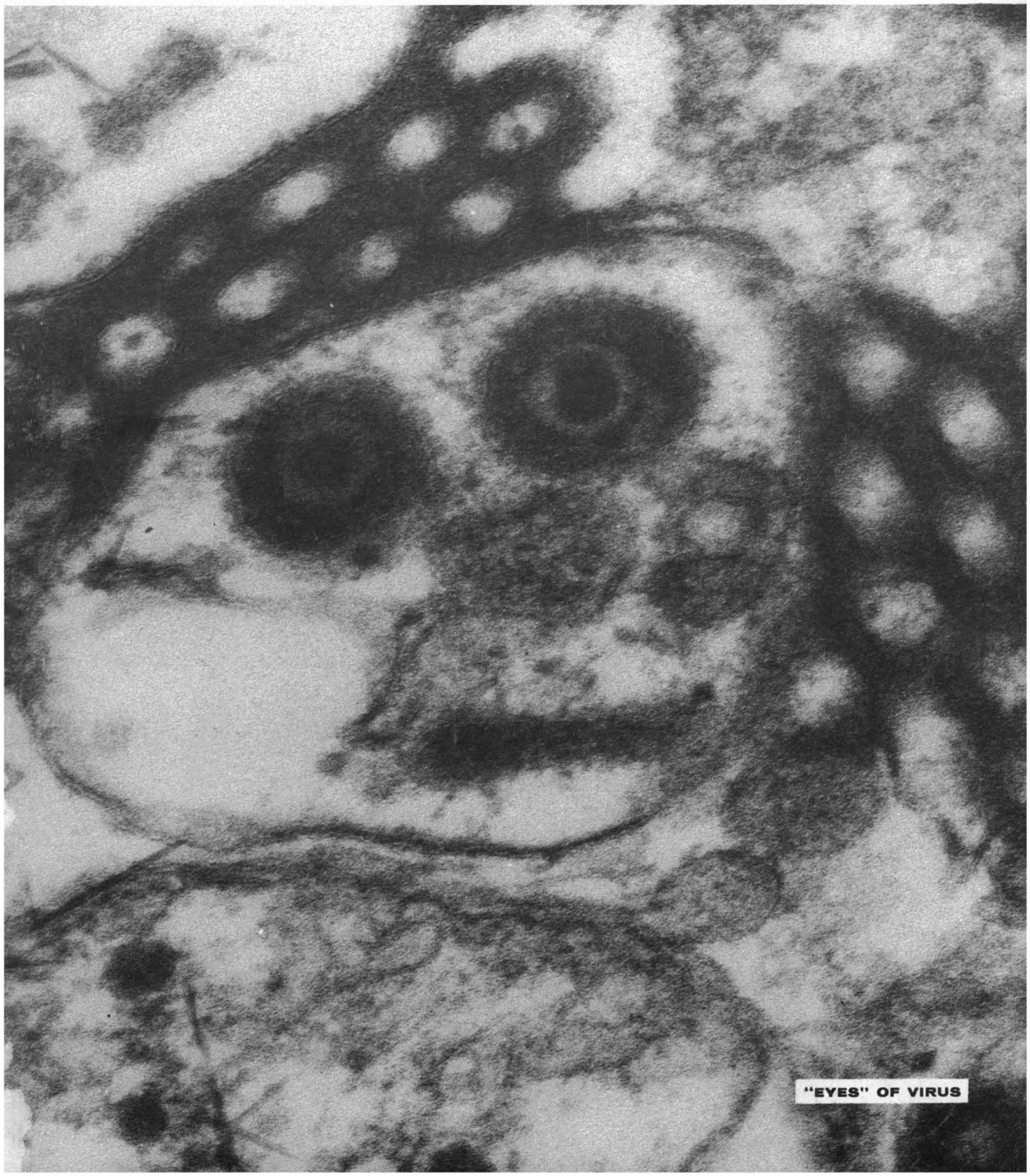
SCIENCE

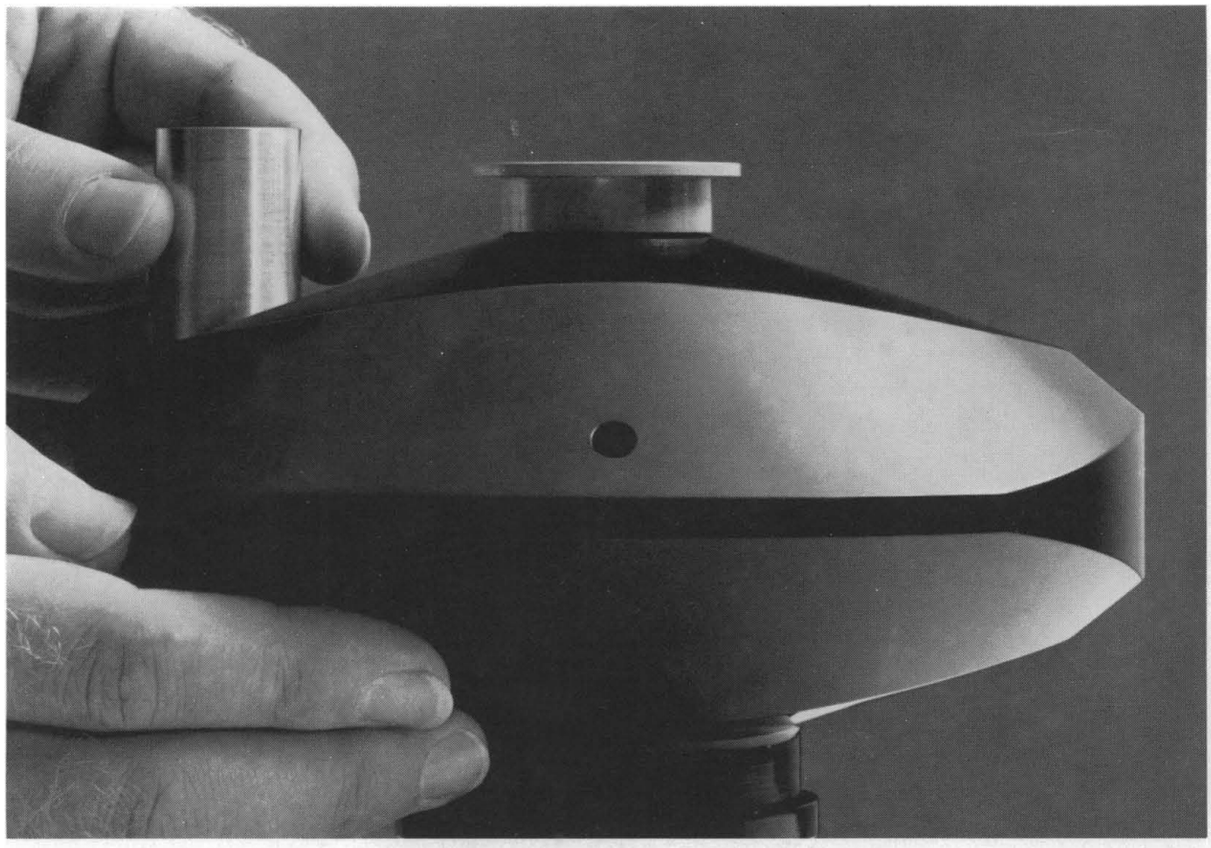
3 February 1967

Vol. 155, No. 3762

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

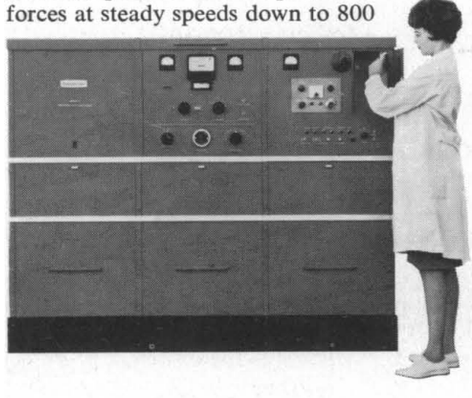


"EYES" OF VIRUS



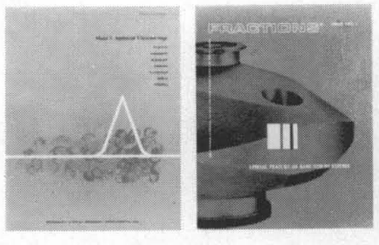
Large molecules and the Analytical Ultracentrifuge

How in touch are you with recent advances in that basic tool for making molecular measurements, the Model E Analytical Ultracentrifuge? Band sedimentation, the short column equilibrium technique, high temperature work with synthetic polymers, the use of computers, direct scanning and recording, higher forces at speeds to 68,000 rpm, lower forces at steady speeds down to 800 rpm for studies of extremely large molecules, new areas of investigation such as the correlation of molecular structure with function—all are steps forward that could very well enable the analytical ultracentrifuge to make a valuable contribution to your research.



Literature Available

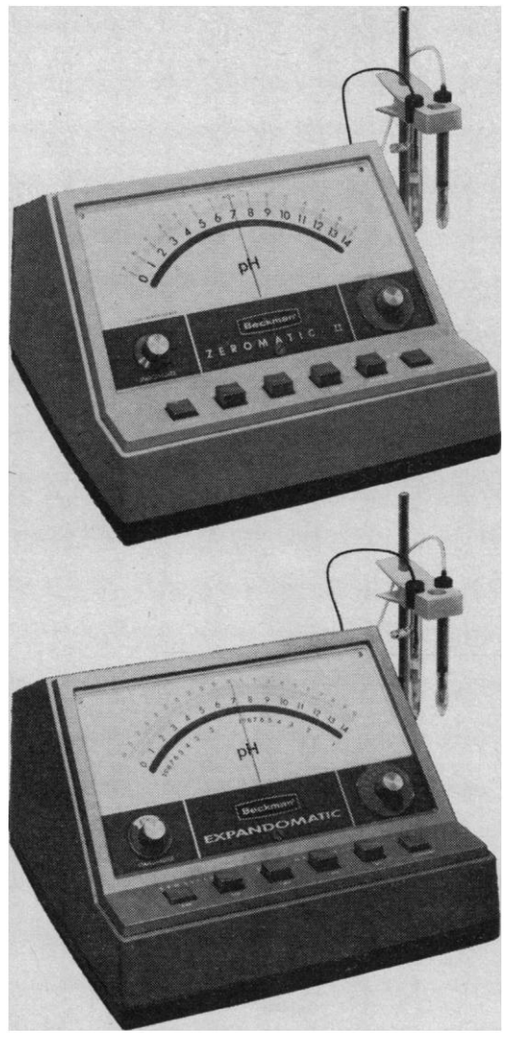
If you've not been following the fast-developing field of analytical ultracentrifugation, we'd like to keep you up to date on advances in theory, technique, and instrumentation. One way is to send you the new brochure on the Model E. It reviews applications, measurements, and methodology, and describes the analytical ultracentrifuge of today. Ask for SB-189A.



Another way is to see that you receive *Fractions*®, our quarterly publication sent to users of Beckman instruments for biochemical research; a note on your letterhead to the Editor of *Fractions* will add your name to the distribution list. Extra copies of the two most recent issues are also available: they feature a review of band sedimentation in velocity studies, and a discussion of computers and the ultracentrifuge. Our address: 1117 California Ave., Palo Alto, California.

Beckman® INSTRUMENTS, INC.
SPINCO DIVISION
PALO ALTO, CALIFORNIA • 94304

INTERNATIONAL SUBSIDIARIES: GENEVA; MUNICH; GLENROTHES, SCOTLAND; TOKYO; PARIS; CAPETOWN; LONDON; MEXICO CITY



After a double-take...read the fine print

Here are two Beckman pH meters made to look alike... but which are significantly different internally. Both instruments provide broad flexibility, precision, and a high degree of accuracy in electrochemical measurement.

ZEROMATIC® II pH METER...*When you need an instrument for general lab pH measurements,* look to the Zeromatic II. This is an instrument ideally suited and designed for general-purpose use in the laboratory. The taut-band meter, with an 8.2-inch scale, offers the ultimate in readability and permits readout over the 0 to 14 pH or 0 to ±700 mv range, which may be extended up to ±1400 mv. It is a line-operated instrument with the capabilities required for most applications.

EXPANDOMATIC® pH METER... *When you need an instrument for more precise pH measurements on an expanded scale* to spot minute differences in pH or millivolts, the Expandomatic should be used. A *standard* scale covering the full 0 to 14 pH (0 to ±1400 mv) range is available for ordinary pH and millivolt measurements. An *expanded* scale displays any 2 pH units or 200 millivolts over full scale with ±0.01 accuracy. A *logarithmic* scale, corresponding to the expanded scale, permits the correlation of any two pH units with their hydrogen-ion activity.

