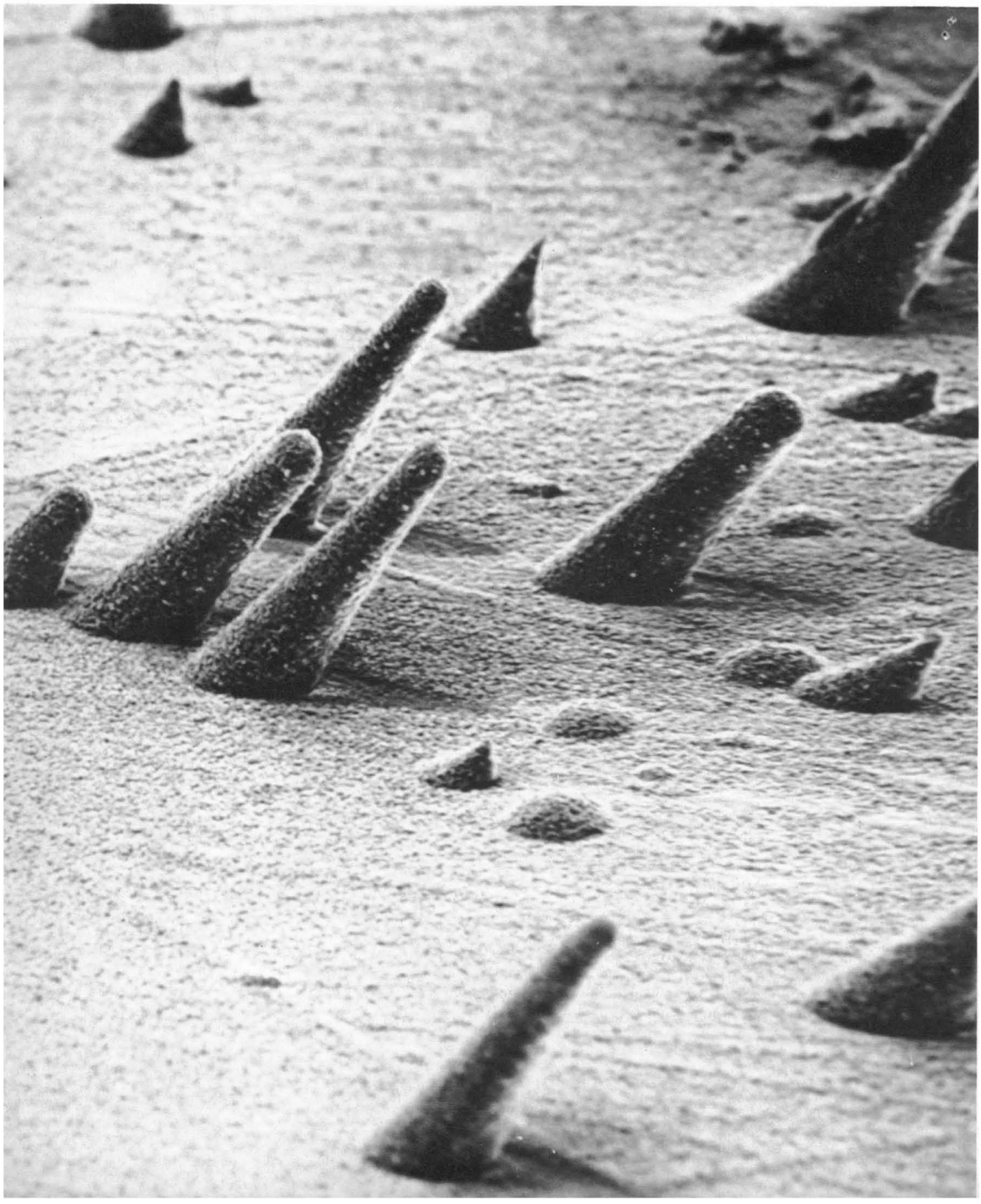
SCIENCE

9 April 1971

Vol. 172, No. 3979

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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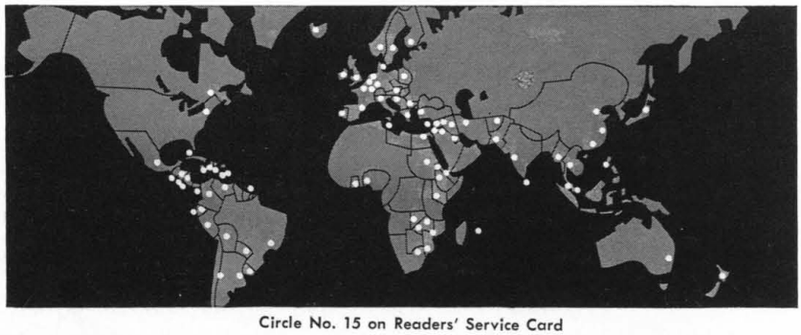

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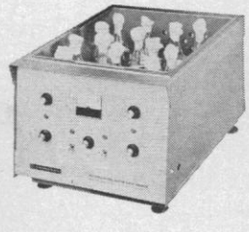

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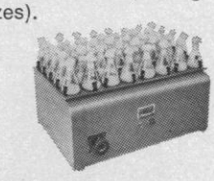

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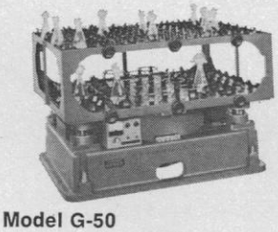

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Incubator Shakers

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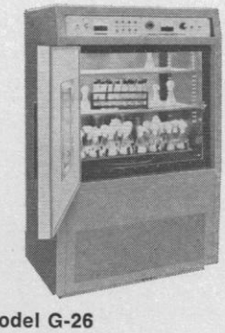

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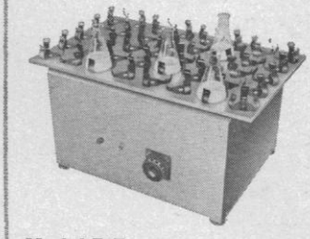
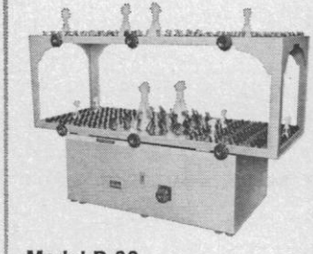


Model R-7
Reciprocating Shaker

A general purpose reciprocating shaker for gentle to vigorous agitation of heavy loads. Interchangeable platforms.



Model R-82
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The R-82 multiplies the capacity of the R-7 by a factor of 2. Variable speed and variable stroke.

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COVER

Sulfur-ion tracks from an Apollo test helmet. Replicas (× 800) of the tracks of sulphur-32 ions were used to calibrate the helmets for cosmic ray detection. Statistical effects of slowing down appear in the form of the varying length of the different tracks. See page 154. [Eric Lifshin, General Electric Research and Development Laboratory, Schenectady, New York]

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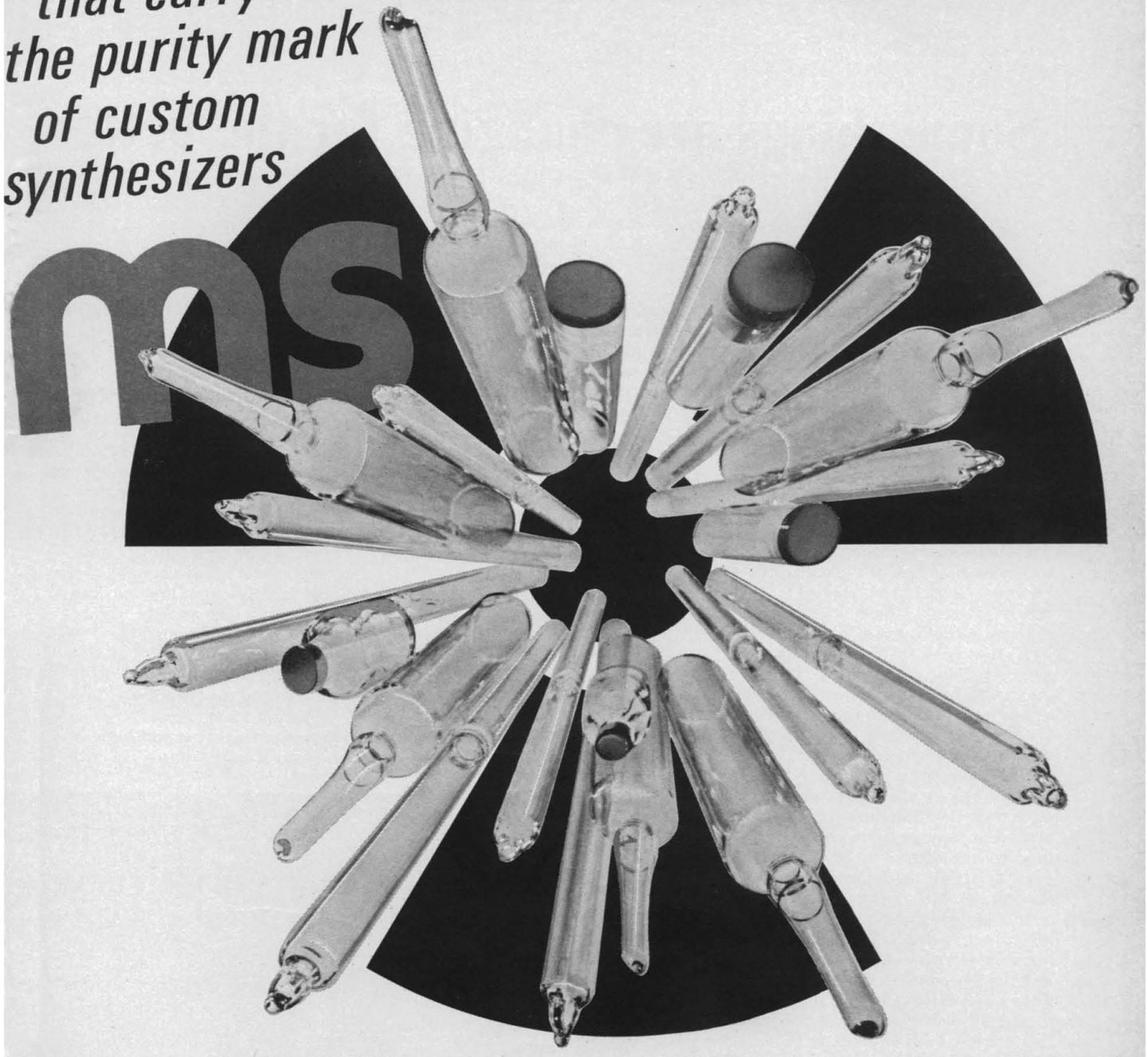

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Some things are changing for the better.

