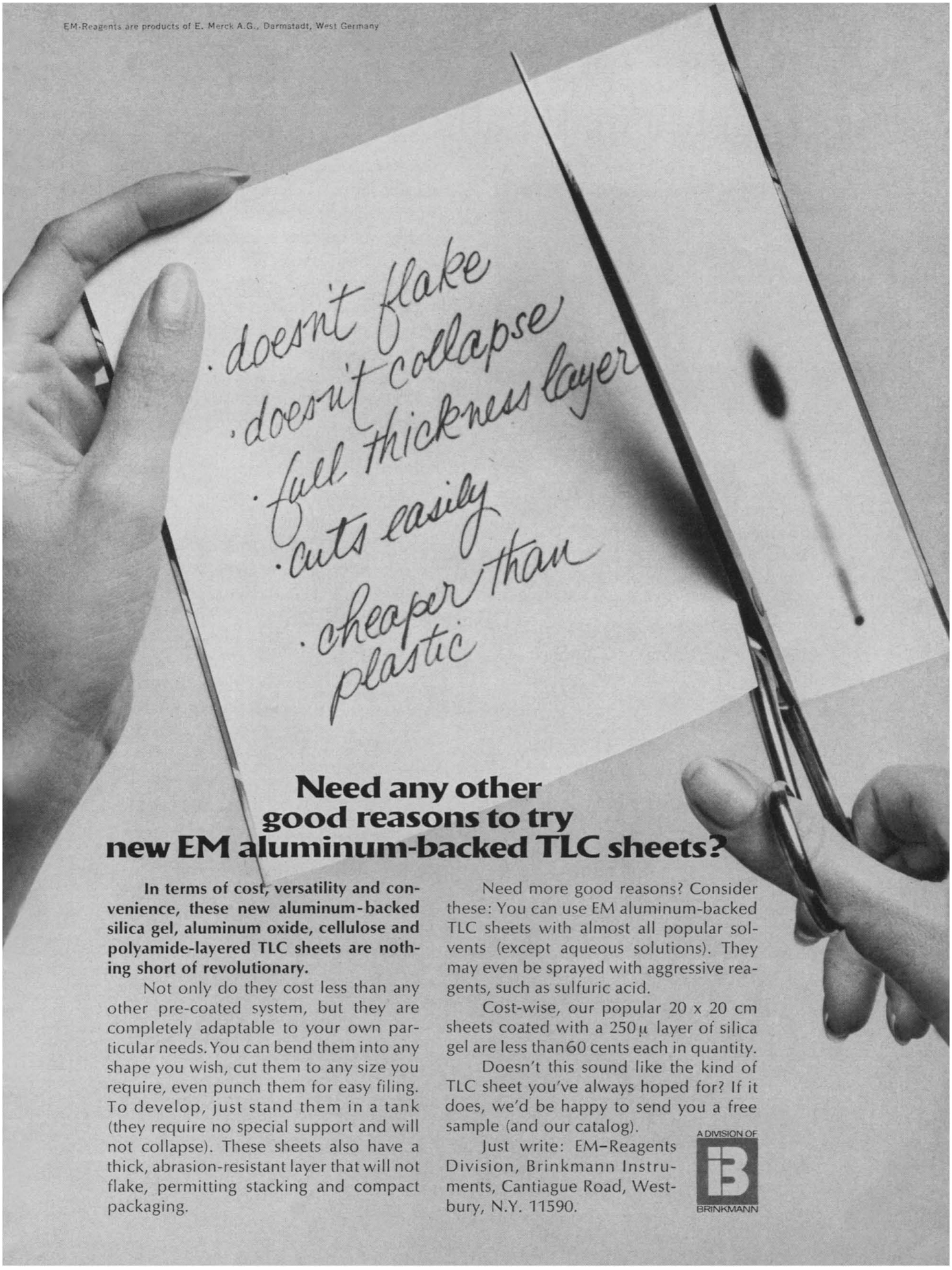
EM-Reagents are products of E. Merck A.G., Darmstadt, West Germany



Need any other good reasons to try new EM aluminum-backed TLC sheets?

In terms of cost, versatility and convenience, these new aluminum-backed silica gel, aluminum oxide, cellulose and polyamide-layered TLC sheets are nothing short of revolutionary.