Otherwise, these two pH meters have the same outstanding features: ±0.05 relative accuracy and ±0.015 repeatability over the full standard scale; an extra large, taut-band meter that is precise and highly readable; easy-to-use push button controls for convenient operation; a die-cast aluminum case resistant to chemicals; a continuously adjustable temperature network which covers the full 0 to 100°C temperature range; and a drift-free performance amplifier. Added to this is the unequalled background and back-up of Beckman sales and service, based on 31 years of experience in perfecting the technique of pH measurement.

Take a second look – choose between the ZEROMATIC II or EXPANDOMATIC. Or you may want both for your laboratory. Contact your local Beckman Sales Office for a demonstration. Or write for Data File No. 2.

Beckman INSTRUMENTS, INC.
SCIENTIFIC AND PROCESS INSTRUMENTS DIVISION
FULLERTON, CALIFORNIA • 92634

INTERNATIONAL SUBSIDIARIES: GENEVA; MUNICH; GLENROTHES, SCOTLAND; TOKYO; PARIS; CAPETOWN; LONDON; MEXICO CITY

3 February 1967
Vol. 155, No. 3762

SCIENCE

SCIENCE is published weekly on Friday and on the fourth Tuesday in November by the American Association for the Advancement of Science, 1515 Massachusetts Ave., N Washington, D.C. 20005. Now combined with **The Scientific Monthly®**. Second-class postage paid at Washington, D.C. Annual subscriptions $8.50; foreign postage, $1.50; Canadian postage, 75¢; single copies, 35¢, except **Guide to Scientific Instruments**, which is School year subscriptions: 9 months, $7, 10 months, $7.50. Provide 4 weeks' notice for change of address, giving new and old address and zip numbers. Send a rec address label. SCIENCE is indexed in the **Reader's Guide to Periodical Literature.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Infectious laryngotracheitis virus in tissue culture cell. This anthropomorphic configuration resulted from the presence of virus particles among elements of cytoplasmic structures. The "wide open eyes" were formed by mature virus particles. The head was formed by electron dense tubular formations (about × 190,000). [A. M. Watrach, College of Veterinary Medicine, University of Illinois]

Electron microscope with true image intensification makes it possible to see images once too faint to view

The all-new EMU-4 provides a remarkable tool for extending the range of electron microscopy. By means of optional true TV image intensification, transient phenomena can be observed and recorded. Images, too faint to view on the microscope screen, are clearly visible. Specimens such as polymers, which are normally altered or destroyed by the electron beam, can now be studied. Use of multiple and remotely located monitors permit many persons to study the images in a lighted room. Television intensification can open up a whole new range of research possibilities.

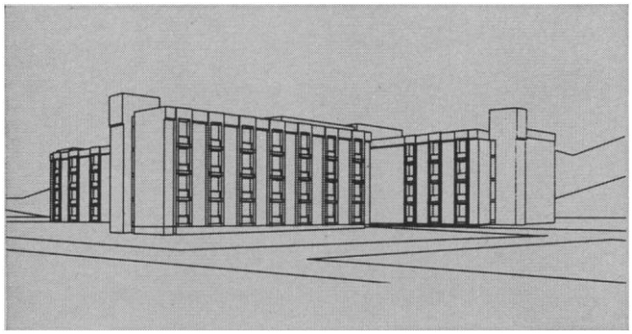
The EMU-4 is the first and only electron microscope to offer the high-reliability advantages that characterize today's space-age technology. Self-adjusting circuits and modular ("building block") design simplify operation, reduce maintenance. And with building block modules, new functions later deemed necessary can easily be added. Routine procedures are automated. New high-capacity photographic facilities and ten-fold larger specimen chamber increase versatility.

Start-up and shut-down time is a matter of seconds, the result of the new push-button vacuum system. Permanent objective aperture is standard equipment.

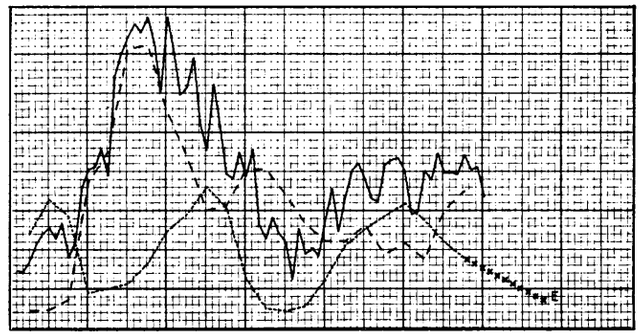
With its many innovations this entirely new instrument adds a new dimension to the field of electron microscopy and scientific research. A full line of accessories is available. Nation-wide service can be provided. For further information, write RCA Scientific Instruments, Building 15-5, Camden, N.J. In Canada: RCA Victor Company Ltd., Montreal.

RCA® **The Most Trusted Name in Electronics**

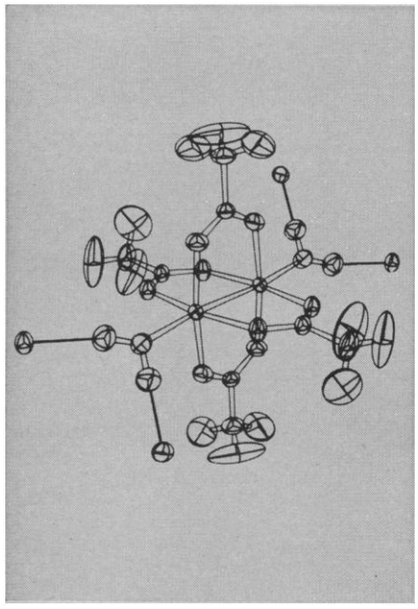
Would you believe a CalComp plotter and any computer can draw pictures like these in seconds?



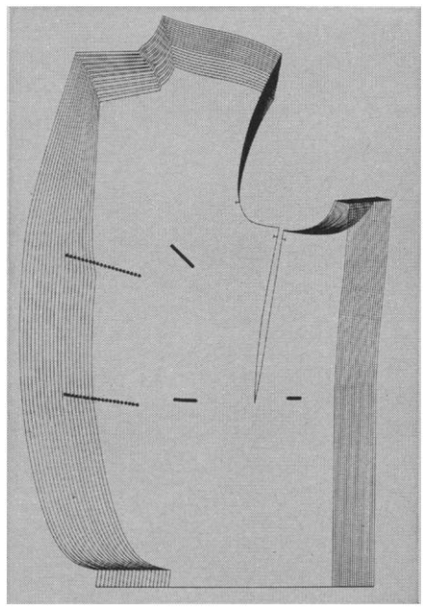
a perspective sketch of your new plant



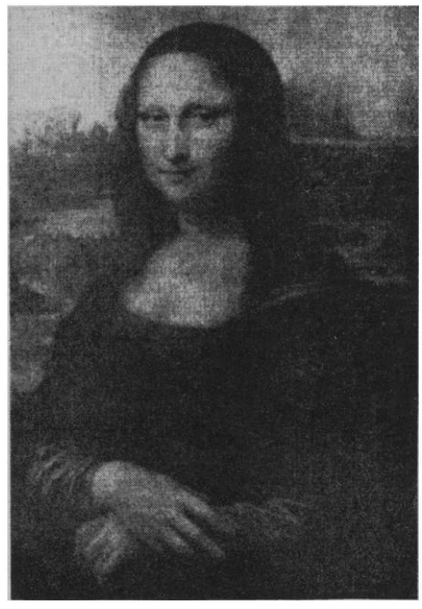
statistical trend charts



molecular structure diagrams



apparel patterns, graded for sizes



and even the Mona Lisa

it can

Call or write Dept. T-2, California Computer Products, Inc., 305 Muller, Anaheim, California 92803. Phone (714) 774-9141.

CALCOMP

Standard of the Plotting Industry

(Talented Engineers and Programmers required—right now.)

GAS OR STEAM

STERILIZERS

FOR SCIENCE AND INDUSTRY

VACUDYNE®

VACUDYNE CORPORATION / 375 E. JOE ORR RD. / CHICAGO HEIGHTS, ILL. / PHONE: 312-374-2200

THE PERKIN-ELMER CORPORATION
NORWALK, CONNECTICUT
VOL. 2
NO. 4
1966

GC NEWSLETTER

The Model F-11 Now Available with Hot Wire Detector

The modern, low cost Model F-11 Gas Chromatograph, which until now has been available in the United States only with a Flame Ionization Detector, can now be obtained with a Hot Wire Thermal Conductivity Detector, as well.

The unique design of the F-11 places all of the components which are in contact with the sample — injectors, columns, and detector — in an interchangeable analyzer unit which forms the lid of the precision oven. To change from one detector to the other is as simple as changing lids.

A primary objective of the F-11 design is to provide the maximum in performance and economy by providing all of the required features in the basic instrument. To this end, the new Hot Wire Detector Analyzer comes complete with fully proportional temperature control for the detector as well as a solid state power supply for filament current. There are, of course, separate temperature controls for the injectors, columns, and detector.

Compare these features of the new F-11 with Hot Wire Detector with those of competitive instruments . . . even the high priced gas chromatographs:

- Dual column with dual injectors.
- Fully Proportional Temperature Control.
- Solid State Power Supply featuring constant current with ten discrete current settings.
- "Check Filaments Control" which gives a direct readout of filament temperature.
- A filament protection circuit.
- Discrete, reproducible temperature settings for the Hot Wire Oven.
- Heated lines for sample collection.

A completely assembled, ready-to-operate hot wire F-11, including analyzer column, oven, and all the necessary gas lines to install the chromatograph, should be ordered as follows:

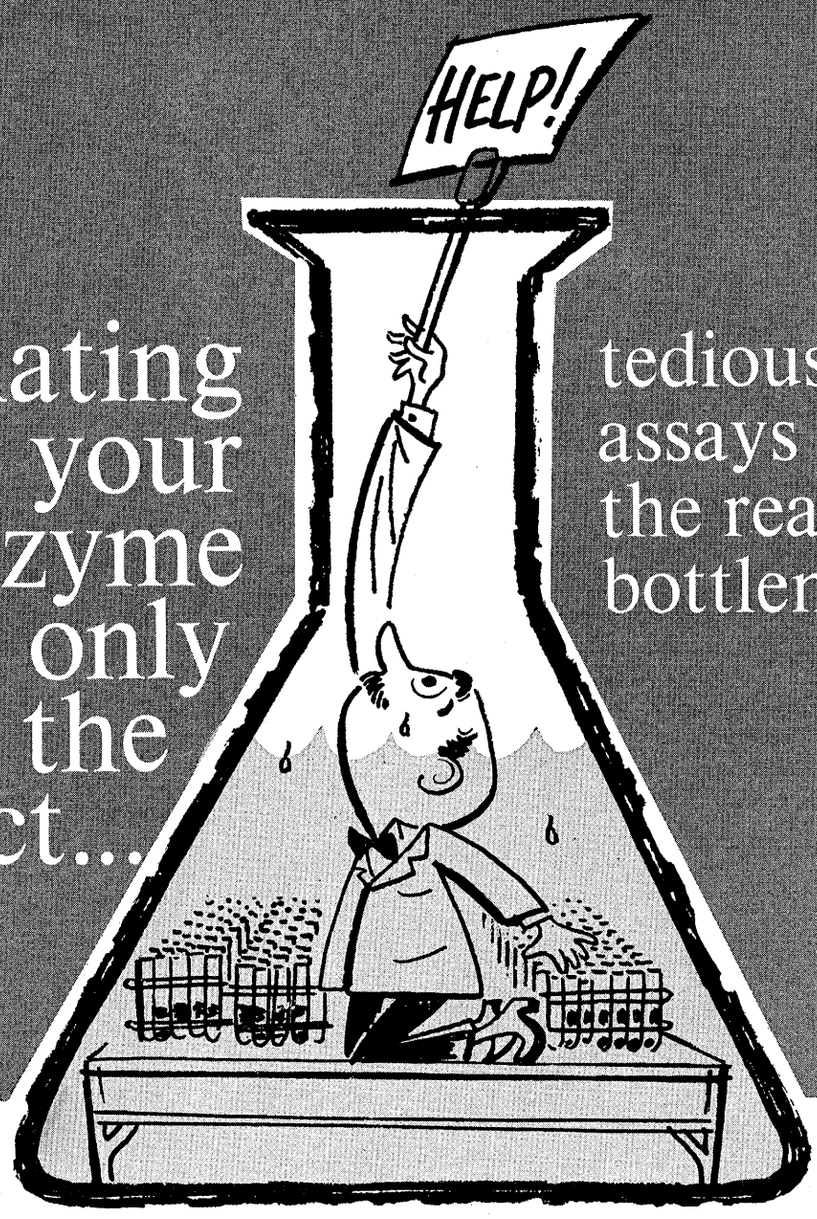
455-0010	Hot wire detector assembly
455-0011	Electronic unit for hot wire analyzer unit
455-0001	Precision oven
228-0901	Installation kit

It should be emphasized that, although the F-11 is ordered under four part numbers, the instrument is shipped completely assembled and ready to operate.