A better way to measure photons from UV to IR

It's our guess that any scientist who has ever made optical power measurements will greet the new HP 8330A/8334A Radiant Flux Meter System with more and more enthusiasm as he finds out more about it. Because it measures total radiant power over the entire IR to UV spectrum, with a flat response that remains accurate regardless of the spectral composition of the source of radiation. Because it's calibrated to better than ± 5% traceable to NBS, at all wavelengths and at any power level, and reads out directly in absolute radiometric units. And because it is the first to have an automatic zero and a built-in self-calibrator that maintain system accuracy with no more effort than pushing a button.

Underlying many of these improvements in the state of the art is a unique thin-film thermopile detector whose extremely low thermal mass gives it a 10 to 100 times faster overall response than conventional thermopiles. Manufactured by vacuum deposition on a thin but tough substrate that gives it body without mass, the HP thermopile is considerably more rugged than previous laboratory designs. But the thermopile derives its most important characteristic—flat response—from a thin layer of gold, the likes of which no jeweler would care to use. Vaporized and deposited on the thermopile's 64 series-connected thermocouples, this gold has such a combination of particle size and structure that it traps and absorbs all incident photons from less than 0.3 to beyond 10 microns . . . and therefore looks black, exactly the opposite of the jeweler's requirements. Since it remains chemically inert, it does not form surface oxides that would act as mirrors. The gold layer also assumes an abnormally high electrical resistivity, so high that it does not "short" the thermocouple junctions which it overlays. Certainly not a jeweler's gold, but a great one for thermopiles.

Equally important in terms of performance, a built-in self-calibrator maintains the accuracy of the system... at the touch of a pushbutton. Incorporating a low-frequency oscillator that delivers a precise amount of power to the thermopile, the automatic calibrator adjusts the gain of the measurement system to match the response of the thermopile. Thus compensated for all changes in sensitivity due to temperature, overload, mechanical shock, aging or even change of detector, the instrument always measures radiant power accurately and directly.

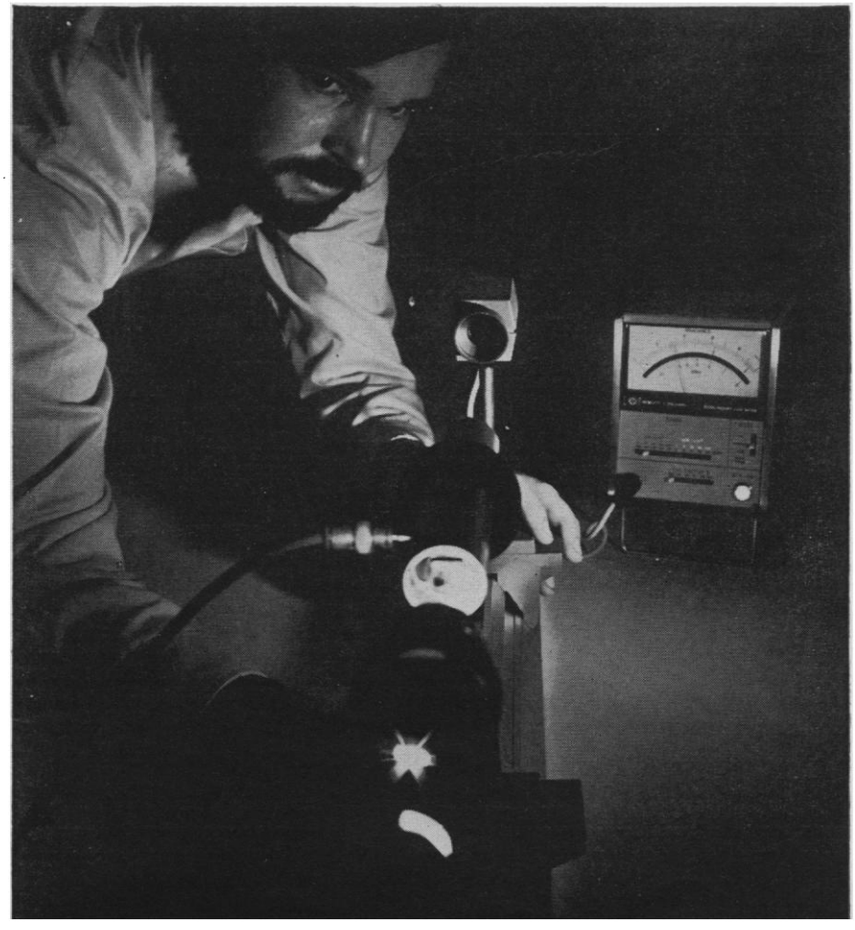
At $1100 for a complete system, the price of the 8330A/8334A represents another quantum improvement in the state of the art that will certainly encourage its use in a variety of electro-optical, analytical and process control applications.

A descriptive brochure of the system awaits your request.

Cardiac Catheterization: A better way for patient and physician

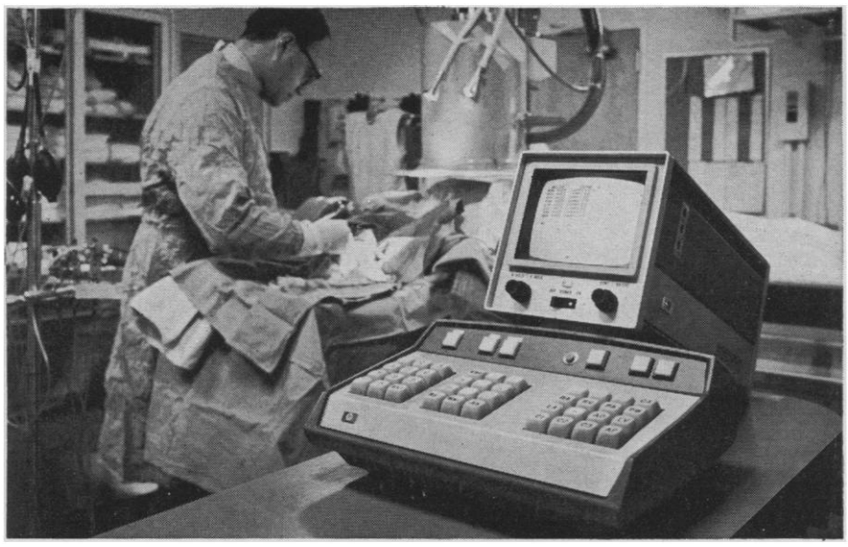
Over 100,000 victims of both cardiac congenital defects and cardiovascular disease visit a catheterization laboratory each year, a necessary step on the road back to good health. For this is where the physician performs cardiac catheterization by inserting a small tube (catheter) into a peripheral blood vessel and pushing it into the heart. Measurements are made of blood pressure in the heart and other physiological factors which give the doctor information he needs for diagnosis and treatment.

A typical "cath" procedure takes about two hours after which the physician spends two to three more



hours examining the data. Complex calculations convert the raw measurements into usable information about the condition of heart and valves.

Now, data sampling, analysis and display can be done automatically *during* catheterization, with HP's new 5690A computerized system. So fast



that the physician can verify each step of the procedure and decide whether additional measurements should be made—thus avoiding the possibility of incomplete or faulty data.

Developed in a joint effort with the Stanford University Medical Center, the new HP 5690A computerized system is a completely integrated hardware and software system, performing data acquisition and real-time cardiac analysis from on-line sampling of pressure waveforms and from patient information the physician enters on a keyboard. The computer calculates all the hemodynamic parameters most often required—displaying results immediately. Price is approximately $85,000.

Where the usage level doesn't justify the full interactive capabilities of a computer-based system, an alternative approach uses the HP Programmable Electronic Calculator to perform the calculations. Merely by inserting a small magnetic card into the instrument, the physician enters instructions for the complex calculations. Then all he has to do is enter on the keyboard the catheterization measurement data.

Once basic data is entered, calculation takes less than five minutes and the desired information—cardiac output, stroke volume, total peripheral resistance, pulmonary and systematic A-V differences, % shunt—appears on the calculator's visual display and printer while the patient is still in the cath lab.