Not only do they cost less than any other pre-coated system, but they are completely adaptable to your own particular needs. You can bend them into any shape you wish, cut them to any size you require, even punch them for easy filing. To develop, just stand them in a tank (they require no special support and will not collapse). These sheets also have a thick, abrasion-resistant layer that will not flake, permitting stacking and compact packaging.

Need more good reasons? Consider these: You can use EM aluminum-backed TLC sheets with almost all popular solvents (except aqueous solutions). They may even be sprayed with aggressive reagents, such as sulfuric acid.

Cost-wise, our popular 20 x 20 cm sheets coated with a 250 μ layer of silica gel are less than 60 cents each in quantity.

Doesn't this sound like the kind of TLC sheet you've always hoped for? If it does, we'd be happy to send you a free sample (and our catalog).

Just write: EM-Reagents Division, Brinkmann Instruments, Cantiague Road, Westbury, N.Y. 11590.

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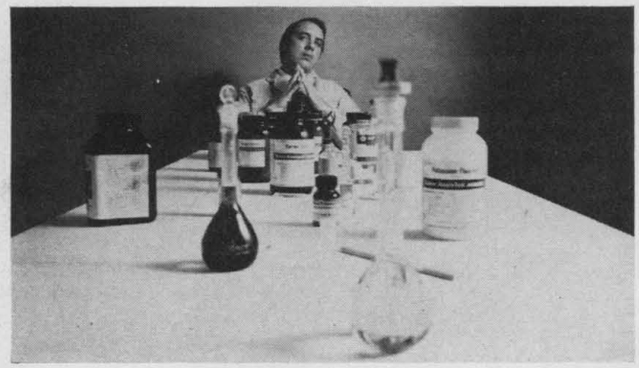
The new Cary 17.
Very simply, it makes absorption spectroscopy.

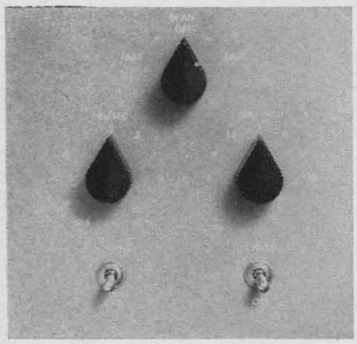


The Cary 17 is more than just another new recording spectrophotometer. It's far and away the best, easiest to use, most versatile spectrophotometer we've ever built. Or anybody else for that matter. The Cary 17 puts spectroscopy on a whole new level. Its own.

A CLOSER LOOK

One of the first things you'll notice about the 17 is its striking visual similarity to the Cary 14. This is no accident. We simply made use of design and performance features which have gone unmatched for almost 15 years.

But it's the new features that make the Cary 17. Solid state electronics, for instance. Accurate, forward-beam near infrared operation. Coupled scan and chart drive with digital scanning so you can—for the first time—actually control the digital scanning mechanism of your spectrophotometer with a computer. And optimum parameters indicators which let you get the best performance in the shortest time.



The Cary 17 is also equipped with a powerful tungsten-halogen high intensity source. Pen period control. A unique wide-range slidewire which does the work of four separate slidewires. And multipots. Without having to purchase another accessory, you can perform an infinite variety of highly accurate routine spectrophotometric measurements. Two standard modifications are also available.. One for high temperature studies such as fused salts. The other for infrared work out to 3.0 microns, even on heat or photosensitive samples.

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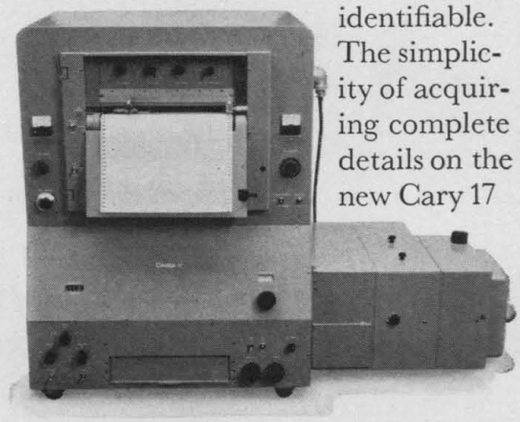
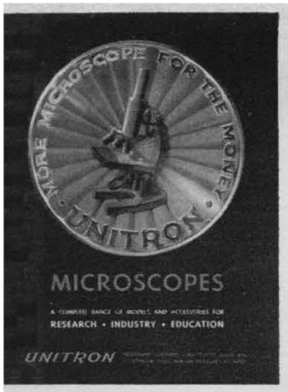
The simplicity of the Cary 17's control panel is the result of many years actual working experience. Each switch, knob, dial and button is placed precisely where it should be. And each is clearly identifiable. The simplicity of acquiring complete details on the new Cary 17



has also been carefully planned. For a brochure, just write Cary Instruments, a Varian subsidiary, 2724 South Peck Road, Monrovia, California 91016. Ask for data file E-002-20.