For further information on the Model F-11, including an illustrated brochure and complete price list, please write Perkin-Elmer Corporation, Instrument Division, 723 Main Avenue, Norwalk, Connecticut 06852. And if you'd like a free subscription to the Perkin-Elmer GC Newsletter, add that to your request.

PERKIN-ELMER

Isolating your enzyme is only half the project...



tedious assays cause the real bottleneck

But they needn't. The frustrations of manually assaying enzymes can be broken with the Technicon® AutoAnalyzer.® The following procedures have been automated at rates up to 60 samples per hour or by continuous monitoring of column effluents:

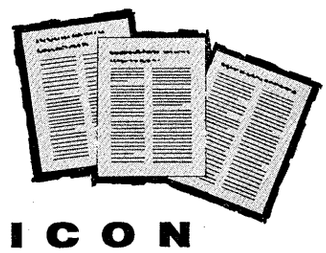
amylase
cholinesterase
cytochrome oxidase
amino acid decarboxylases
dehydrase
alcohol dehydrogenase
lactic dehydrogenase
glucokinase
glucose oxidase
glucuronidase
hexokinase
histidase
urease
glutamine synthetase
ornithine transaminase
6-phosphogluconate-1, dehydrogenase
hydrolytic enzymes
lysolytic enzymes
NAD-NADH systems
peptidase
phosphohexose isomerase
phosphorylase
acid phosphatase
alkaline phosphatase
proteolytic enzymes
sulfatase
glutamic oxalacetic transaminase
glutamic pyruvic transaminase
ornithine carbamoyl transferase
and others

Reaction rates...quantitation... assay...chromatography

It is quite likely that we can automate the assay for the enzyme system you have under investigation.

Contact us...we may already have done so.

In any case, we will be happy to furnish a selection of reprints which report the methods and equipment employed to effect significant savings in time, labor and material.



TECHNICON
INSTRUMENTS CORPORATION
Ardsley (Chauncey), New York 10502

What type of data are you generating, and how fast? Bits? Bytes? Nuclear events? Analog signals? . . . 50,000 words per second? Up to 250,000? One million? (PDP-9 can handle your problem easily *and* economically. Low speed devices interface to the I/O bus inexpensively; higher speeds can be handled by the standard, built-in data channels. Truly high speeds, up to one megacycle or 18,000,000 bits per second, can be achieved by the Direct Memory Access Channel unavailable on less serious computers.)

Do you have lots of input devices? Ten measuring tables digitizing data from photos of nuclear events? Scalers attached to x-ray diffractometers? Nuclear event detectors? A room full of gas chromatographs? Analog-to-digital converters? (PDP-9 can take them all. A unique, 32-channel automatic priority interrupt option assures that no data will be lost. Devices interface directly to the I/O bus with low cost R series FLIP CHIP modules and without expensive options. Up to eight data channels can be used at no additional cost.)

Do you have many tasks for the same computer? Data collection? On-line analysis? Mathematical analysis and problem-solving? . . . Do you want to do serious programming? Develop your own software library? (PDP-9 has the right instruction set, the right standard features — like built-in high speed paper tape reader and punch and 8K of memory — the right word length and memory size, the right software — the all-new PDP-9 ADVANCED software system with FORTRAN IV, macro assembler, and two monitor systems — and the right bulk storage systems and options.)

THE SERIOUS PDP-9 HAS: 18-bit word length for easier addressing, larger instruction set, more data per word; standard 8K core memory, expandable to 32K; 1.0 μsec cycle, 2.0 μsec add time; 18,000,000 bits per second maximum I/O transfer rate; standard real-time clock; 300 cps paper tape reader and 50 cps paper tape punch; console teleprinter; wide range of peripheral options including card readers, line printers, CRT displays, plotters, A/D and D/A converters and multiplexers, magnetic tape, DECtape, and drums. Write for full story.

Even $35,000 for a computer is serious.

Answer some serious questions.

digital
COMPUTERS · MODULES

DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts 01754. Telephone: (617) 897-8821 • Cambridge, Mass. • New Haven • Washington, D.C. • Parsippany N.J. • Rochester, N.Y. • Philadelphia • Huntsville • Pittsburgh • Chicago • Denver • Ann Arbor • Houston • Los Angeles • Palo Alto • Seattle • Carleton Place and Toronto, Ont. • Reading, England • Paris, France • Munich and Cologne, Germany • Sydney and West Perth, Australia • Modules distributed also through Allied Radio

of dependents it supports, either by importing adults whose rearing has been paid for elsewhere or by exporting the dependent elderly, thereby enjoys an advantage. If the adults imported are an especially able group, the advantage is enlarged.

A second statement which suggests an enormous ignorance of the educational structure of the underdeveloped countries is this: "At the same time, a student's studies abroad and his failure to return home do not mean that his native country's stock of *educated* people is reduced by one; rather that the stock of *uneducated* people is reduced, since the emigrant's vacant place in his country's educational system is taken by a person who otherwise would not have received the schooling." This might be true if students were brought to this country at the age of six, though the native economy would still have borne the expense of rearing them to that age without any return. Actually, most foreign students enter at the university or the graduate level, having occupied some of the limited places in the schools through their secondary and often their college level training.

I do not have a solution for the "brain drain" problem. It has both a moral and an economic aspect. The freedom of the advantaged individual to migrate may well ill serve the community or nation that nurtured him. The world is not a single economic community. The loss of a skilled engineer, manager, or physician does hurt India's economy and welfare.

HOMER ASCHMANN
Department of Geography, University of California, Riverside

Grubel's recommendation that teachers of foreign students should encourage them to return home by awakening and nurturing patriotic sentiments is not workable. I cannot speak with authority about other countries, but I know many Indians who, as students in India during the days when Gandhi and his party were struggling for independence, contributed their share in winning freedom. Full of patriotism and respect for Nehru, they returned to India after getting their U.S. degrees but stayed only a year or two because they found that Indian administrators, in their struggle to remain in power, would resort to favoritism, nepotism, and corruption, and many well-qualified scientists were ignored when appointments were made. Under such high-handed administrators, there were instances where foreign-trained scientists committed suicide.

Countries like India will not suffer if their young scientists stay abroad. The scientific methods require management to produce results. The partnership between management, on one hand, and science, on the other, is an absolute necessity if improvement is to be expected in developing countries. Homi Bhabha, the late great Indian scientist, was obliquely referring to this problem, I believe, when he said in his last speech, "It is my personal view . . . that the general absence of the proper administration for science is a bigger obstacle to the rapid growth of science and technology than the paucity of scientists and technologists because we are less effective through the lack of [the] right type of administrative support."

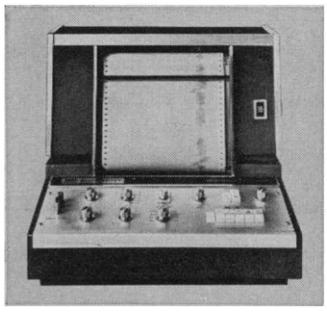
The problem of migration of scientists is not new. Tycho Brahe while migrating from Denmark to Czechoslovakia in 1597 wrote, "And when statesmen or others worry him too much then he should leave with his possessions—with a firm and steadfast mind one should hold under all conditions, that everywhere the earth is below and the sky above, and to the energetic man, every region is his fatherland." Even now the earth is everywhere below and the sky above, and thousands of scientists are making decisions to move from one country to the other because world conditions everywhere are more favorable than ever before for their migration.

G. R. SAINI
Research Station, Canada Department of Agriculture, Fredericton, New Brunswick

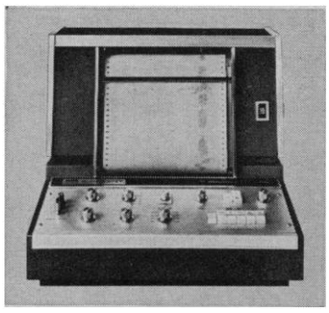
The casuistry of Grubel's statement that "economic theory establishes a very strong presumption that emigrants, brainy or not, do not affect the well-being of the remaining population" calls for vigorous refutation. I base my objection in part on the number of physicians in relation to population in an underdeveloped country with which I am familiar. The same situation undoubtedly applies to many other underdeveloped countries. This small country in Latin America has a good medical school and graduates about 50 physicians per year. The capital city has one physician per 2500 of population, and the rest of the country fewer than one to 5000. The number of physicians graduated per year needs to be doubled

Yes, our MR Recorder often seems like many instruments at work

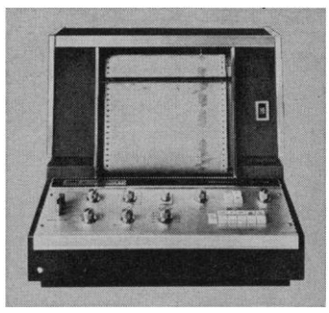
(and the specs tell you why)



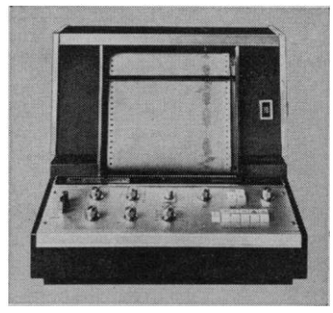
DESCRIPTION: SARGENT MODEL MR RECORDER—automatic, self-balancing, 10-inch potentiometer recorder. Includes special high gain amplifier, and high stability solid state reference power supply requiring no standardization. Line operated.



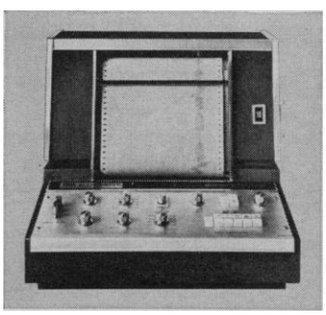
QUANTITY RECORDED: mV, V, μa and ma—selected by panel switch.



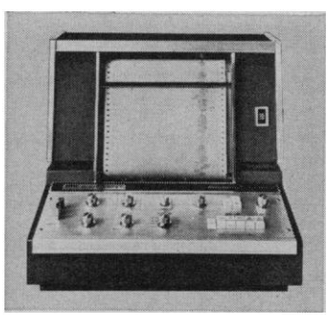
ELECTRICAL RANGE: twelve pre-calibrated ranges by switch selection — 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000. Variable range expansion from 100% (off) to 40% of selected range with continuously adjustable dial.



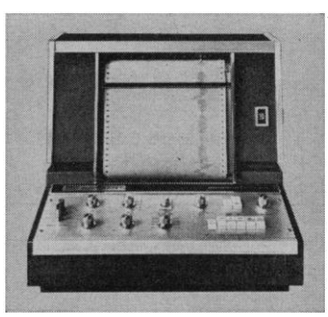
LIMIT OF ERROR: 0.1% or 5 μV, whichever is greater.



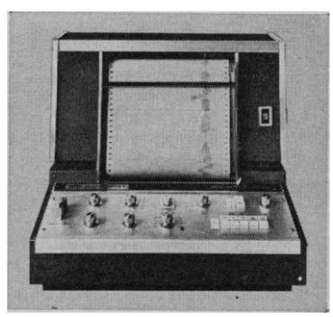
ZERO DISPLACEMENT: calibrated ranges of 10, 100, 1000 and 5000 of the selected units, upscale or downscale. Continuously adjustable reading dial for 0 to 100% of selected range.



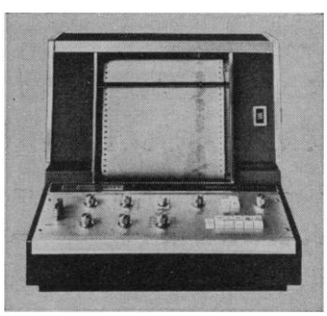
SOURCE RESISTANCE TOLERANCE: 50,000 ohms in most sensitive range, increasing with increasing range.



ELECTRICAL FILTERING: four position switch to reject transverse and common mode A.C. superimposed on the D.C. signal, without loss of sharp balancing characteristics.



PEN SPEED: 1 second for full scale transverse.