Fully documented HP cardiology programs available to all calculator users help speed catheterization data analysis. Additional programs to meet special requirements are easily prepared and permanently stored on magnetic cards for instant reuse. Calculator prices start at $3950.

Write us of your interest in either system and we'll respond with complete information.

Computer helps GC simulate distillation

A far cry from the alembic used by the 16th century alchemist, the artful glassware used by the modern oil chemist for True Boiling Point (TBP) distillation nevertheless employs the same basic technique: boil and condense. To this day, TBP distillation remains the accepted way to establish the basic marketing specification of petroleum products . . . and it leaves a lot to be desired. Those who refine petroleum products don't like it because it takes so long: TBP distillation of a wide-boiling distillate can take as long as 100 hours, and the results are useless in controlling the operation of a refinery. Those who buy petroleum products don't like it because the method is not very reproducible, especially as it applies to the initial and final boiling points. Those who perform the distillation don't like it because the procedure itself is a long and boring task.

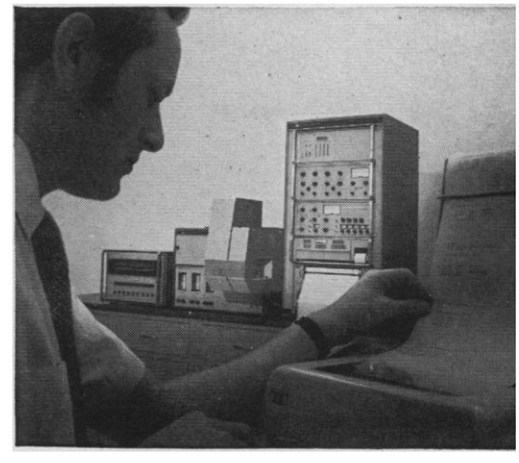
A group of scientists at HP's Avondale Division have devised a completely automatic method that employs gas chromatography (GC) to simulate distillation and produces boiling point distribution data more precisely and in much less time—about 40 minutes—than TBP distillation. The new method employs the HP 7600A Chromatograph System which is capable of automatic unattended operation from sample measurement and injection to final analysis report.

The recipe for simulated distillation with the 7600A is relatively simple. Set the GC for a linear program of 6 to 10°C/minute starting at —20°C, load the sample tray with as many as 36 different calibration and analytical samples, even of widely diverse boiling ranges up to 1000°F . . . and push the *start* button: the rest is automatic.

Complete sets of programs provided with the 7600A enable its HP computer (opt. 003) to determine the initial and final boiling points of each sample and print out the analysis report of boiling point distribution at 1% increments.

No knowledge of computer programming is required by the analyst. At each stage of the computer-performed calculations, the computer asks for the information it requires and the operator answers by typing the requested number or word on the keyboard.

The precision of the 7600A Simulated Distillation method with wide boiling range samples is greater than is possible by any distillation method. Its speed—an average of 40 minutes per sample—completely outclasses distillation methods.



This new automated Simulated Distillation method is examined in much more meaningful detail in Data Sheet 7600. Write to Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

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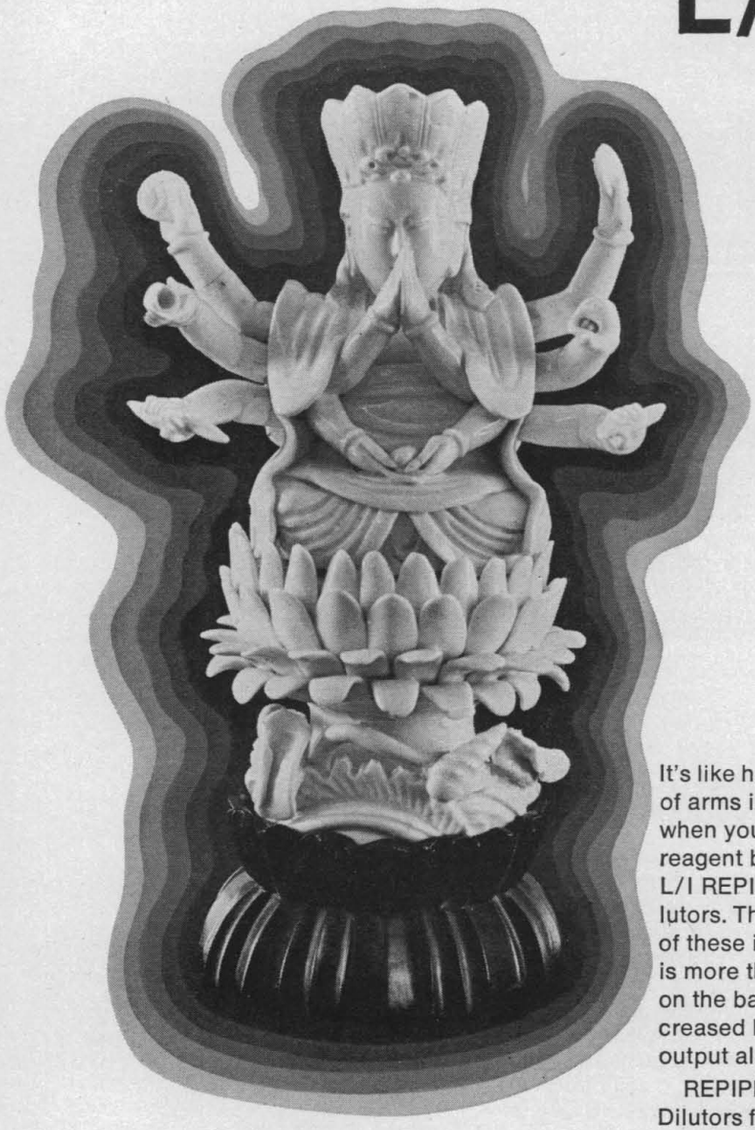

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The new Continuous Flow Zonal Rotor is in production and ready for immediate delivery. For more details, write to International Equipment Company, 300 Second Avenue, Needham Heights, Massachusetts 02194.

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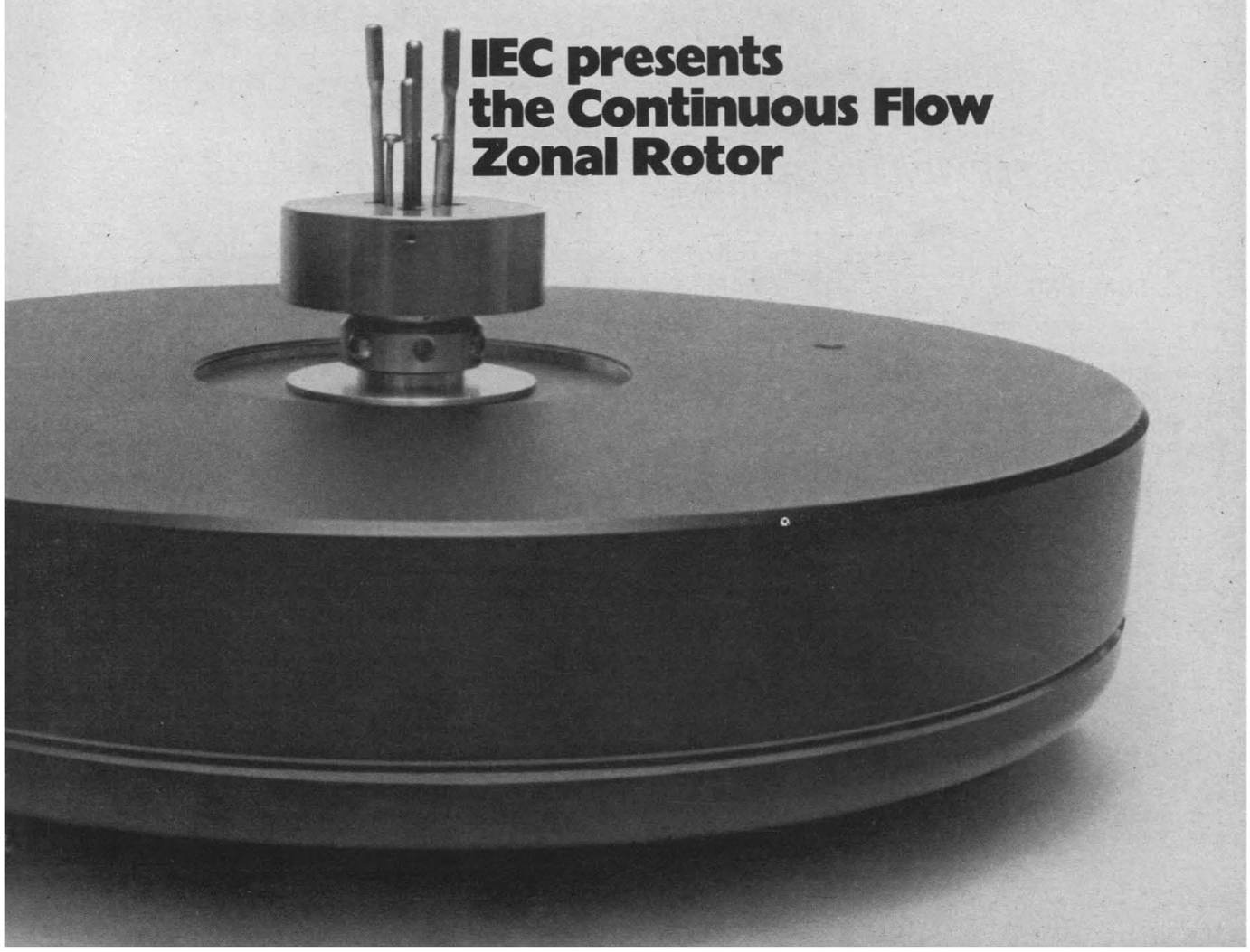