cary instruments



FREE MICROSCOPE BUYING GUIDE

Shown here in miniature are just some of the informative brochures which comprise the UNITRON Catalog . . . your buying guide to quality microscopes at prices within your budget. Whether your application is routine laboratory analysis, advanced biological research, or industrial quality control, you will find the instrument you need in UNITRON's complete line.

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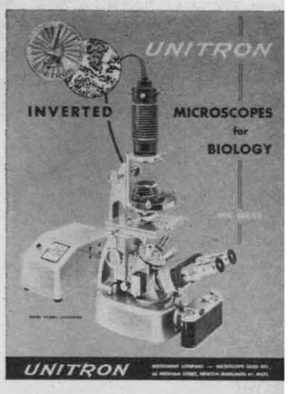

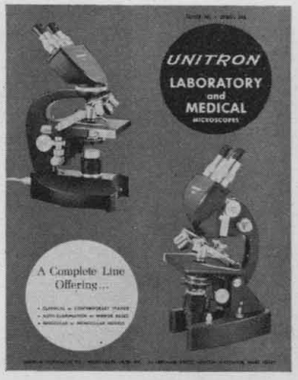

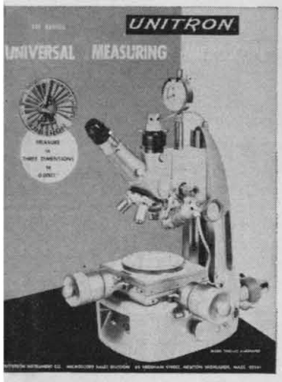

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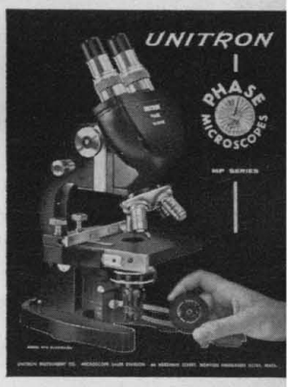

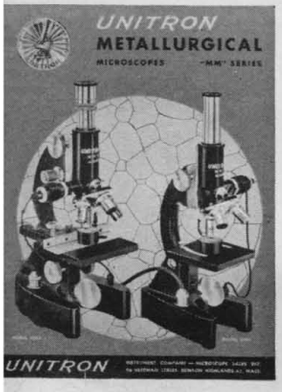

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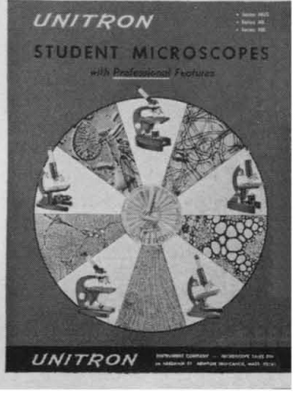

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The new PAR™ Model 131 Instrument/Computer Interface System brings the full power of interactive time-sharing computers to the laboratory. So you can take advantage of the problem-solving capabilities of large-scale computers, no matter how complex – or simple – your experiment may be. And use easy-to-program languages such as BASIC or FORTRAN, to save more time and add to efficiency.

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With the Model 131, the time-sharing computer can operate in the Question/Response mode. In answer to the computer's requests, you can input varying parameters for the experiment to obtain new test results from the same set of data. You can also use the time-sharing computer to monitor and control experiments. And it can even amplify the power and capabilities of certain laboratory instruments.

The Modularized Model 131 System is easily expanded as your instrumentation and data processing requirements grow. Price of a typical system consisting of an analog multiplexer, analog to digital converter, a system interface, and teleprinter is less than $5,500.

For more information, ask for P.A.R. Bulletin T-206A. Write Princeton Applied Research Corporation, Box 565, Princeton, New Jersey 08540, or call (609) 924-6835.