DAMPING GAIN ADJUSTMENT: automatic with range change; panel dial for fine adjustment—particularly for low resistance systems like thermocouples.

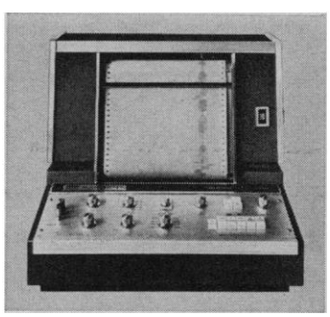


CHART DRIVE: twelve synchronous speeds—0.5, 1, 2, 4, 10, 20—by dial selection, inches per hour or per minute by panel switch. Magnetically braked in "off" position. Free clutch system scans chart with rapid drive; averages 50 feet per minute in forward or reverse directions.

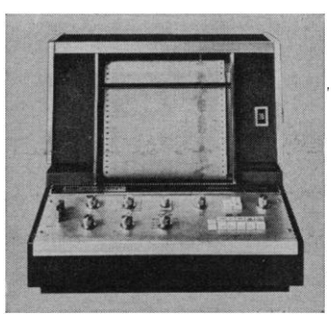
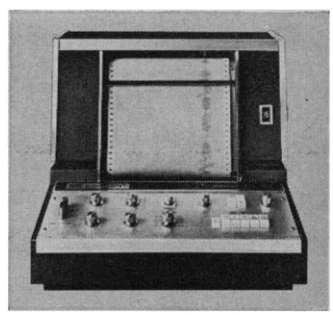


CHART TAKE-UP: automatic, by motor with preset torque—or by-pass for free end chart tear off.



SYNCHRONIZATION: chart drive may be synchronized with external systems connected to rear panel, and operated by the chart drive switch. Or chart drive may be operated from an external switch.

This gives you some idea why the SARGENT MODEL MR RECORDER can do the work of *several* less versatile recorders, manual potentiometers or precision meters. To get the complete picture, write for Bulletin MR.

SARGENT® SCIENTIFIC LABORATORY INSTRUMENTS • APPARATUS • CHEMICALS

E. H. SARGENT & CO.
4647 West Foster Avenue
Chicago, Illinois 60630

Chicago • Anaheim, Calif. • Birmingham • Cincinnati • Cleveland
Dallas • Denver • Detroit • Springfield, N.J. • Toronto, Canada

in order to bring the ratio to population 1 to 2500 in 15 years. This ratio is far below that in any Western European country.

The per capita income of the country is less than $300 per year, and the cost to the government for the training of one physician is at least $10,000 U.S. equivalent, taking into consideration both the premedical and medical school years. If two of the 50 graduates per year—a percentage drain less than half that which Grubel views with equanimity—leave to practice in the United States, the country has not only had $20,000 go down the drain, but is deprived of an essential public service. In terms of per capita income relative to that of the United States, this loss is equivalent to more than $200,000.

Were these two physicians to remain in their country, their effect on the well-being of the population would far exceed anything they might absorb in social services. In the course of a year each one could convert a hundred persons made invalid by parasitic diseases into productive workers, whose contribution to the national income would be many times the "more than an average value of government services" that Grubel has the skilled professional absorb in an underdeveloped country. The drain of these two brains impoverishes their land by a far greater proportionate amount than the contribution they can make to the United States.

JACOB SACKS
Department of Chemistry, University of Arkansas, Fayetteville 72701

Radio Astronomy: Conflict of Frequencies

On 6 December 1966 a scientific satellite was launched from Florida with one of its carefully designed and important experiments purposely rendered inoperative. This expensive decision, and the events that led to it, simultaneously represent a failure of scientific liaison, furnish an example of generous international cooperation, and illustrate the importance of achieving international agreement on the protection of radio frequencies for space research and for radio astronomy.

On 9 November we learned quite accidentally that NASA scientific satellite, ATS-E, proposed for launching in a year or so, was to carry a radio-beacon transmitter for ionospheric research into a synchronous orbit. The proposed frequency band was centered on 406.8 megahertz. A synchronous satellite is almost stationary with respect to the earth, at an altitude of approximately 22,000 miles. The radio signals can be received over nearly a full hemisphere of the earth's surface.

It happens that a number of the world's most important radio telescopes operate exclusively in the same frequency band. These instruments have extremely great sensitivity, to the degree that they would be interfered with in a very harmful way by radiated power sufficient to accomplish the ionospheric research mission of the satellite. As the satellite is nearly fixed with respect to the telescope, the interference would be continuous for several years.

During discussion of this situation with our colleagues in ionosphere research, we learned that a similar satellite was, in fact, already on the launching pad at Cape Kennedy, to be positioned over the Pacific Ocean in direct view of the new Mills Cross telescope near Canberra, Australia.

An immediate decision was necessary. One can imagine the dilemma in which NASA officials found themselves. On the one hand, the ionospheric experiment was ready to launch. It was part of an expensive complex of experiments. Ground stations were ready. To cut it off at the last minute might cause some unexpected interaction which could jeopardize other experiments on board. Many scientists and engineers had planned and hoped and worked for years to bring the experiment into being. On the other hand, the Mills Cross, a major instrument of the Cornell-Sydney Astronomy Center supported jointly by U.S. government and Australian funds, would probably be put out of action for as long as 5 years. Radio telescopes in other parts of the world could be adversely affected, as well.

The NASA people made a courageous and farsighted decision: expensive and risky and disappointing though the action was, they disconnected the beacon transmitter.

How did this unfortunate situation arise? Radio astronomy, as a latecomer among the users of the radio-frequency spectrum, has never been able to secure adequate frequency protection on either national or international scales. International frequency-allocation practices have been regional rather than worldwide in scope and have led to intercontinental inconsisten-

Kinetic study of reactions of peroxy and phenoxy radicals in hydrocarbon systems yields previously unattainable information.

Much of the present knowledge of the ease of formation and chemical reactivity of free radicals and atoms has been obtained from kinetic studies of chain reactions in which these species occur as reactive intermediates. A free radical species of considerable interest in many areas of chemistry is the phenoxy radical. One system in which phenoxy radicals are generated as intermediates is the free radical initiated liquid phase oxidation of hydrocarbons containing trace amounts of phenolic compounds.

Work at Ford Motor Company Scientific Laboratory has revealed that the kinetic equations which describe the rates of oxygen absorption of liquid hydrocarbons containing phenols are of two types. The rate of oxygen absorption observed when hindered phenols and hydroquinones are the additives is directly proportional to the ratio of hydrocarbon to phenol concentration and is also first order in initiator concentration. This expression is consistent with a competition between the hydrocarbon and the phenolic compound for the chain carrying peroxy radical. The phenoxy radical formed then rapidly terminates or, equivalently, is incapable of any other kinetically significant reaction.

In contrast, an entirely different kinetic behavior is observed with all other phenolic compounds investigated. At a constant concentration of hydrocarbon and phenolic compound the rate of oxygen absorption is proportional to the one-half power in the initiator concentration. As shown in figure 1 the dependence of the rate on the phenol concentration cannot be described by integral orders throughout a wide range of concentrations. The data may be fitted (solid curve Fig. 1) to a general rate equation derived from a kinetic scheme which includes the chain restarting reactions of the phenoxy radical. Under these conditions there are two chain carrying radicals. At low concentrations the predominant chain carrying radical is the peroxy radical while at high concentrations of the phenol the phenoxy radical is the main species. The parameters obtained from this analysis have yielded previously unavailable information regarding the rates of formation, hydrogen abstraction reactions and modes of destruction of phenoxy radicals.

These parameters have then been analyzed in terms of the energies of the highest occupied molecular orbitals (HOMO) of the phenoxy radicals as calculated by the Hückel technique. One such correlation is presented in figure 2. It is seen that the log of the rates of hydrogen abstraction by the peroxy radical from the monohydroxyphenols is linearly related to energy of the HOMO of phenol. A similar correlation is obtained for the dihydroxyphenols. The relative rates of peroxy-phenoxy radical and phenoxy-phenoxy radical termination are also found to be extremely sensitive to structure; a variation of 10^3 is observed in the relative rates of these processes. Again, this effect may be correlated with the energy difference in the HOMO of the phenoxy and peroxy radicals.

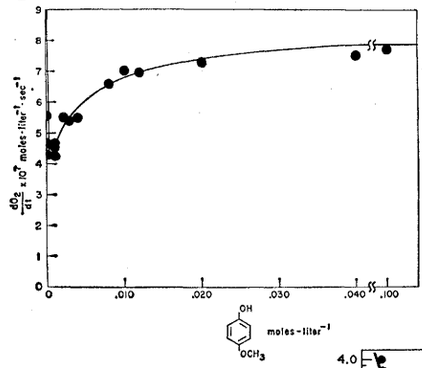


Figure 1. Rate of oxygen absorption versus concentration of 4-methoxyphenol for a chlorobenzene solution containing 0.099 M 9,10-dihydroanthracene and 0.0031 M 2,2', 3,3'-tetraphenylbutane at 60.0 C.

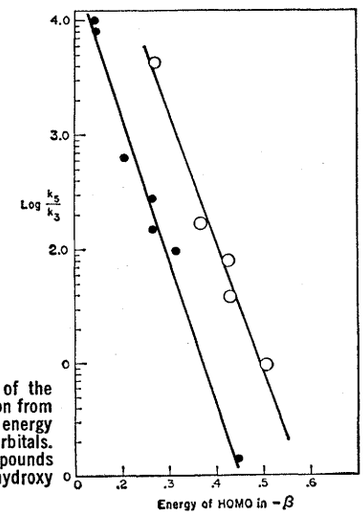


Figure 2. Correlation of the log of the relative rates of hydrogen abstraction from phenols by peroxy radical versus the energy of their highest occupied molecular orbitals. The dark points are dihydroxy compounds and the unshaded points monhydroxy compounds.

cies in the frequency bands allocated to radio astronomy. With the advent of man-made radio transmitters in space, the situation has become very serious.

The band 401 to 406 megahertz is allocated by international agreement to "meteorological aids," including radiosondes and weather satellites. The band 406 to 420 megahertz is allocated to the "fixed service," which includes mainly point-to-point communication systems. Historically, radio astronomers have long desired some space in this region of the spectrum, but the most that has been achieved to date is the rather weak footnote in the Final Acts of the Extraordinary Administrative Radio Conference, Geneva, 1963:

> The band 404-410 in Region 2 and the 406-410 in Regions 1 and 3 are also allocated to the Radio Astronomy Service. An appropriate continuous band within these limits shall be designated on a national or area basis. In making assignments to stations of other services to which these bands are allocated, administrations are urged to take all practicable steps to protect Radio Astronomy observations from harmful interference.

In the United States, only the band 404 to 406 megahertz has been so protected.

Thus, radio telescopes operating in this part of the spectrum run the risk of interference from transmitters outside their respective national jurisdictions. Nonetheless, because other suitable frequencies have not been available, and because they have been able to obtain protection on a purely local basis, several radio observatories in Europe and Australia have constructed elaborate radio telescopes operating at or near 406 megahertz.

Technically, the choice of 406.8 megahertz by NASA was perfectly logical. The ionospheric experiment needs two widely separated frequencies with a constant electrical phase relationship. Both ground and satellite instrumentation are greatly simplified if one is a harmonic of the other. In this case, 406.8 megahertz is the third harmonic of the frequency of the existing data-transmission and tracking-beacon transmitter, the latter being chosen in accordance with the international allocations for space research. It is a time-honored practice to transmit on *any* frequency, regardless of allocation, so long as the transmitted power is so low that it will not interfere with any of the *primary* uses of the frequency. In this case the latter criterion was certainly satisfied with

respect to the meteorological aids and the fixed services. Nonetheless, the extreme sensitivity of the radio telescope, which radio engineers of other services often appreciate only with difficulty, makes it extremely vulnerable to such transmissions from satellites.

NASA has demonstrated in the most dramatic way possible its desire to cooperate in international protection of radio astronomy observations. Clearly, then, a failure of liaison within both scientific and frequency-management communities was responsible for the last minute cancellation of the experiment. We understand that NASA on 15 September sent a routine announcement of proposed frequency usage, including the experiment in question, to the appropriate governmental agencies in Australia and other countries. The proposed usage was discussed and approved by the cognizant U.S. government committee, but apparently the staff of the National Academy of Sciences Committee on Radio Frequency Requirements for Scientific Research did not become aware of the conflict until too late. Similarly, the Inter-Union Committee on the Allocation of Frequencies for Scientific Research, an international committee of scientists, apparently did not learn of the matter until the last minute (*1*).