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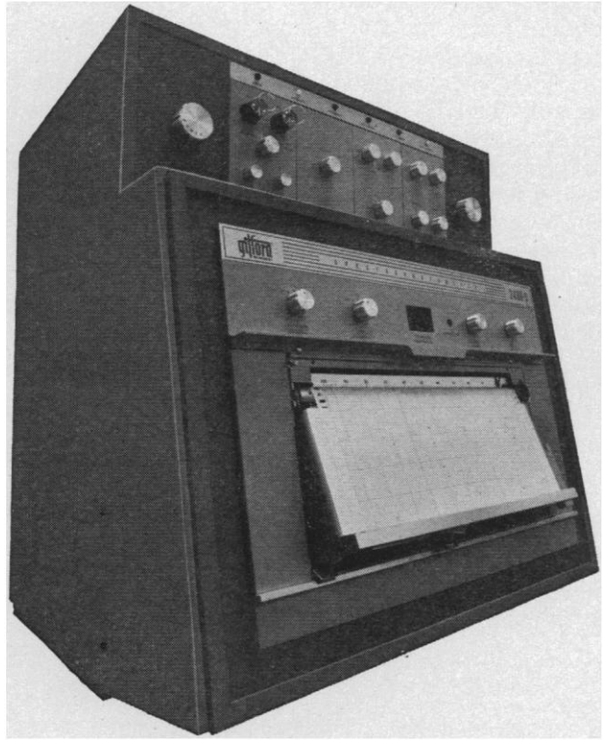

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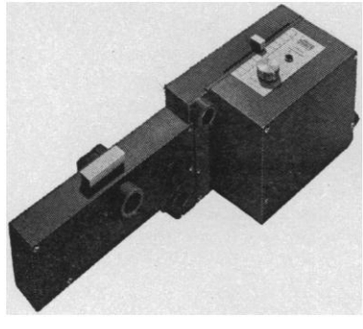

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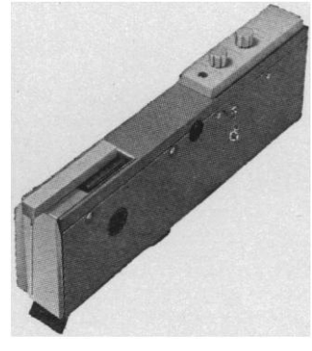

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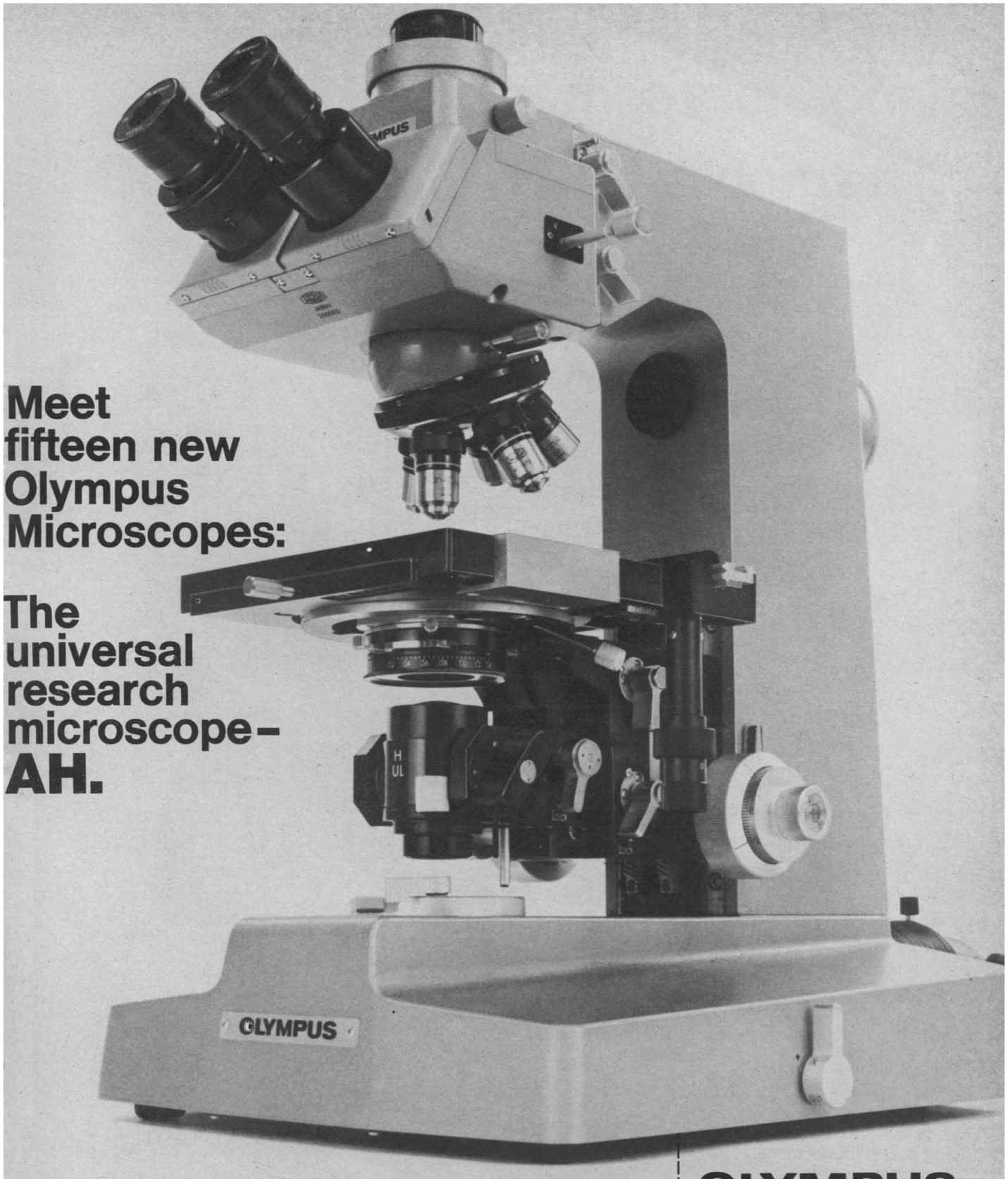

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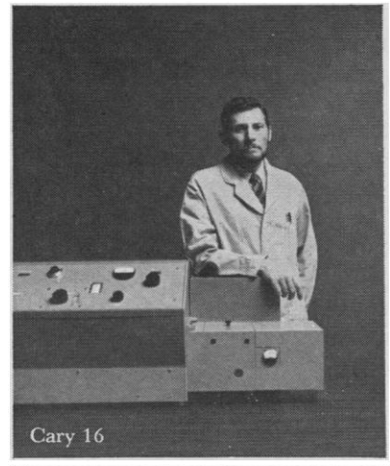
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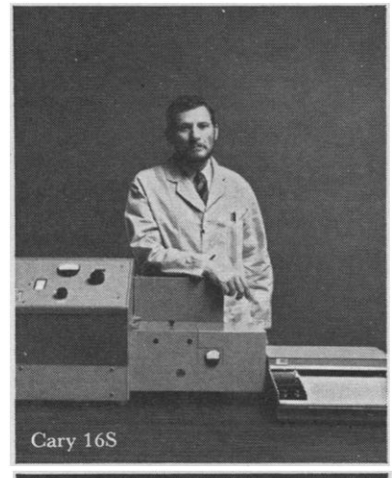
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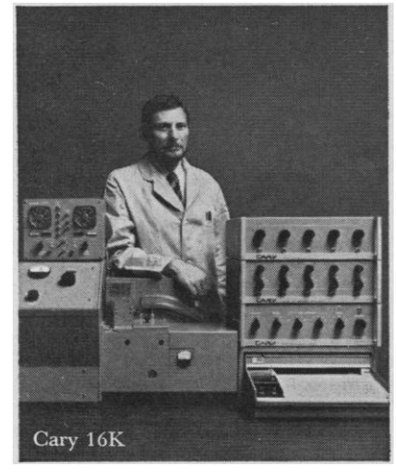
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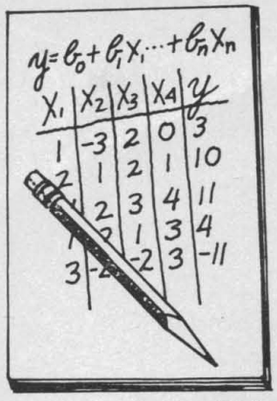