PAR **PRINCETON APPLIED RESEARCH CORPORATION**

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RUN FOURIR

***NAME THE FILE THAT CONTAINS THE DATA.....   PSBXC.DAT

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 0.5050505E-01   0.0858935       0.1624469       0.0337667
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DO YOU WISH TO ANALYZE ANOTHER FILE? 1=NO 2=YES .....   2

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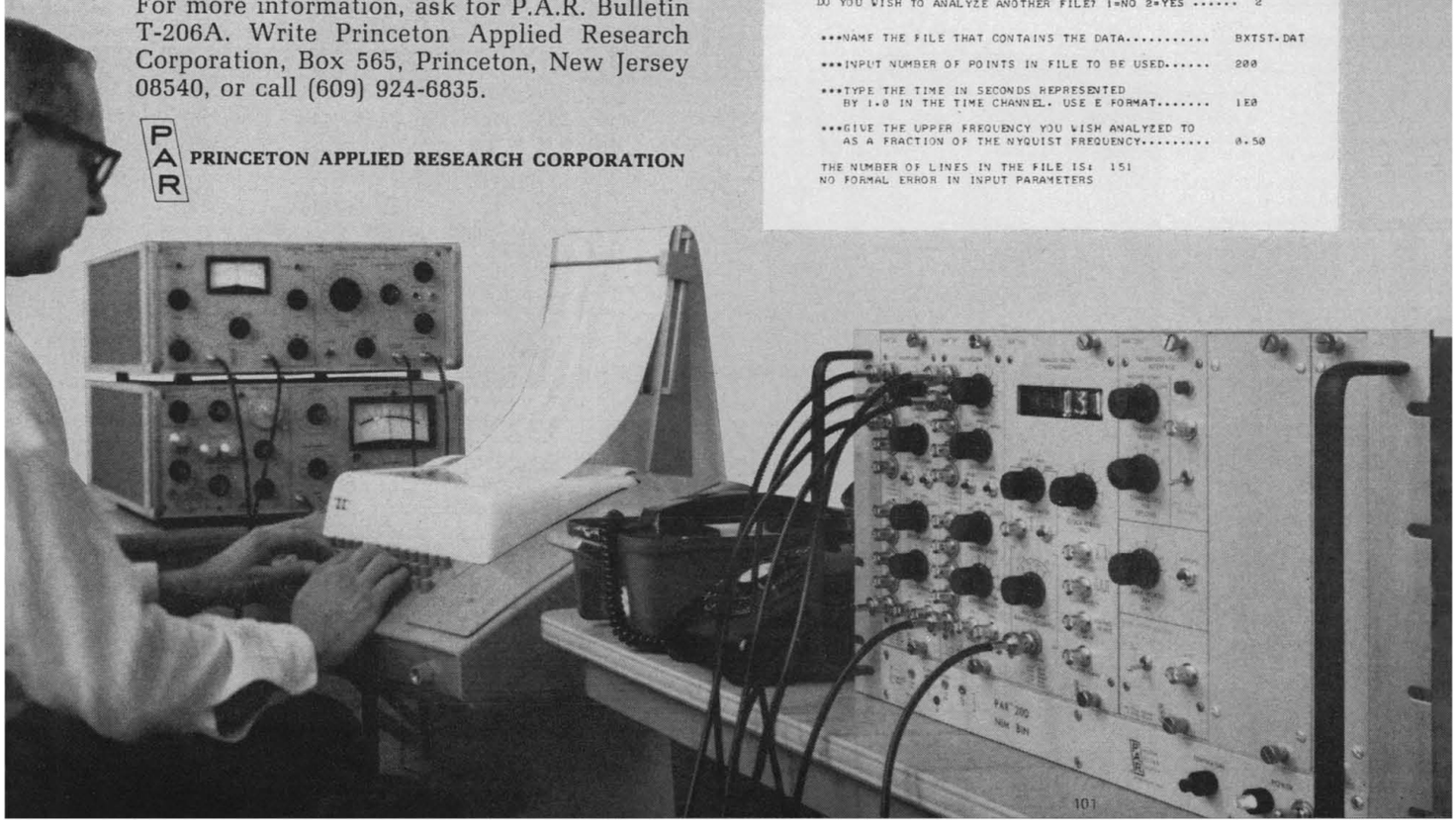
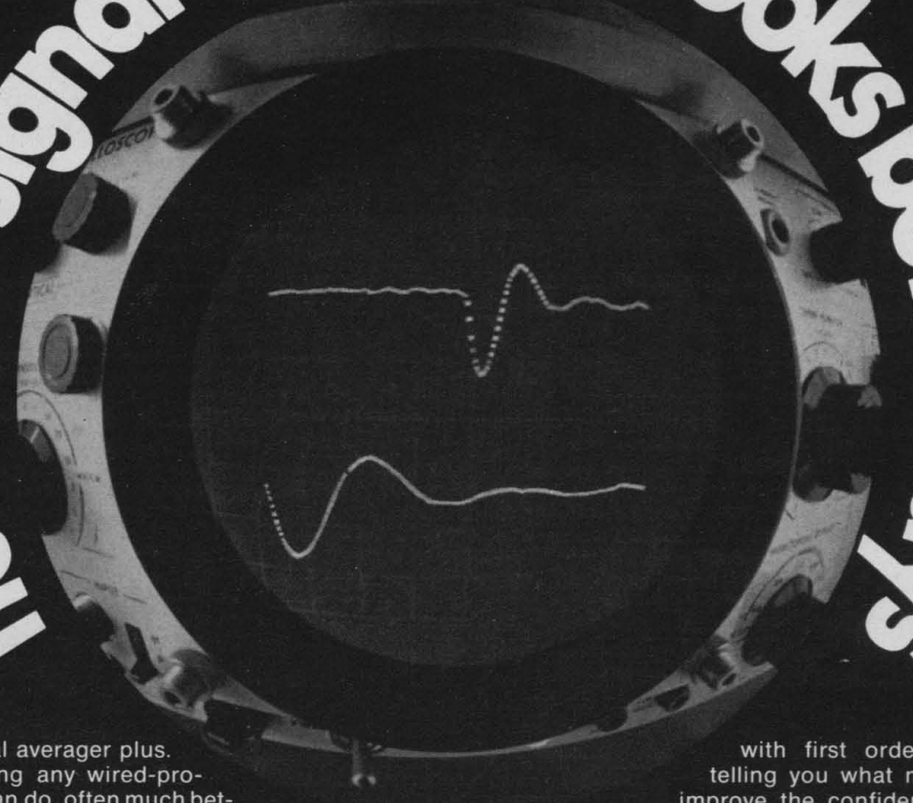