Any one of these agencies could have given *timely* warning of the conflict, had they recognized the danger. The lessons are clear: liaison among scientific users of frequencies must be more systematic and intensive; renewed efforts must be made to provide worldwide, exclusive allocations for radio astronomy and space research; radio astronomers must become more alert to frequency protection problems and must cooperate more in resolving them. In particular, agencies proposing transmissions which are potentially harmful to radio astronomy should request information from the International Frequency Registration Board, Palais Wilson, Geneva, Switzerland. Radio astronomers should make certain that their frequencies are on record with the IFRB.

G. W. SWENSON JR.*
National Radio Astronomy Observatory, Charlottesville, Virginia
R. N. BRACEWELL
Radio Astronomy Institute, Stanford University, California

Reference and Note

1. R. L. Smith-Rose, *Nature* **203**, 7 (1964).
* On leave of absence from the University of Illinois, Urbana.

3 February 1967, Volume 155, Number 3762

SCIENCE

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Phone: 202-387-7171. Cable: Advancesci, Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. ADVERTISING CORRESPONDENCE: Rm. 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE 6-1858.

John Edward Fogarty

When John Fogarty entered Congress in 1941, at the age of 27, his background included a high school education and 10 years as a bricklayer and union official. At his death, on 10 January, he was highly respected for his knowledge of many aspects of public health and his effectiveness in fostering medical research. He had received more than 100 awards, including many honorary degrees.

Representative Fogarty began service on the Labor and Federal Security Agency Subcommittee of the House Appropriations Committee in 1947 and became subcommittee chairman in 1949. In the first year of his service on the subcommittee, the total budget of the National Institutes of Health was about $3 million. In the current year the NIH budget approximates $1.4 billion. Accomplishing this great expansion was not easy. Traditionally the Appropriations Committee seeks to hold down expenditures. Often Fogarty placed his career in jeopardy by clashing with the committee chairman, then Clarence Cannon.

Fogarty never wavered in his belief in the value of medical research, and he fostered its expansion with single-minded zeal. His resources included great energy and unusual political sagacity. Reports of the hearings of his subcommittee reveal a master craftsman at work patiently building an extraordinarily good case for expanded support of medical research. In his efforts Fogarty had an effective partner in Senator Lister Hill. On occasions when House leadership succeeded in thwarting Fogarty, Senator Hill obtained support for increased appropriations in the Senate. Other important allies were James Shannon (director of NIH), Mary Lasker, and the medical research community. Possessing a combination of charm, brains, energy, and money, Mrs. Lasker has had access to all recent Presidents and can mobilize important support for medical research. From the medical community Fogarty could depend on such well-known expert witnesses as Paul Dudley White, Karl Menninger, Sidney Farber, and Michael De Bakey.

Fogarty built skillfully and well. He understood the vital relationship between the support of fundamental science and practical objectives. He built for permanence. His methodical care year after year won for him and the programs he fostered broad support in Congress. The *Congressional Record* for 19 January 1967 provides an indication of the respect he enjoyed. Tributes to him by more than 100 of his colleagues are recorded there. Many of the words of praise are devoted to the enduring value of his efforts in expanding medical research.

There is considerable sentiment in Congress to implement an idea that Fogarty advanced in September 1963:

> . . . I should like to see a plan to bring into being at Bethesda a great international center for research in biology and medicine dedicated to international cooperation and collaboration in the interests of the health of mankind as so boldly envisaged by the President. This center would encompass conference facilities, laboratory and study space, and living quarters to permit the assembly for discussion, study, and research of the outstanding health scientists of the world. I visualize this center associated with the great facilities of the National Institutes of Health and the National Library of Medicine as representing the visible and tangible embodiment of this Nation's devotion to the use of science for peaceful purposes and the good of mankind.

Congressman Laird (R–Wis.), on 18 January 1967, spoke for many Congressmen (and scientists) when he stated, "I can think of no more fitting and lasting tribute to this great humanitarian than the establishment by this Congress of such a center—the John E. Fogarty International Center for Advanced Study in the Health Sciences. Not only will such an institution be a living embodiment of the spirit and aspirations of John Fogarty, but it will serve a needed and valuable role in securing the progress of science in the cause of the well being of all mankind."

—PHILIP H. ABELSON

NEW MODEL 3375 TRI-CARB®
LIQUID SCINTILLATION SPECTROMETER...

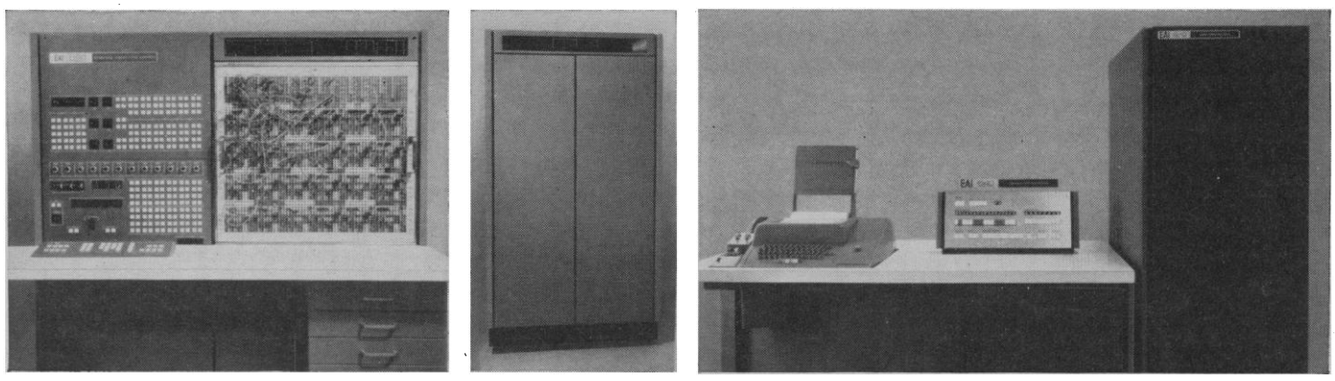
with these exclusive features:

- Push-button channel selection for single, double or triple label experiments; front panel adjustment permits normalization as required to retain factory-optimized counting conditions
- Patented, volume-independent Automatic External Standardization using a *compound source* of Americium-241 and Radium-226; choice of Ratio or Count methods of standardization
- Patented, "3+2" counting channel configuration; three completely independent channels of pulse-height analysis, each with precision gain control and continuously adjustable discriminators . . . *two additional* channels exclusively for Automatic External Standardization
- "On-line" electronic computation with continuous display of count rate and percent standard deviation; push-button selection of desired display, and full print control; complete selection of all possible Channel Ratios
- IBM Selectric Typewriter data presentation on continuous pre-printed forms . . . easy to read, organize and file

Model 3375 gives you these exclusive features and the latest, reliable integrated circuitry, plus the outstanding performance that is typical of all new Tri-Carb Spectrometer Systems. For complete information see your Packard Sales Engineer or write for Bulletin 1057U to Packard Instrument Company, Inc., 2200 Warrenville Road, Downers Grove, Illinois 60515.

Packard

HOW TO USE SIMPLE ADDITION TO SOLVE COMPLEX PROBLEMS:



680+693+640+SOFTWARE=690

THE 690 is the new EAI hybrid computing system. Now you *can* get a working hybrid computing system by adding two EAI computers and an interface together and loading the software into memory.

The new EAI hybrid has an analog computer ready and waiting for a digital that was designed for the hybrid hookup . . . where the interface was designed to take maximum advantage of both computers' features . . . where the software is standard, already written and tested and ready to load. In short, a working hybrid computing system that's still more than the sum of its parts, but is created by straightforward interconnection.

This simple addition means a single responsibility for the system. It also means reliable software maintenance and updating, as well as the advantages of other laboratories using the standard 690 systems.

It means you can start toward a hybrid system from either an analog or digital computer and expand in orderly fashion without running the risk of "experimentation" in your system.

The four parts of the EAI 690 that you add together were designed together to deliver more computational return on your invested dollar.

First in the addition is the EAI 680 analog computer, embodying over a decade of EAI experience. It's a sophisticated 156-amplifier machine, which even in its basic form includes a healthy complement of digital logic and control.

Then there's the EAI 640 digital computer. It was designed from the start with an extremely flexible input-output structure so that it is integrated easily into a hybrid configuration.

Between them is the EAI 693 which functions as both a data converter and comprehensive monitor and control interface unit for the system.

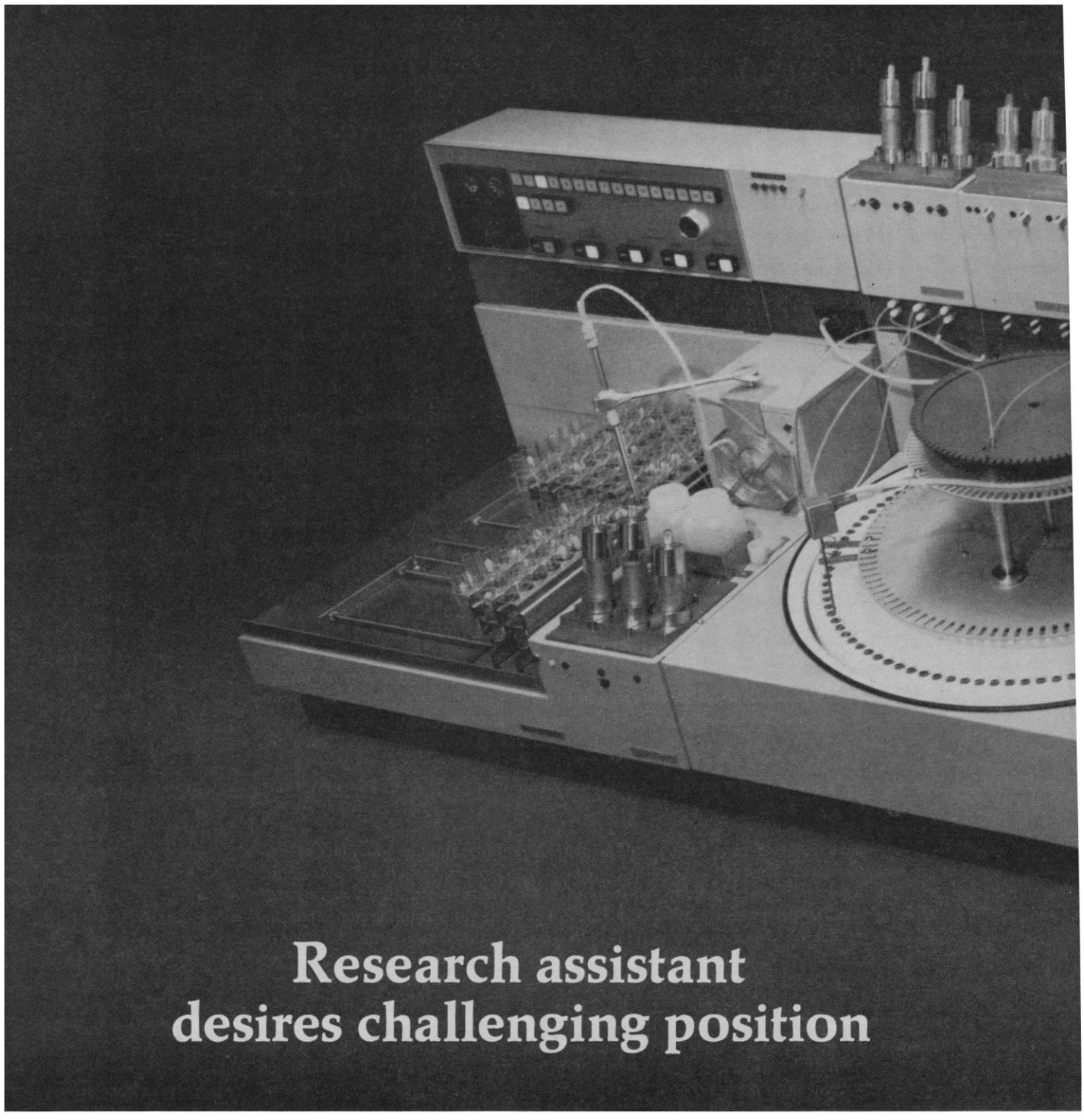
Finally, there's the 690 software which solves problems rather than creates them. It includes hybrid FORTRAN, HYTRAN℠, Operations Interpreter, Hybrid Debug, Hardware Diagnostics and a Hybrid Subroutine Library.

All this adds up to a superior capability for scientific problem-solving. You get high-speed analog capability for the simulation of system dynamics combined with the memory, logic and high-precision numerical capability of the digital computer. The engineer, the scientist, the designer is still "part of the loop", still capable of direct interaction with the program to add his own creative input.