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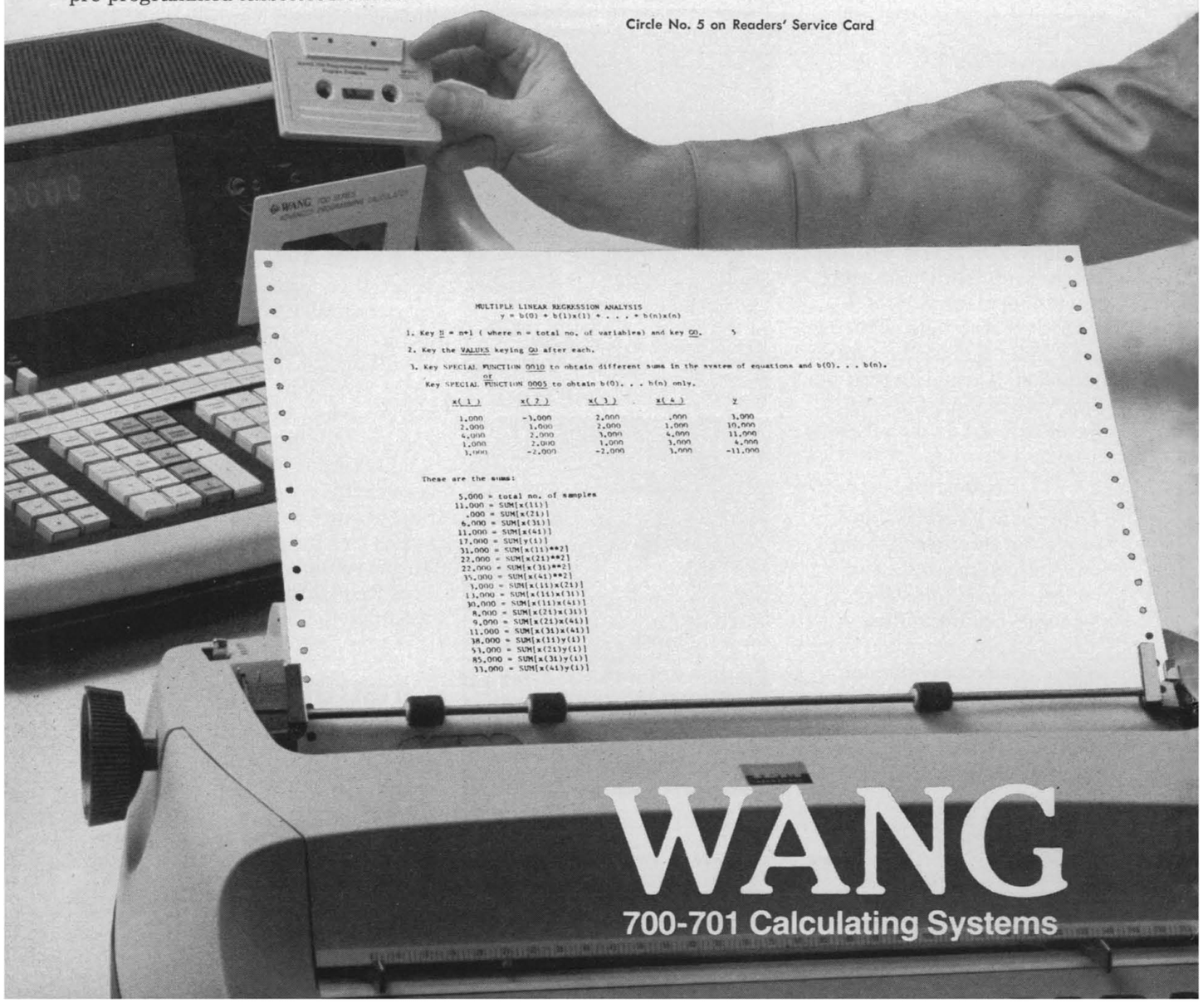

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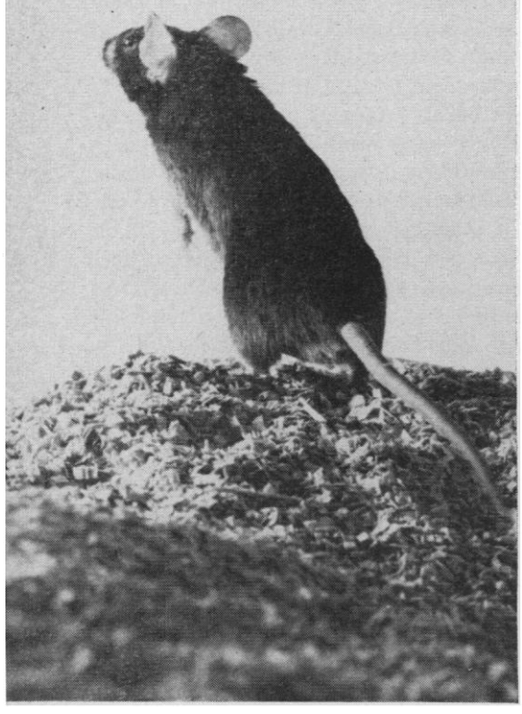

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predicts that the future may bring about certain constraints upon human rights and current individual freedoms neither means that one *endorses* or *likes* such possible eventualities. As soon say that George Orwell *advocated* the state of human society he foresaw as possible in *1984*. If Steinberger is really interested in my views, he will find them discussed at much greater length in numerous earlier writings of mine, especially in *Science and Liberal Education* and *Science and Ethical Values*. I reiterate that "the right that must become paramount is not the right to procreate, but rather the right of every child to be born with a sound physical and mental constitution, based on a sound genotype." And again, "Just as every child must have the right to full educational opportunity and a sound nutrition, so every child has the inalienable right to a sound heritage." Perhaps that can be achieved on a voluntary basis, through educational understanding, genetic diagnosis, and wise counseling. That, of course, would be preferable. But if such means prove insufficient for the task, social compulsion may indeed be the only alternative, whether we like it or not. Human societies in the past have practiced harsher measures, directed against the unfortunate child or infant. Better that restriction be directed at the stages of conception or embryonic implantation, or even at the fetus, in cases of indubitable physical or mental incapacitation. The difficulty will always be to achieve certainty in diagnosis and to harmonize enlightened voluntary action with social compulsion. Much social inventiveness and ethical analysis must be directed at these matters, and I am far from claiming authority in such.

BENTLEY GLASS
State University of New York at Stony Brook 11790

AAAS Council: Moving Toward Elitism?

As a member of the AAAS Council, I noted Strasser's and Slifkin's concern with the election of the AAAS president (Letters, 19 Feb.). Whatever the Council is, it is not a presidium. Neither is it the "elite" group described by *Time* magazine. In the election of officers the Council acts with little more knowledge than the total membership would have. Routine biographical data really does not give a basis for intelligent choice.

In the same issue (p. 709), there is a summary of the 1970 Council meeting. A point is made that the meeting lasted only 3 hours and 35 minutes and this was attributed to "general economies of time" as a result of doing some business by mail. Far more significant, in my opinion, was the arbitrary and authoritarian manner in which this particular Council meeting was run. There was an obvious attempt to hold discussion to a minimum, probably for fear of disruption. . . .

Few people attend the AAAS Council meeting or accept election to office with other than the best of motives. The basic problem lies in the fact that the AAAS is not fundamentally a professional organization. There are no professional qualifications for membership. Yet in modern times it has tried to take a very professional role as a spokesman for all organized science, thus creating a great division between the Council and the Board of Directors. When a large, unwieldy body with an ill-defined membership and an extremely limited mandate meets briefly once a year, it cannot be expected to have much significance.

In 1969 the Board of Directors announced and the Council endorsed a goal of increasing the membership by an order of magnitude or more by 1980. In 1970 the Council rejected a nominee for president who was a member of the Board and who had been active in developing this goal! Also in 1970 the Council on its own initiative advised the Special Committee on Governance that "it is a sense of the Council that any changes in governance should insure that control of activities of the AAAS will be in the hands of bona fide scientists or societies of scientists." This says that we want the control to be in the hands of a specialized group within the organization without that group paying the financial price of that control; that is, high dues. The 10-year membership goal, if accomplished, will merely exacerbate our problems. The program goals for the AAAS require such a membership base unless the membership costs are to increase greatly. The control is to remain in the hands of a restricted (elite?) group, the bona fide scientists. Apparently we—or at least the majority of the Council voting—wish the larger membership group to support with its dues decisions and programs in whose development and approval it has no real part.

To worry merely about the undemocratic means involved in the selection

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of the president of the AAAS is the tip of the iceberg. I have no proposal to change the situation, only a conviction that these various pronouncements call for an elite controlling group financially dependent on a large membership. Rieser and his Special Committee on Governance will need the wisdom of a collection of Solomons if they are to resolve satisfactorily the contradictions in our present situation.

E. G. STANLEY BAKER
Department of Zoology,
Drew University,
Madison, New Jersey 07940

"Friends" of the Ecology Movement

I cannot ignore Esther Landau's letter (19 Feb.) criticizing the review by Haefele and Kneese of James Ridgeway's *The Politics of Ecology*. Those who remember when Senator Joe McCarthy was considered by many to be above criticism must be appalled at McCarthyism in the ecology movement. For example, when two reviewers in *Science* say that a certain book on ecology is inaccurate, misleading, and in general a pretty poor job, it draws a vituperative letter right along the line of the McCarthy supporters: "Anything said against Communism (today, read 'pollution') is good. Anything said against an anti-Communist statement is bad, and whoever says it must have ulterior motives." Landau proceeds to question the motives of your reviewers, although their true position with respect to ecological problems seems perfectly clear in their review. And she employs that favorite McCarthy ploy: guilt by association.

The ecology movement can protect itself against its enemies, but may Heaven protect it from such "friends."