no other signal averager looks both ways



LAB-8 is a signal averager plus. It does everything any wired-program averager can do, often much better. Plus pre-sync averaging, contingency sorting, blowups of parts of curves, displays of 95% confidence limits, displays of first order trends, and a few other useful things.

Take pre-sync averaging, for example. If you want to collect and display an epoch *before* a sync pulse arrives, LAB-8 will digitize the incoming signal and store it in a temporary buffer. When the sync pulse arrives, there it is—on the oscilloscope. The most recent complete epoch prior to the sync.

LAB-8 can do this because it has a computer buried inside—the most popular small computer ever made: PDP-8. You may never want to use it as the full general purpose computer that it is. But it gives the LAB-8 features that no other signal averager has.

LAB-8 can sample channels at two different rates, permitting simultaneous EMG and EEG studies. Blowups of particular areas of interest, without affecting the averaging process or display, also result from the ability to sample—at different rates. LAB-8 permits sorting of data contingent on some external event. LAB-8 displays averaged signals along with 95% confidence limits, along with first order trend curves, telling you what must be done to improve the confidence in the data.

Yet LAB-8 costs approximately as much as a conventional averager. The basic price includes everything you need to get the job done better. And it is ready to run the day it comes into the laboratory. Write for a complete brochure.

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6 February 1970, Volume 167, Number 3919 **SCIENCE**

Threatened Faculty Pensions

TIAA and CREF are in trouble. Ever since they were established, the Teachers Insurance and Annuity Association and the College Retirement Equities Fund have been regulated by the insurance department of the state of New York but have not been subject to different regulations by other states. Because of this uniformity, and because TIAA and CREF have employed no agents and have had no commissions to pay, the system has been economical and has had a high ratio of benefits to costs. Because of the uniformity of regulations and because annuities have been fully and immediately vested in the individual, participating faculty members have all had the same kind of contracts and have enjoyed easy mobility from institution to institution—a policy that has worked to the individual advantage of faculty members and the collective advantage of higher education.

Now uniformity is threatened. As a result of judicial decisions which dealt primarily with insurance programs, the regulatory powers of the individual states have been enlarged. Insurance commissioners and commercial insurance companies in some states have sought legislation to require TIAA-CREF to comply with state regulations, some of which would be inappropriate, for TIAA-CREF has no agents, makes no profits, and in other important ways differs from other retirement or insurance programs.