We'll be happy to send a complete technical description of the EAI 680 analog computer or the EAI 640 digital computer, as well as the EAI 690 hybrid computing system. That way we can also get across what we mean by the EAI backup services, such as training, maintenance and five computation centers with standard systems, as well as total system responsibility, software maintenance and the users library. Write today.

EAI® ELECTRONIC ASSOCIATES, INC.
West Long Branch, New Jersey

sm Service Mark of Electronic Associates, Inc.



Research assistant desires challenging position

WARNER-CHILCOTT'S ROBOT CHEMIST—The Automated Test Tube — wants a job performing wet chemical analyses in your laboratory.

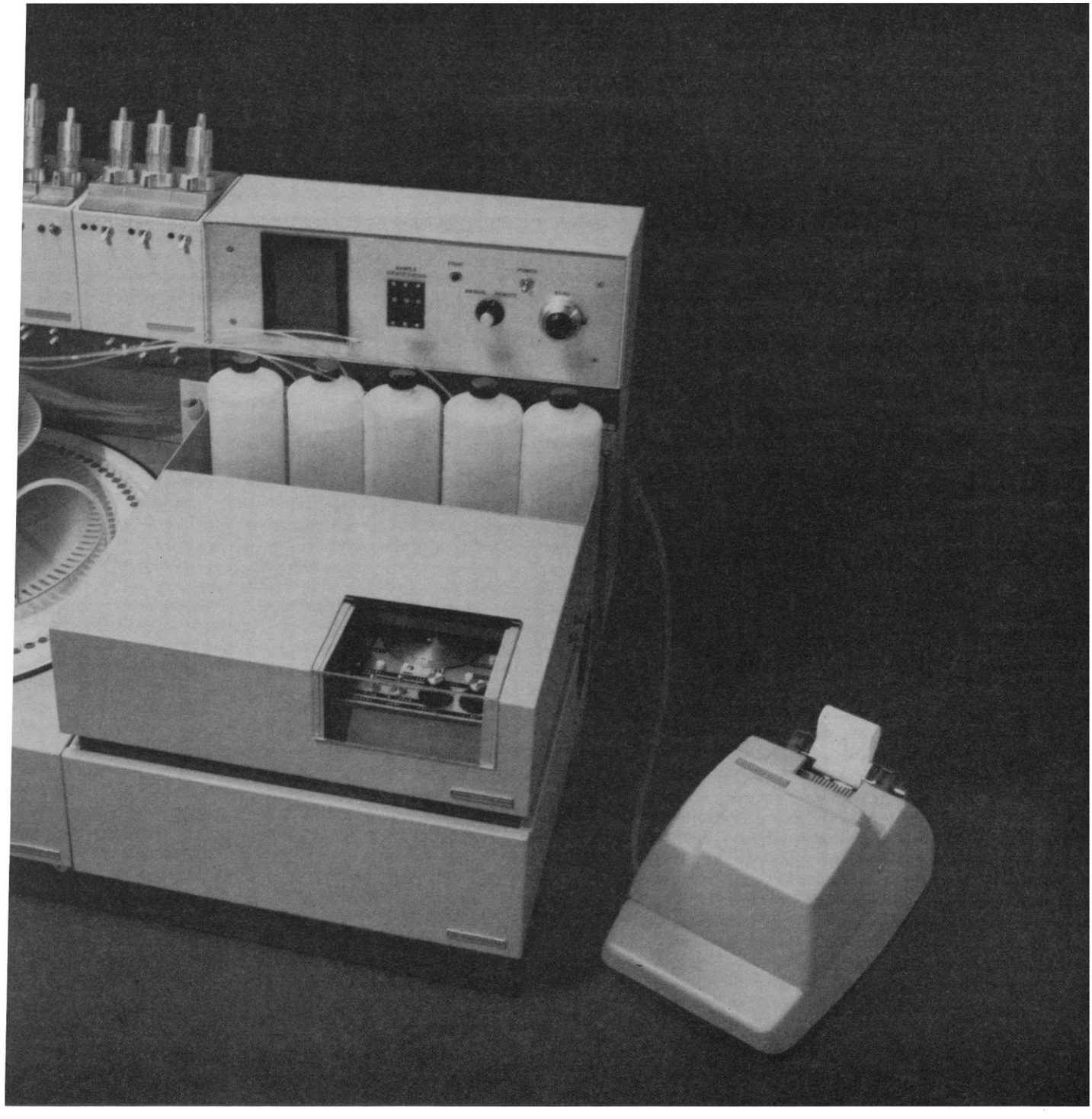
Make the ROBOT CHEMIST your assistant, and it will give you:

1) MORE ACCURATE ANALYSES. The ROBOT CHEMIST minimizes human error. It accurately pipettes and delivers samples as small as 20 μl. Its precision micrometer-controlled pumps for reagent dispensing and an incubation turntable with high thermal stability — combined with a dual beam spectrophotometer — give you high accuracy and reproducibility.

2) MORE DEPENDABLE RESULTS. The ROBOT can perform 120 wet chemical determinations per hour if you desire. That means you can increase the number of tests performed and thus achieve a higher certainty of accumulated data.

MEET THE AUTOMATED TEST TUBE

The ROBOT CHEMIST is an instrument that performs as your assistant (except that it never gets tired or leaves you for another position). It samples, dilutes,



adds and mixes reagents, incubates, reads and prints out a test result. Then, it rinses, washes, dries itself, and gets ready for the next sample. All at your command.

HOW VERSATILE IS THE ROBOT CHEMIST?

It can perform virtually any colorimetric determination, including glucose, urea, calcium, total protein, and enzymes... using your **own** analytical procedures.

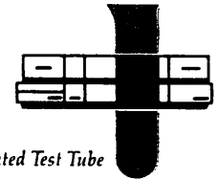
BUY OR LEASE

Purchase your hard-working ROBOT CHEMIST outright or lease it for as little as $325 per month (with the first month's rent sufficient for delivery).

Conference. Booth #123

For more information and specifications, please write Warner-Chilcott Instruments Division, 200 South Garrard Blvd., Richmond, California 94804.

WARNER-CHILCOTT
INSTRUMENTS DIVISION

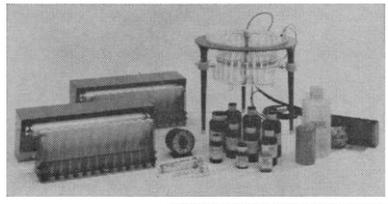


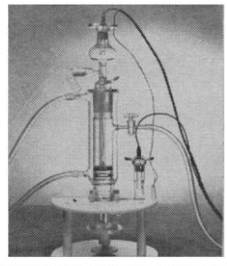
The Automated Test Tube

If you're separating, analyzing, collecting and recording, chances are you can do it better with Canalco instruments.

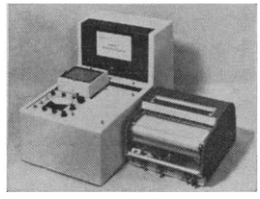
for electrophoresis . . .

Analytical **Disc Electrophoresis** offers fast, extremely sensitive separations of 20-30 human serum fractions, equally remarkable resolution of enzymes, polynucleotides, hormones and other protein mixtures. Requires only micrograms of sample. Various models accommodate up to 24 simultaneous separations in one bath assembly, come complete with all chemicals and accessories. **Trial Kit**—for introduction and classroom training. **Models 6 and 66**—compact bath assemblies for economical processing of 6 or 12 samples. **Models 12 and 24** — larger baths, for 12 or 24 samples, to aid the high-workload user. (Model 24 shown.) Regulated current supplies, safety-interlocked, also available. Write for Bulletin DE-S11.





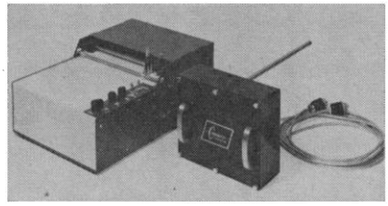
Prep-Disc Electrophoresis applies the high-resolution capabilities of Disc Electrophoresis to the large-scale separation of up to 500 milligrams of material. Unique adjustable elution space, full gel visibility and prepurified and tested chemicals combine to provide dependable, artifact-free runs. Complete selection of components includes basic apparatus, coolant supplies, flow monitors, fraction collectors and power supplies. Write for Bulletin PD-S11.



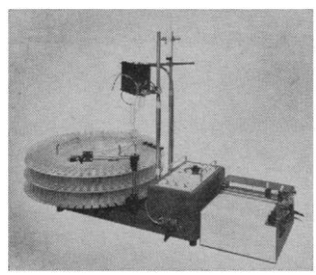
Microdensitometers for all modern electrophoresis techniques. Particularly accurate for resolving and recording fine bands in Disc Electrophoresis. **Three Models: D,** for scanning with common lab recorders; **E,** contains its own high-speed recorder for fastest scanning; and **F** (shown), with 10" wide chart for accurate presentation of even weakest bands. Write for Bulletin MC-S11.

for flow analysis and fraction collection . . .

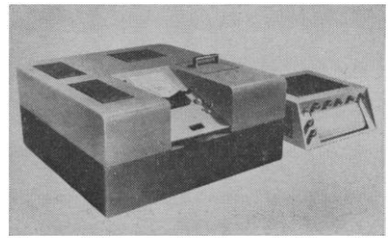
New ultraviolet flow monitors with wide-chart recorders and optional automatic scale expansion give unsurpassed sensitivity for both proteins and nucleotides in column chromatography. The **Wide-Track 85 Series** includes four models, for single-cuvette (non-absorbing solvents) or dual-cuvette (baseline-compensating for gradient elutions) analysis, with either manual or automatic expansion. All four models incorporate reference phototube and ratio circuitry for stability against source fluctuations. **Models S and D** are single- and dual-cuvette, with manual scale expansion; **Models SA and DA** add automatic scale expansion. Model **DA** shown. Write for Bulletin WT-S11.



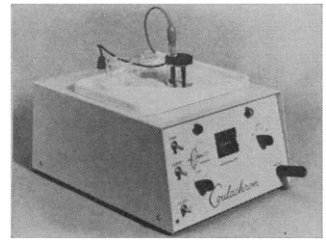
Versatile, reliable **Automatic Fraction Collector** collects up to 240 measured amounts of sample, in any one of three ways; volumetric siphoning, timed flow, or drop counting. Unique distributor head permits simultaneous collection of fractions from two, three or four columns or other sources. Write for Bulletin FC-S11.



Canalco's **Model M2 UV-Visible Spectrophotometer** is especially designed for automated analysis of column effluents or other flowing samples, as well as for general-purpose spectroscopy. Double-beam chopped-light system using high-efficiency grating monochromator can monitor selected wavelengths or scan selected spectral ranges on command, recording all absorption peaks that exceed selected levels. Optional features include selectable scanning speed, automated scan, linear absorbance presentation, wide-range lamps and photomultipliers. Write for Bulletin M-S11.



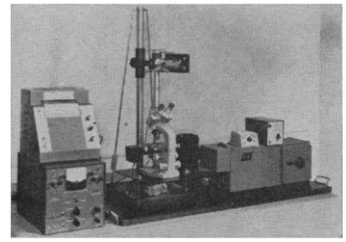
for titration . . .



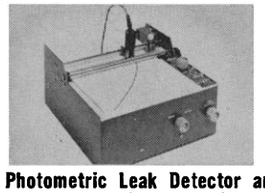
The **Coulachron Automatic Titrator** and optional Research Panel generates its own titrants, providing fast analysis of many materials of clinical and industrial interest, without standard solutions. Only microliter samples are required for analysis, usually better than 0.5% accurate. Gives digital readout directly in microequivalents. Write for Bulletin CR-S11.

for micro spectrophotometry and microdensitometry . . .

Canalco's **Dual Beam Ultra-Microspectrophotometer** can be used for either single or dual beam measurement. Advanced engineering design eliminates error due to light or line fluctuation; does away with repetitive readings; automates I_s/I_o computation. System accuracy better than 0.2%. Exclusive reference monitor automatically compensates for light source fluctuations. Optional modules available for scanning densitometry, quantitative microfluorescence and interference microscopy. Write for Bulletin UM-S11.



and for related areas . . .



Back-Track is a versatile recorder/curve-follower which records continuously-changing variables for replay. Accepts any 8½" width blank paper either in sheet or roll. Write for Bulletin BT-S11.