GEORGE ELWERS
1507 High Ridge Road,
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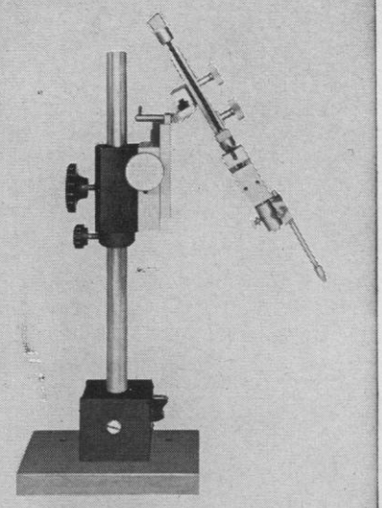
Polywater: Homely and Universal

The reports on the spectrum of polywater by Davis, Rousseau, and Board (15 Jan., p. 167) and Rousseau (15 Jan., p. 170) suggest that polywater is, in the words of Edison, "1 percent inspiration and 99 percent perspiration."

R. D. MURPHY
Department of Physics,
Memorial University of Newfoundland,
St. John's, Newfoundland, Canada



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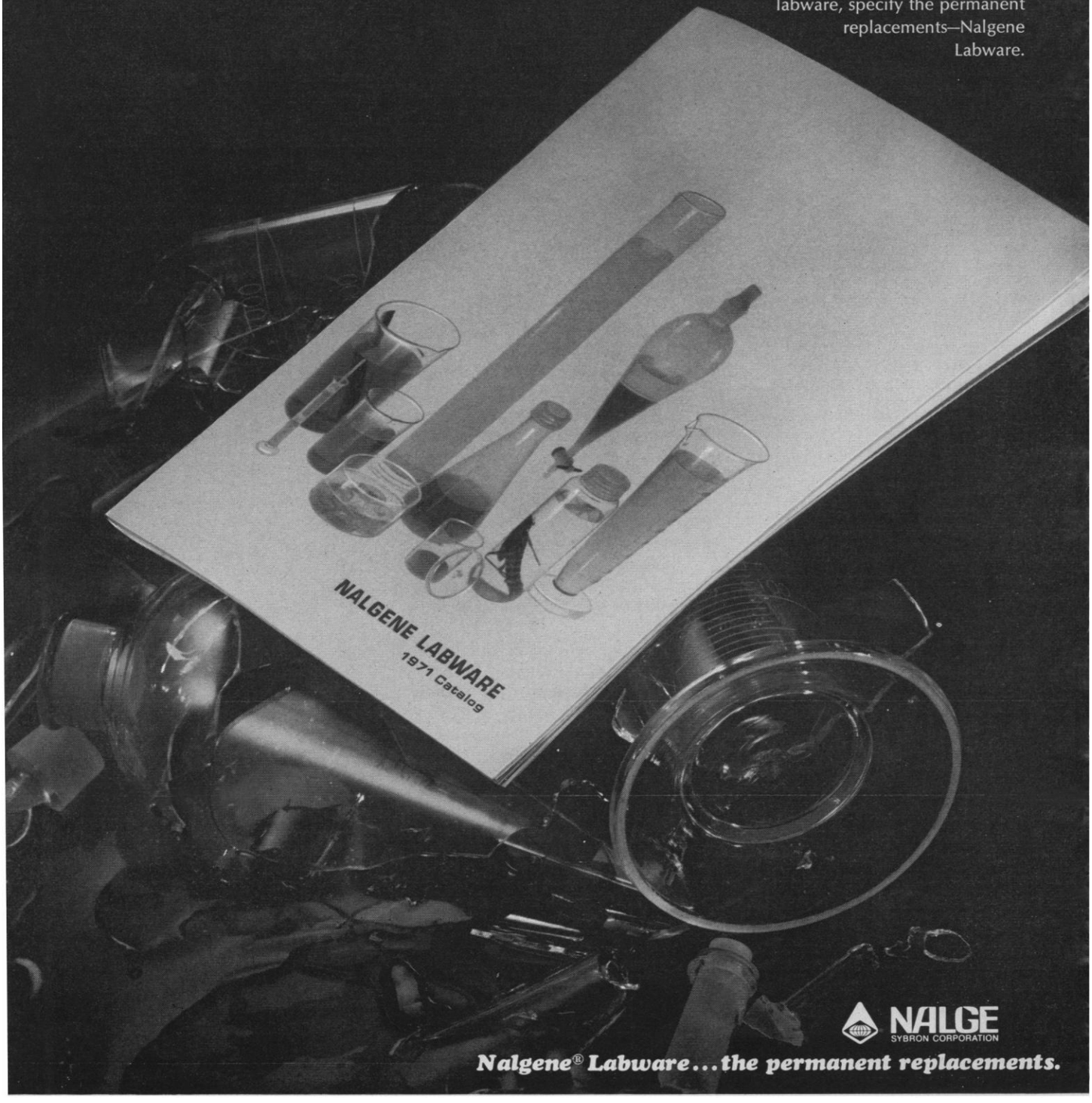

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A Time to Take Stock

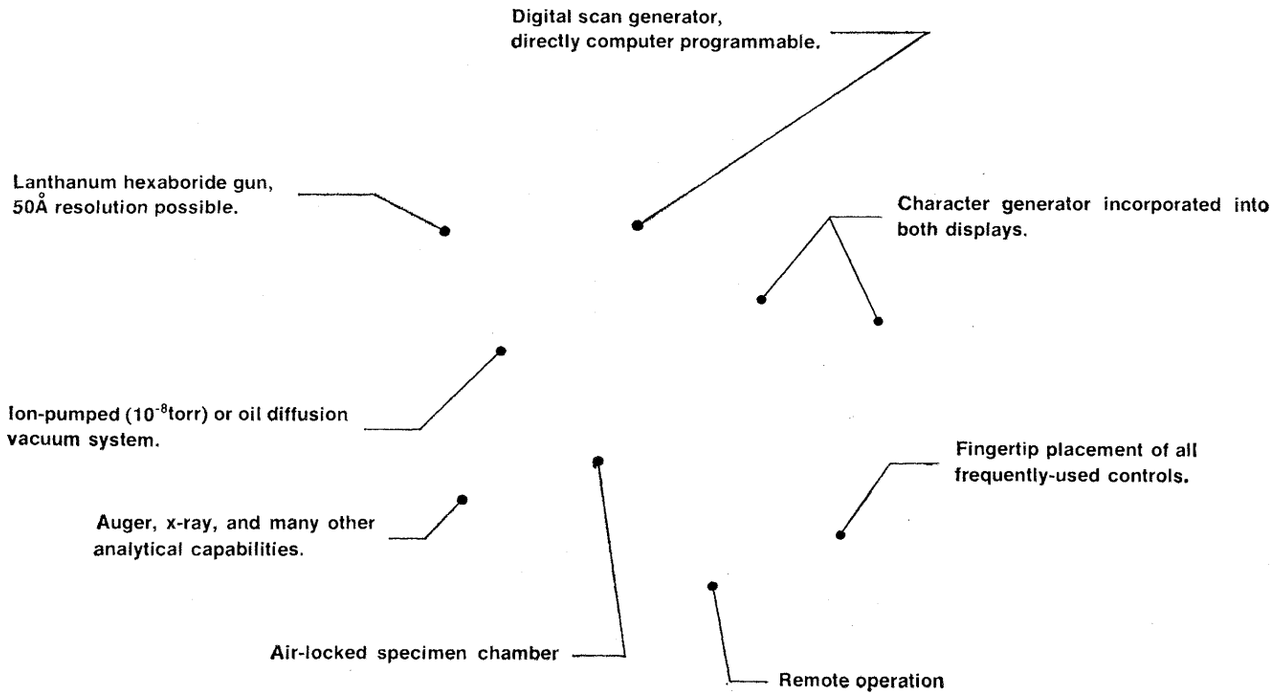
Scientists include a few inspired and dedicated individuals, some self-deluded charlatans who overestimate what they know and can do, and a very large number of intelligent, well-taught, skilled, and talented men and women who are capable of contributing substantially to man's knowledge, capabilities, and welfare.

Scientists have friends in government who want to see them well nourished and well employed. Scientists also face serious hazards and temptations. Scientists are assailed by people who believe that ignorant and intense talk, concern, love, hate, and social and political action bring human betterment rather than stultifying and unprofitable conformity. Scientists are tempted by others who want to give them huge sums of money toward ends that scientists have neither the knowledge to reach nor highly promising avenues of approach.

Mammon worship holds that money can buy anything. Organization worship holds that organization can accomplish anything. Money can buy many scientists, but it cannot always buy results. Organizations can consume scientists, but they do not necessarily produce results.

With money and organization, the atom bomb was made quickly, because scientists already knew how to go about making it. Money and organization put men on the moon, because scientists knew how to get there. Money and organization have not produced fusion power or a cure for cancer because scientists do not yet know how to attain these goals. Scientists do know that the achievement of these goals will require basic understanding that they do not yet possess. They do have fruitful ideas for research. They cannot predict when research will give them the knowledge necessary to attain the goals, but they will know when research has produced adequate basic knowledge to make the goals attainable.