These difficulties could be solved by granting TIAA-CREF a federal charter which would require continued regulation by New York but would abolish the threat of 49 other sets of regulations. Last year Senator McClellan and 17 other senators introduced a bill, S. 1290, for this purpose. At hearings on 17 and 18 July, some insurance representatives opposed the bill and representatives of many public and private colleges and universities supported it. Since then the bill has been resting in the Senate Committee on the Judiciary.

A companion bill, H.R. 9010, has been introduced into the House of Representatives by Emanuel Celler, and identical bills have been introduced by several other representatives. As in the Senate, sponsorship is bipartisan. Hearings will soon be held before a subcommittee of the House Judiciary Committee, consisting of Byron G. Rogers (Colorado), Andrew Jacobs (Indiana), Jerome R. Waldie (California), Edwin W. Edwards (Louisiana), Charles E. Wiggins (California), Hamilton Fish (New York), and R. Lawrence Coughlin (Pennsylvania).

The fate of these bills is of immediate concern to the 300,000 staff members of colleges, universities, and other nonprofit institutions who hold TIAA-CREF contracts. If a federal charter is granted, TIAA-CREF can continue to offer a unique, economical, and uniform retirement program, at no financial loss to any state, for no state taxes are involved. If the states are permitted to introduce their own individualistic regulations, any of the 2000 institutions with TIAA-CREF coverage could soon come to have on its staff individuals whose differing contracts were written in different states. Each of the 2000 institutions would have to cope with up to 50 different types of contracts, and TIAA-CREF would have to deal with anywhere from one to 50 different plans in each of 2000 institutions! What was intended to be, and so far has been, a uniform system, treating all participants alike, would become an accounting nightmare, full of inconsequential differences and serious inequities for the participants. TIAA-CREF policy holders have a direct, personal interest in letting members of the Senate and members of the House committee know which system they prefer.—DAEL WOLFLE

Making instrumentation measurements? Let HP put them on tape for you. Right now.

Hewlett-Packard's new HP 3960 Instrumentation Recorder is so portable and versatile that our field engineer can carry it into your facility, connect it to whatever you've got going and have it working for you immediately. You can run it yourself without any specialized operating knowledge. And buy it without beating your budget into the ground.

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Design features for reliability and low maintenance include rugged single casting capstan assembly, permanently adjusted brakes, and built-in FM calibration facilities. Put the HP 3960 in the lab or out in the field. Use it for vibration and stress analysis, medical research, acoustical evaluation or any other application you can find. Our lightweight portable gives you maximum information for minimum dollars. Instantly. Call your local HP field engineer for a demonstration or write Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

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42905A

Aspen Conference on Quantum Crystals

During the week 1–5 September 1969, approximately 100 participants gathered in Aspen, Colorado, for a Conference on Quantum Crystals. The outstanding facilities of the Aspen Institute for Humanistic Studies were made available, and support was provided by the National Science Foundation for the attendance of a significant number of foreign scientists. The organizing committee, consisting of H. R. Glyde, J. A. Krumhansl, H. Meyer, L. H. Nosanow, J. C. Raich, M. G. Richards, and C. A. Swenson, selected a conference format similar to that of the Gordon Conferences, which gave attendees the opportunity during the afternoons to sample the recreational endowments of the Aspen area.

The subject matter comprising the conference was the solid phases of helium and molecular hydrogen in their various isotopic forms. Properties associated with the lattice vibrational degrees of freedom of these crystals were considered, as well as those arising from the nuclear and (for molecular hydrogen) orbital angular momentum degrees of freedom. In addition, attention was given to isotopically and rotationally mixed crystals.

One of the most perplexing situations to emerge from the conference was the decided differences found between the hexagonal close-packed (hcp) and body-centered cubic (bcc) phases of He^3. It was reported several years ago from two different laboratories that the specific heat of bcc He^3 was larger at temperatures below 1°K than expected on the basis of normal lattice vibration theory.