Photometric Leak Detector and Vacuum Gauge monitors any change in pressure or characteristics of gas present through ionization process. Small, lightweight, inexpensive . . . **Nitro Freeze,** a compact, liquid nitrogen freezer for freeze-preserving living biological materials. Electron optical components and high voltage power supplies.

CANALCO INDUSTRIAL CORPORATION
5635 Fisher Lane
Rockville, Maryland 20852/(301) 427-1515

Sales and Service Offices in • Boston • Chicago • Cincinnati • Denver • Houston • Los Angeles • Minneapolis • New York • Philadelphia • San Francisco • St. Louis • Washington, D.C.

scribed a steroid-hydroxylating system in adrenal mitochondria which contain, in addition to the components in the liver microsome system, a ferrodoxin-like protein with a molecular weight of 22,000 and two inorganic iron and two acid-labile sulfur atoms per mole of protein. Careful electron spin resonance studies conducted by H. S. Mason excluded the presence of nonheme iron in preparations of microsomal liver hydroxylase. Thus, characteristic patterns of electron flow in the different subcellular organelles participate in hydroxylation in these tissues.

The biological role and the chemical nature of the copper-containing phenylalanine hydroxylase were reviewed by S. Kaufman. This enzyme uses molecular oxygen to convert phenylalanine to tyrosine, but, unlike other mono-oxygenases, it utilizes tetrahydrobiopterin rather than reduced pyridine nucleotide as a reductant. Purified phenylalanine hydroxylase contains no inorganic or heme iron; instead it contains catalytically essential copper atoms, which undergo oscillation in charge during the catalytic process. A. Kertesz demonstrated that polyphenoloxidase exists as a tetramer containing four copper atoms per molecular weight of 128,000; the tetramer can be converted to a catalytically active dimer by dodecyl sulfate.

Crystalline salicylate hydroxylase, lysine oxygenase, and imidazole acetate oxygenase are monooxygenases which contain no metals but do contain FAD. Although the nature of the interaction of these enzymes with oxygen is unknown, participation of the flavin moiety in the catalytic reaction is demonstrable by spectrophotometry. S. Yamamoto has shown that, under anaerobic conditions, the substrate reduces the FAD which then undergoes reoxidation by molecular oxygen. Insight into the mechanism of the conversion of salicylicate to catechol by salycilate hydroxylase was provided by M. Katagiri, who demonstrated the formation of E-FAD-S and E-FADH-S (E, protein moiety of enzyme; S, salicylate) complexes during the catalytic reaction. Thus, the activation of oxygen, before its incorporation into organic molecules, may occur without the participation of metals.

Some studies were concerned with the reaction mechanism of the dioxygenases. Metapyrocatechase, pyrocatechase, protocatechuate-4,5-oxygenase, and protocatechuate-3,4-oxygenase were all purified to the crystalline state by M. Nozaki from species of *Pseudomonas* cultured with the appropriate carbon source to induce the enzyme of interest. Metapyrocatechase has a single ferrous iron atom per mole enzyme; it seems to be bound to the enzyme with a mercaptide linkage. Pyrocatechase has two iron atoms per molecule of enzyme; addition of substrate to the enzyme under anaerobic conditions leads to modifications in absorption spectra and ESR signals suggestive of combination of the substrate with the ferric iron, which is subsequently reduced to the ferrous state. Admission of oxygen reversed these changes in spectra and ESR signals, an indication that the iron of native pyrocatechase might be in the trivalent state, but that it undergoes reduction and reoxidation during the enzyme-catalyzed oxidation of catechol.

The isolation and crystallization of 3,4-dihydroxyphenylacetate-2,3-oxygenase from induced *Pseudomonas* was described separately by both Y. Takeda and S. Senoh. The sulfhydryl reagents, *p*-chloromercuribenzoate and *o*-phenanthroline, competitively inhibit enzyme activity by displacing ferrous iron. Senoh demonstrated that the loss in catalytic activity following the addition of six equivalents of *p*-chloromercuribenzoate to the enzyme was accompanied by the release of six ferrous atoms and concomitant dissociation of the enzyme into three monomers. Thus, thio-iron linkages are concerned with both maintenance of structural integrity and catalytic function. From their ESR studies S. Senoh and T. Yamano contributed further insight into the catalytic mechanism of action of this enzyme. Addition of substrate and oxygen to the ferrous-enzyme results in the transient formation of an enzyme-Fe^{+3}–substrate-O_2 complex.

P. Feigelson reported on the catalytic mechanism and activation of purified *Pseudomonas* tryptophan oxygenase (tryptophan pyrrolase). Preparations of this dioxygenase, purified to specific activities above 10, contain both copper and tightly bound ferriprotoporphyrin. The heme participates actively in the catalysis; the heme iron undergoes oscillation in charge, being successively reduced by tryptophan and reoxidized by oxygen. Both trivalent and divalent forms of the enzyme were catalytically active, and latent enzyme preparations could be activated without net reduction of the ferriprotoporphyrin component. The heme component of the purified *Pseudomonas* tryptophan pyrrolase was converted to the pyridine

hemochrome and spectrophotometrically identified as ferriprotoporphyrin IX by Y. Ishimura. If the specific activity is 5.8 and the molecular weight is 150,000, then each mole of enzyme contains one mole of heme and 0.09 to 0.60 mole of copper. Ishimura concludes that the amounts of copper found were too small for copper to be considered a constituent of the enzyme. Resolution of the controversy concerning the presence of copper in tryptophan oxygenase awaits isolation of the enzyme in a homogeneous state.

Possible theoretical mechanisms for the oxygen-activating functions of horseradish peroxidase were considered by I. Yamazaki. He postulated that combination with peroxidase and subsequent reduction bestows upon oxygen the potential for multitudinous hydroxylation and oxidative reactions. He further purposed that, for catalysis to proceed, horseradish peroxidase and oxygenases, such as tryptophan oxygenase, must first catalyze the one-electron reduction of oxygen. These theoretical considerations may be compared with the reaction mechanism, empirically derived from tryptophan oxygenase, which involves electron transfer from tryptophan through heme to oxygen, resulting in activation of these substrates and their subsequent interaction.

The nature of the activated form of oxygen which serves as the hydroxylating agent was discussed by H. Staudinger and L. E. Orgel from experimental and theoretical viewpoints, respectively. Staudinger compared the stereochemical nature of the products of various nonenzymic model systems which generated hydroxyl radicals or oxygen atoms with those resulting from the enzymatic hydroxylation of the same substrates. In each of several instances, model systems generating oxygen atoms, but not those generating hydroxyl radicals, yielded hydroxylated products qualitatively similar to those formed by the microsomal hydroxylase system. Thus, it would seem that hydroxylations may be mediated by the generation of oxygen atoms, not by free hydroxyl radicals. Orgel reviewed the electronic nature of the high and low spin states of iron and factors influencing their ESR spectra. He also discussed theoretical and practical limitations and even the wisdom of attempting to distinguish between the various interconvertible complexes of iron and oxygen, such as Fe^{+2}--$O_2 \leftrightharpoons Fe^{+3}$--$O_2^{-1} \leftrightharpoons Fe^{+4}$--$O_2^{-2}$. He emphasized

that in metallo-oxygen complexes, the total number of electrons within the complex may be determinable but, since the charge distribution may vary continuously, it is frequently pointless to assign a discrete structure in which a particular electron distribution between the metal and the oxygen is designated.

Profound insight into the regulation and catalytic mechanisms of the oxygenases awaits future empirical and conceptual advances. It is evident, however, that this colloquium has richly contributed to these ultimate goals. The proceedings of this conference have been published in English as "Biological and Chemical Aspects of Oxygenases," edited by K. Bloch and O. Hayaishi, and may be purchased for $6.95 from Maruzen Company, 6 Tore Nichome Nihongashi, Chuoku, Tokyo, Japan.

PHILIP FEIGELSON
College of Physicians and Surgeons, Columbia University, New York

Forthcoming Events

February

17–18. American Psychopathological Assoc., New York, N.Y. (F. A. Freyhan, Room 1006, Cronin Research Bldg., St. Vincent's Hospital, 153 W. 11 St., New York 10011)

17–18. **Thyroid**, 3rd Midwest conf., Columbia, Mo. (Executive Director, Continuing Medical Education, M-176 Medical Center, Univ. of Missouri, Columbia)

18–22. American Acad. of **Allergy**, 23rd annual mtg., Palm Springs, Calif. (Executive Secretary, 756 N. Milwaukee St., Milwaukee, Wis. 53202)

19–23. American Inst. of **Mining, Metallurgical and Petroleum Engineers**, annual mtg., Los Angeles, Calif. (Executive Secretary, 345 E. 47 St., New York 10017)

19–25. **Biochemistry**, Chemical Inst. of Canada, conf., Ste. Marguerite, P.Q. (General Manager, 48 Rideau St., Ottawa 2, Ont.)

20–25. American Acad. of **Forensic Sciences**, mtg., Honolulu, Hawaii. (S. R. Gerber, 2153 Adelbert Rd., Cleveland, Ohio 44106)

21–24. **Offshore Exploration**, conf., Long Beach, Calif. (M. Richardson, Box 88, 2516 Via Tejon, Palos Verdes Estates, Calif. 90274)

22–24. **Biophysical** Soc., 11th annual mtg., Houston, Tex. (A. Cole, M. D. Anderson Hospital, Univ. of Texas, Houston 77025)

23–25. American **Physical** Soc., mtg., Austin, Tex. (K. K. Darrow, American Physical Soc., Columbia Univ., New York 10027)

26. **Psychoanalysis**, 5th annual conf., New York, N.Y. (D. M. Kaplan, 175 W. 12 St., New York 10011)

26–2. International **Anesthesia Research**

Soc., 41st congr., Bal Harbour, Fla. (Executive Secretary, 227 Wade Park Manor, Cleveland, Ohio 44106)

27. **Thermoanalysis**, Chemical Inst. of Canada, symp., Toronto, Ont. (H. G. McAdie, Ontario Research Foundation, Toronto, Ont.)

27–1. American **Astronautical** Soc., mtg., Huntsville, Ala. (S. S. Hu, Northrop Space Labs., P.O. Box 1484, Huntsville)

27–1. Fundamental **Cancer Research**, 21st annual symp., Houston, Tex. (D. E. Frei, M.D., Anderson Hospital, Univ. of Texas, Houston 77025)

27–1. **Sounding Rocket Vehicle Technology**, conf., American Inst. of Aeronautics and Astronautics, Williamsburg, Va. (C. A. Sandahl, Mail Shop, 214A, NASA, Langley Station, Hampton, Va. 23365)

27–3. Australian **Dental** Congr., 18th Melbourne. (J. M. Newton, 53 Martin Pl., Sydney, Australia)

27–3. **High Energy Physics and Nuclear Structure**, intern. conf., Rehovoth, Israel. (M. Sela, Weizmann Inst. of Science, Rehovoth)

27–3. **Membrane Structure and Function**, symp., Chemical Inst. of Canada, Ste. Marguerite, P. Q. (K. K. Carroll, Collip Medical Research Lab., Univ. of Western Ontario, London, Ont.)

28–1. **Systems Effectiveness**, 2nd conf., Los Angeles, Calif. (A. M. Wilson, Engineering Dept., Electronic Industries Assoc., 2001 Eye St., NW, Washington, D.C. 20006)

March

1–3. **Effect of Malnutrition on Mental Development, Learning and Behavior**, intern. conf., Cambridge, Mass. (Dept. of Nutrition and Food Science, Massachusetts Inst. of Technology, Cambridge 02139)

1–3. International **Particle Accelerator**, conf., Washington, D.C. (Office of Technical Activities Board, 345 E. 47 St., New York, 10017)

1–3. **Particle Accelerator**, natl. conf., American Physical Soc., Washington, D.C. (J. A. Martin, Oak Ridge Natl. Lab., P.O. Box X, 4500S, S-103, Oak Ridge, Tenn. 37830)

2–4. **Indian Ocean**, symp., New Delhi, India. (N. K. Panikkar, Natl. Inst. of Oceanography, CSIR, Rafi Marg, New Delhi)

2–4. **Nuclear Magnetic Resonance**, conf., Pittsburgh, Pa. (B. L. Shapiro, Dept. of Chemistry, Illinois Inst. of Technology, Chicago, Ill. 60616)

2–10. **Radioactive Dating and Methods of Low-Level Counting**, symp., Vienna, Austria. (J. H. Kane, Conference Branch, Atomic Energy Commission, Washington, D.C. 20545)

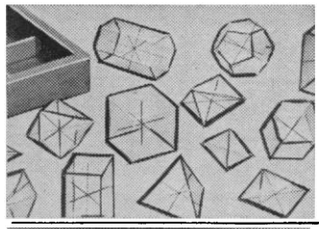
5–9. International **Gas Turbine**, conf., Houston, Tex. (Meetings Manager, 345 E. 47 St., New York 10017)

6–7. **High Speed Testing:** The Rheology of Solids, 6th intern. conf., Boston, Mass. (R. H. Supnik, Plas-Tech Equipment Corp., 4 Mercer Rd., Natick, Mass. 01760)

6–10. **Analytical Chemistry and Applied Spectroscopy**, conf., Pittsburgh, Pa. (G. L.