In the end, most scientists will do whatever there is money for doing. Scientists know, or should know, which socially and economically useful goals are within reach and which have a good chance of accomplishment through promising research. Yet, in their personal and collective actions, scientists often seem more concerned with the total number of dollars, with the public image of science, and with the cry for certain specific results than with the sensible selection and vigorous pursuit of fruitful areas of research and application. It will be a sad thing for scientists if they fail to choose wisely and act energetically toward valuable and attainable goals—for, if they do not choose what they shall do, others will choose for them.—J. R. PIERCE, *Bell Telephone Laboratories, Murray Hill, New Jersey*



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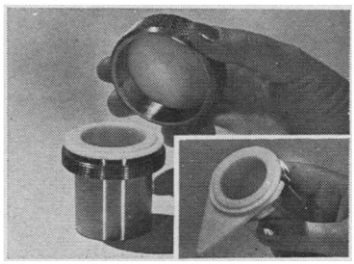

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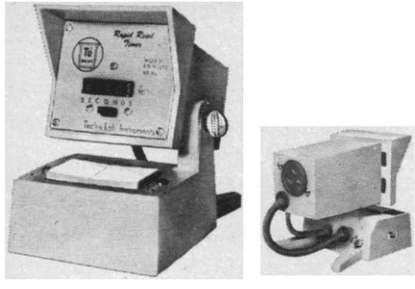

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trasted with the role of cyclic AMP in catabolite repression in bacteria.

Data were presented to indicate that proteins may be grouped in categories according to their rate of evolution: histones evolve slowly, cytochrome c and proteases are intermediate, and gamma globulins and fibrinopeptides evolve rapidly. Evolution through gene duplication was discussed in the light of repetitive DNA sequences found in higher organisms. A fascinating new theory was presented which attempts to describe in kinetic and thermodynamic terms the fundamental features of self-reproducible systems and the evolution of biological macromolecules.

During the second part of the meeting the topic was biological organization at the level of supramolecular aggregates, as represented by microtubules, viruses, ribosomes, and membranes. A large and rapidly growing body of information exists about the structure of individual macromolecules and about the intricate mechanisms that determine and control the individual functions. The major issue considered was the relation of this body of information to the structure, assembly, and function of supramolecular aggregates.

The first part of the meeting was devoted to discussion of the nature of the molecular interactions involved in macromolecular systems and to manifestations of symmetry in supramolecular aggregates. The role of hydrophobic interactions received particular consideration, that is, the decrease in free energy that occurs when two structures come into noncovalent contact, causing a release of the water molecules originally associated with their interacting structures. For example, it is clear from x-ray data on hemoglobin that apolar residues predominate at the relatively large interface of the alpha and beta subunits. Although many residues come into contact in the tetrameric molecule, the overall free energy change involved in subunit interaction may be only a few kilocalories per molecule, as judged by studies of hybrid aggregates in solution. A correct alignment of a few hydrogen bonds or of ionic groups of subunits at the joint interface may be critical for favorable interaction and thus may impart specificity to their assembly.

It appears that the symmetry of an aggregate is the result of the specific structures and specific interactions of the component parts. The polymorphism often encountered in the assembly of viral subunits is probably a reflection of the fact that the free energy changes in subunit interaction are small and nearly the same for different modes of assembly.

The degree of spontaneity in the assembly of supramolecular aggregates was considered next. In the assembly of T4 bacteriophages and the bacterial ribosomes in vitro and in vivo, many steps in the assembly process occur spontaneously: given a suitable mixture of component parts, no energy source or further processing of the components being added is required. Some of these steps, however, can only occur after a particular stage in the assembly process has been reached, thereby defining a temporal sequence in the assembly. With bacterial flagella, a special membrane-bound structure is apparently required as a template to initiate the appropriate polymerization of the flagellin subunits.

In some instances, the ultimate size attained by complex aggregation is determined by the size of a specific unit functioning as a template. This seems to be so in the case of tobacco virus RNA. In other aggregates, however, no such template appears to be involved. The size of a flagellum, for instance, may be determined by the rate of addition of further subunits from the interior of the bacterium to the growing point on the outer tip of the flagellum. Alternatively, the attachment of additional layers of subunits may result in a "cumulative strain" which stops further growth.

One of the most interesting facts that emerged was the realization that a limited number of covalent bonds needs to be cleaved during the assembly process. This feature is common to many different systems. A protein of simple RNA viruses is apparently synthesized as a long polypeptide chain and subsequently cleaved into several smaller fragments in the intact virus particle. Similarly, the major protein of the head of T4 bacteriophage undergoes scission in the assembly process. As a possible prototype of such processes, the proteolytic conversion of fibrinogen to soluble fibrin and the covalent bonding of fibrin subunits into the fibrin clot were examined in some detail. In this system, the proteolytic cleavage releases two small peptide fragments from the fibrinogen molecule and exposes regions which can interact to form an aggregate. The aggregate is

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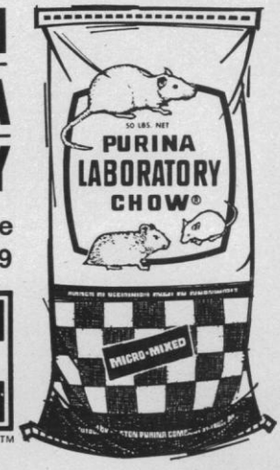

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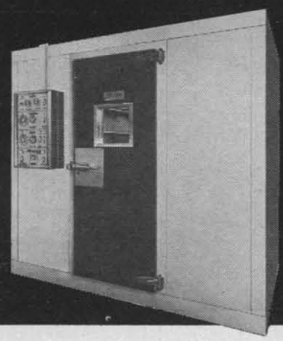

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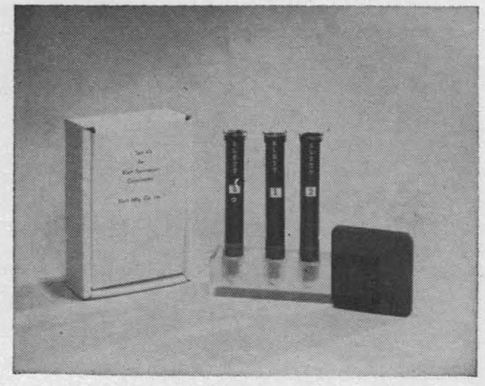

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then cross-linked at specific sites. In other cases, as in the assembly of the RNA of the 30*S* and 50*S* ribosome subunits or of the DNA of the lambda phage, covalent bond scission of nucleic acids is involved in the assembly process. In lambda phage, the DNA is synthesized as a multicistronic, double-stranded unit which is cleaved at one specific bond in each strand as a late step in the assembly of the mature virus.

Membrane structure was also discussed. The heterogeneity of the lipids and proteins of membranes suggests that membranes are unlike other types of supramolecular aggregates whose components appear to be present in stoichiometric proportions. It was therefore suggested that membranes are specifically constructed to permit such heterogeneity, namely, as a mosaic of globular proteins embedded in a lipid matrix. Protein-lipid interaction may be sufficiently nonspecific to allow a large number of different proteins to be fitted into such a combination.

Binding of fluorescent or spin-labeled molecules to membranes revealed that the lipid regions are fluid and subject to subtle structural perturbations by changes in ionic strength and other variants. This fluidity may be of crucial importance to membrane function. The identification of specific membrane proteins involved in the transport of beta galactoside in *E. coli* and in the initiation of nerve impulse in excitable membranes was described. Possible carriers and other steric mechanisms in the function of these proteins were examined. Two public, evening lectures were given: "The Evolution of Biological Macromolecules" by Manfred Eigen and the "Human Enterprise" by George Wald.

In all, the conference provided a unique opportunity for the participants to exchange ideas both in formal sessions and in personal discussions for which ample time was provided during each of the 2 weeks. It is hoped that similiar conferences will be held in the future.

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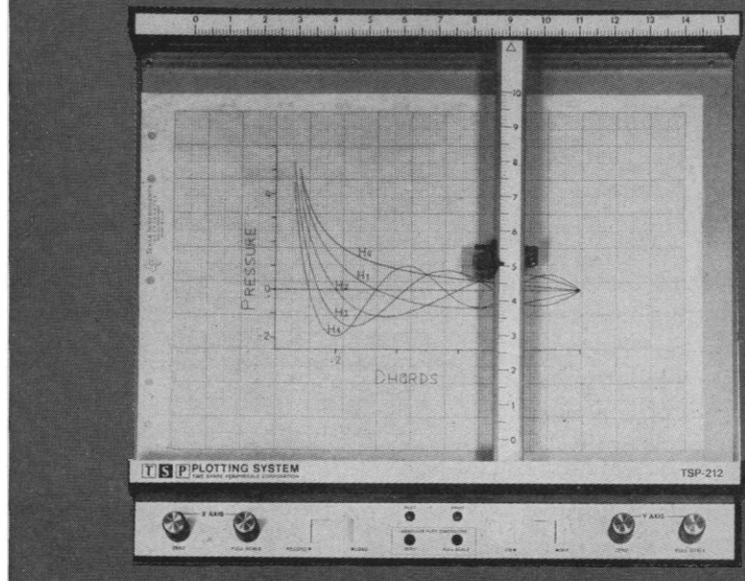

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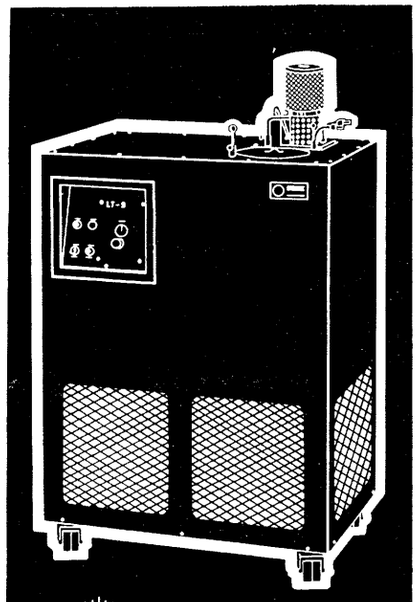

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Pantheon (Random House), New York, 1971. xviii, 300 pp. $6.95.