Only recently, however, has this observation been recognized as a real effect, not due to quirks of experimental technique. Work reported by E. D. Adams (Florida) has confirmed the observations using sensitive strain gauge measurements. In addition, low-temperature thermal conductivity measurements by W. C. Thomlinson (Yale), in the region where the phonon mean free path is limited by sample boundaries so that the temperature dependence of the thermal conductivity is given by the specific heat, also indicate an anomaly for the bcc phase but not for the hcp phase. Effects of He^4 impurities can be ruled out. It is hard to escape the suspicion that this is somehow connected with the nuclear spin system of He^3, and the suspicion was enhanced by a reemphasis by M. G. Richards (Sussex) that the spectral density for spin fluctuations [by nuclear magnetic resonance) (NMR)] in the bcc phase was much more nearly of exponential form rather than the Gaussian found in the hcp phase.

Progress reported in techniques for orienting crystals of helium was quite encouraging. The birefringence of the hcp phase of He^4 was used by groups associated with J. P. Franck (Alberta) and with D. Lee (Cornell) to help obtain the ultrasonic elastic constants. The feasibility of orientation by x-ray diffraction in hcp He^4 was demonstrated by S. Fain and D. Lazarus (Illinois) in conjunction with the observation of anisotropy in thermal conductivity. Inelastic coherent neutron scattering has been used successfully by groups at Brookhaven and at Iowa State to obtain phonon dispersion curves, again for hcp He^4. Many of these techniques should also be applicable to hydrogen, particularly in its hcp phase. Similarly, observation of a long wavelength optical phonon in Raman scattering from hcp hydrogen, by W. Hardy *et al.* (North American Rockwell), should also be possible in helium. Neutron scattering experiments in hydrogen were reported by W. Schott (Karlsruhe), in fair agreement with lattice dynamical calculations of W. Biem (Oak Ridge) and F. G. Mertens (Jülich) using the Nosanow treatment of zero-point motion.

Considerable light was shed on the nuclear spin ordering transition expected in He^3. The fact that this would be an antiferromagnetic state, with Néel temperature at about 2×10^{-3} °K, was confirmed in several ways. No less than three groups (Cornell, Brookhaven, Stanford) reported nuclear susceptibility measurements fitted to a Curie-Weiss form. In good agreement was a determination inferred from strain gauge measurements, again by the Florida group. The most recent theoretical computations of the associated exchange splitting by R. Guyer (Harvard) agree with experiment to within a factor of 2, and with density dependence much improved over earlier calculations. The spin disorder of the solid above 2×10^{-3} °K can be used to cool by adiabatically compressing spin-ordered liquid into solid, a technique conclusively demonstrated by groups associated with J. Wheatley (La Jolla) and with Lee (Cornell). It would appear that this refrigeration de-

vice will be of great practical importance for carrying out a wide variety of other experiments in the few millidegree temperature range.

In hydrogen, where the molecule can have a metastable $J = 1$ excitation, an orientation ordering is known to take place due primarily to electric quadrupole interactions. Phonon zero-point vibrations modify the quadrupolar coupling constant, as calculated by A. B. Harris (Pennsylvania), with experiment and theory gradually converging. The orientational transition is closely accompanied by, but now found (groups at Duke and at Los Alamos) not to be simultaneous with, a lattice structural transformation. In the ordered state, rotational wave excitations ("librons") are expected; their observation in the Raman scattering spectrum reported by Hardy *et al.* suggests an inconsistency with the previously accepted orientational arrangement. Further doubts were cast on the accepted arrangement by H. James (Purdue) on the basis of computer simulations of the most stable orientational structure. Studies of these effects by NMR relaxation, as well as of the effects of isotopic and molecular spin mixing, were discussed by J. R. Gaines (Ohio State University) and by H. Meyer. T. Nakamura (Osaka) presented calaculations of the energy of pairs of $J = 0$ molecules in an otherwise ordered $J = 1$ crystal.

Experimental emphasis in the area of helium isotopic mixtures was on spin-lattice relaxation of He^3 with dilute He^4, as reported by M. Bernier (Saclay) and by H. Reich (IBM), and thermal conductivity of He^4 with dilute He^3, carried out by groups at Oxford and at Duke. Theoretical investigation by C. M. Varma (Bell Telephone Laboratories) indicated that effective force constant changes and strain fields are induced around an isotopic defect, due to the large zero-point lattice motion in helium, with sizable effect on phonon transport scattering rates but little effect because of cancellations on the local exchange splitting. This is confirmed in experiments discussed by R. C. Richardson (Cornell). Observed changes in spin-lattice relaxation times with impurity content, as observed at Saclay and IBM, may be connected with defect migration, which drives the known low-temperature phase separation of solid mixtures.

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