A Book of the Basques. Rodney Gallop. University of Nevada Press, Reno, 1970. xvi, 298 pp. + plates. $7.

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Catalogue of Star Clusters and Associations. G. Alter, J. Ruprecht, and V. Vaňysek. Second edition, edited by G. Alter, B. Balázs, and J. Ruprecht. Akadémiai Kiadó, Budapest, 1970. Booklet (76 pp.) + 3085 cards, boxed. $36.

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Cells and Organelles. Alex B. Novikoff and Eric Holtzman. Holt, Rinehart and Winston, New York, 1970. x, 338 pp., illus. Paper, $6.25.

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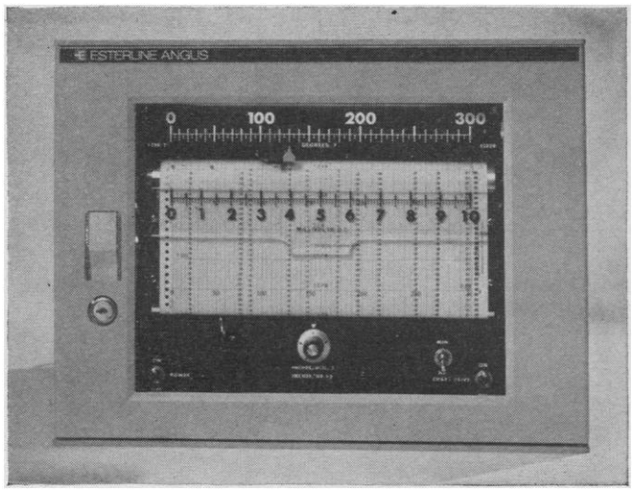

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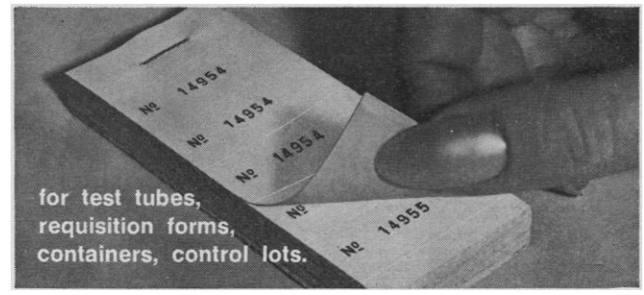

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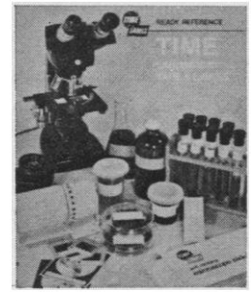

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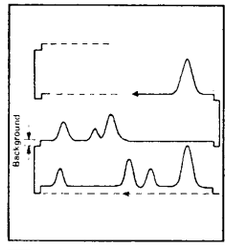

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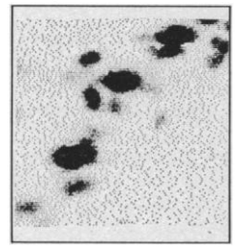

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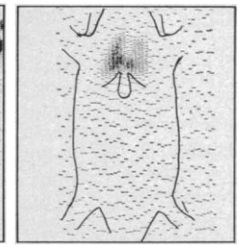

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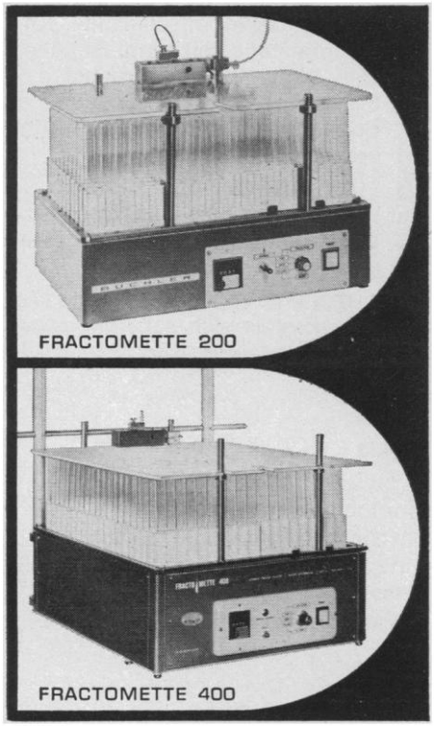

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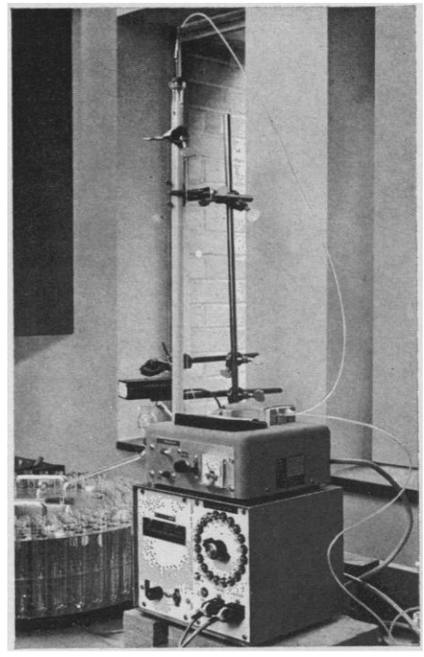

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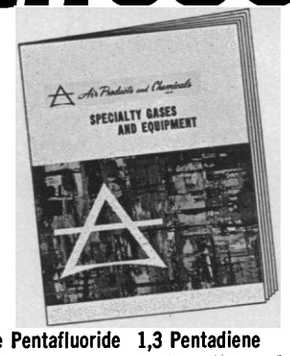

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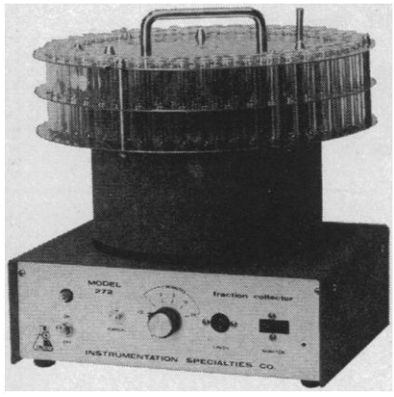

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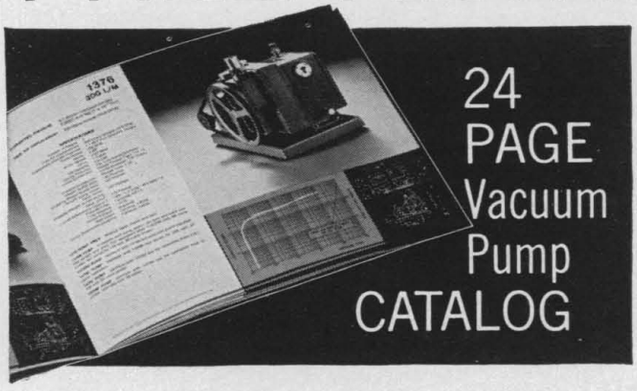

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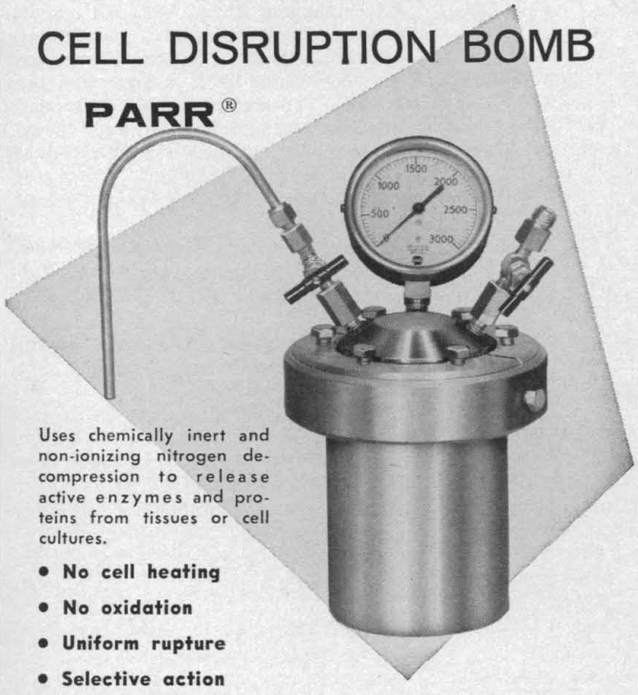

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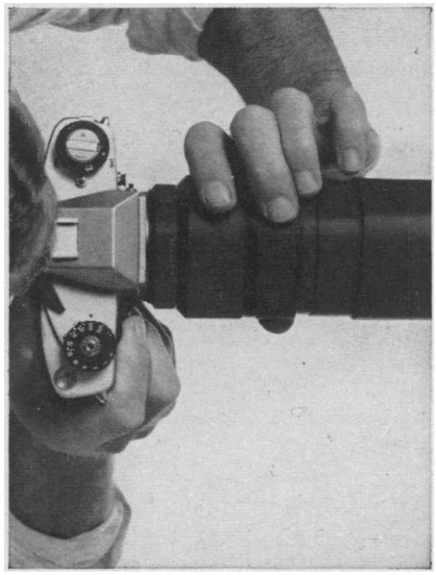

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