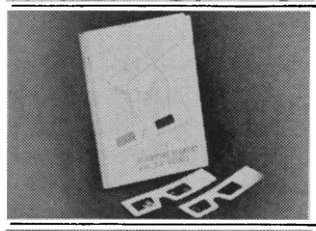
MAIL ORDER INDUSTRIAL MART UNUSUAL VALUES

Products available by mail. Money-back guarantee. Order by Number. Send check, m.o. or open account to rated firms. $10. minimum order.



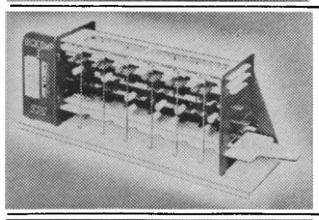
NEW . . . TRANSPARENT CRYSTAL MODELS

Set of 15 Basic Symmetries with Built-in Crystallographic axes. For lab study, exhibition, demonstration. Colored threads built into each precision-made hollow plastic model show position of all axes. Easily marked with china pencil. Cube measures 1¾"—14 others (see at left) in proportion. Packed in poly bags separately in compartmental wooden case. $64.00 ppd. Order #70,821W. Edmund Scientific Co., Barringotn, New Jersey 08007.



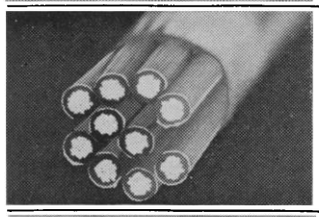
DESCRIPTIVE GEOMETRY—WITH 3-D FIGURES

Unique new text greatly simplifies subject. Original approach quickens and increases comprehension. Reader actually sees 2-color illustrations in sharp 3-D. Contains 284 anaglyph & 235 reg. figures. Forms basis for engineering drawings. Excellent help at any level of technological instruction. Covers Solid Geometry, Curves & Surfaces, intro. to Atonometric & Perspective Drawings, etc. Imported. 196 p. 9½" x 6⅝". Two viewers incl. $12.50 PPd. Order #9377W. Edmund Scientific Co., Barrington, New Jersey 08007.



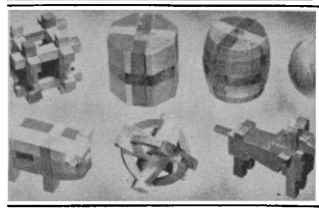
NEW MODEL DIGITAL COMPUTER

Solve problems, tell fortunes; play games with miniature version of giant electronic brains! Adds, subtracts, multiplies, shifts, complements, carries, memorizes. Colored plastic parts easily assembled. 12" x 3½" x 4¾". Incld. step-by-step assembly diagrams, 32-p. instruction book covering operation computer language (binary system programing, problems & 15 experiments. $5.98. Ppd. Order stock #70,683W. Edmund Scientific Co., Barrington, N. J.



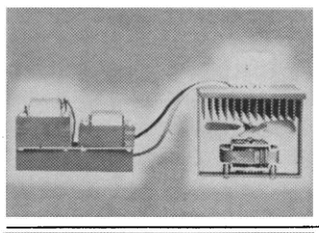
DUPONT PLASTIC LIGHT GUIDE KIT

Experiment with amazing new plastic fiber optic light guides. 1001 uses for mfrs., experimenters, hobbyists. Use for exciting new projects and products. Guides transmit light same as wire conducts electricity. Use to illuminate remote areas, multiple locations from single source, confine light to small areas, conduct sensing and control systems. Incl. 2 guides, source, lens, dyes, connectors. $10 ppd. Order No. 70,855W. Edmund Scientific Co., Barrington, New Jersey 08007.



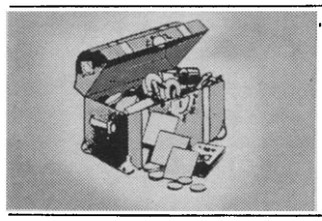
WOODEN SOLID PUZZLES

Here's a fascinating assortment of 12 different puzzles to provide hours of pleasure and stimulate ability to think and reason. Animals and geometric forms. Take them apart and reassemble them. Lots of fun for the whole family—young and old. Will test skill, patience and ability to solve problems. Order yours now. $3.00 ppd. Order Stock No. 70,205W. Edmund Scientific Company, Barrington, New Jersey 08007.



NEW THERMOELECTRIC COOLING SYSTEM

Complete, solid state unit. Amazingly versatile. Excellent for experimental uses in industry, universities, research lab! Silent, motionless. Simple to operate. No moving parts to wear out. No fluid leakage. At 80°F. ambient temp., unit pumps up to 35 BTU/hr., yet keeps transfer bar at 25°F.—can be cooled to 13°F. Save thousands of dollars in producing prototypes, mock-ups, models. Ideal as spot cooler in instruments, electronic and other industrial equipment. Wt. 8 lbs. Full inst. $62. Ppd. Order #70,818W. Edmund Scientific Co., Barrington, New Jersey 08007.



SCIENCE TREASURE CHESTS

Hundreds of thrilling experiments plus a Ten Lens Kit to make telescopes, microscopes, etc. Incl.: extra powerful magnets, polarizing filters, compass, one-way mirror film, diffraction grating, many other items. $5.50 ppd. Order Stock No. 70,342W Deluxe Chest: Above plus crystal growing kit, electric motor, molecular set, and lots more. $10.50 ppd. Order Stock No. 70,343W. Edmund Scientific Co., Barrington, New Jersey 08007.

GIANT FREE CATALOG

Completely new 1967 edition—148 pages. Bargains galore! New categories, items, illustrations. 1,000's of buys for industry—Optics, Science, Math. On-the-job helps, quality control aids. Optics for research labs, design engineers, experimenters. Instruments for checking, measuring . . . to speed work, improve quality, cut costs. Hard-to-get war surplus bargains. Write for Catalog-W, Edmund Scientific Co., Barrington, New Jersey 08007.

Carlson, Mellon Inst., 4400 Fifth Ave., Pittsburgh 15213)

6–10. **WESTEC,** 4th Western Metal and Tool Exposition and Conf., Los Angeles, Calif. (Director of Engineering Conf., 20501 Ford Rd., Dearborn, Mich. 48128)

8–10. **Viscoelastic Response of Engineering Materials,** mtg., Boston, Mass. (R. H. Supnik, 4 Mercer Rd., Natick, Mass. 01760)

8–22. **United Nations Regional Cartographic** Conf. for Asia and the Far East, Canberra, Australia. (United Nations, New York, N.Y.)

9–11. National **Medicolegal** Symp., Miami Beach, Fla. (Miss B. Spies, Law Dept., American Medical Assoc., 535 N. Dearborn St., Chicago, Ill. 60610)

10–11. National Conf. on **Rural Health,** Charlotte, N.C. (B. L. Bible, Secretary, American Medical Assoc., 535 No. Dearborn St., Chicago, Ill. 60610)

10–12. American Assoc. of **Pathologists and Bacteriologists,** Washington, D.C. (J. Lowell Orbison, School of Medicine and Dentistry, Univ. of Rochester, 260 Crittenden Blvd., Rochester, N.Y.)

13–14. **Astronautics,** symp., Ottawa, Ont., Canada. (The Secretary, Canadian Aeronautics and Space Inst., 77 Metcalfe St., Ottawa 4, Ont.)

13–15. 32nd North American **Wildlife and Natural Resources** Conf., San Francisco, Calif. (Wildlife Management Inst., 709 Wire Building, Washington, D.C. 20005)

13–17. International **Laboratory Apparatus** and Materials Exhibition, London, England. (U.T.P. Exhibitions Ltd., 3 Racquet Ct., Fleet St., London E.C.4)

13–17. Use of **Plutonium as a Reactor Fuel,** intern. symp., Brussels, Belgium. (J. H. Kane, Div. of Technical Information, U.S. Atomic Energy Commission, Washington, D.C. 20545)

14–15. American **Astronautical** Soc. 5th Goddard Memorial Symp., "The Voyage to the Planets," Washington, D.C. (M. B. Lees, General Electric Co., Defense Programs Div., 777 14th St., NW, Washington, D.C. 20005)

14–15. **Space,** natl. mtg., Los Angeles, Calif. (D. P. Chandler, 3370 Miraloma Ave., Anaheim, Calif. 82803)

14–15. **Temperature Measurements** Soc., 5th conf., Los Angeles, Calif. (R. A. Finch, Conf. and Exhibit Chairman, Atomics International, P.O. Box 309, Canoga Park, Calif. 91304)

15–17. **Instrumentation for the Iron and Steel Industry,** Natl. Instrument Soc. of America, 17th conf., Pittsburgh, Pa. (F. J. Barchfeld, Jones & Laughlin Steel Corp., 900 Agnew Rd., Pittsburgh 15230)

16–18. **Hydrogeology of the Northeast,** Geological Soc. of America, Boston, Mass. (M. Prinz, Tufts Univ., Medford, Mass.)

16–17. **Hypervelocity Techniques,** 5th symp., Denver, Colo. (A. A. Ezra, Research Inst., Univ. of Denver, Denver 80201)

16–19. International Assoc. for **Dental Research,** 45th general mtg., Washington, D.C. (G. H. Rovelstadt, c/o Navy Dental School, Natl. Naval Medical Center, Bethesda, Md. 20014)

17–21. National **Science Teachers** Assoc., conv., Detroit, Mich. (Executive Secretary, NSTA, 1201 16th St., NW, Washington, D.C. 20036)

19–24. Southeastern **Surgical** Congress, Bal Harbour, Fla. (A. H. Letton, Executive Secretary, 340 Boulevard N.E., Atlanta, Ga. 30312)

19–26. Canadian-American **Medical and Dental** Assoc., Vail, Colo. (T. Trapasso, Secretary, 816 Ashmum St., Sault Ste. Marie, Mich. 49783)

20–23. Institute of **Electrical & Electronics Engineers**, intern. conv., New York, N.Y. (A. B. Giordano, The Institute, 345 E. 47 St., New York 10017)

20. **Field-Ion Microscopy**, mtg., Cambridge, England. (Meetings Officer, Inst. of Physics and Physical Society, 47 Belgrave Sq., London S.W.1, England)

20–22. **Physical Electronics**, annual conf., Cambridge, Mass. (Research Lab. of Electronics, Massachusetts Inst. of Technology, Cambridge)

22–24. **Astrogeology**, symp., University of Michigan, Ann Arbor, Mich. (E. W. Heinrich, Dept. of Geology and Mineralogy, Univ. of Michigan, Ann Arbor 48104)

22–24. **Modern Optics**, intern. symp., New York, N.Y. (J. Fox, Polytechnic Inst. of Brooklyn, 333 Jay St., Brooklyn, N.Y. 11201)

23–24. **Seismological** Soc. of America, Santa Barbara, Calif. (D. Tocher, U.S. Earthquake Mechanism Lab./ESSA, 390 Main St., San Francisco, Calif. 94105)

23–24. **Social Facilitation and Imitation Behavior**, symp., Miami Univ., Oxford, Ohio. (E. C. Simmel, Dept. of Psychology, Miami Univ., Oxford 45056)

23–25. Institute of **Mathematical Statistics**, central regional mtg., Columbus, Ohio. (G. E. Nicholson, Jr., Dept. of Statistics, Univ. of North Carolina, Chapel Hill 27515)

23–25. Society of **Toxicology**, Atlanta, Ga. (C. S. Weil, Mellon Inst., 4400 Fifth Ave., Pittsburgh, Pa. 15213)

26–30. Association of American **Geographers**, 63rd annual mtg., St. Louis, Mo. (Executive Officer, 1146 16th St., NW, Washington, D.C. 20036)

27–30. American **Physical** Soc., Chicago, Ill. (R. G. Sachs, P.O Box 344, Argonne, Ill.)

27–30. Canadian Inst. of **Mining and Metallurgy**, 69th annual mtg., Ottawa, Ont., Canada. (Secretary, 121 Richmond St. W., Toronto 1, Ont.)

28–30. Engineering Aspects of **Magnetohydrodynamics**, symp., Stanford, Calif. (R. H. Eustis, Stanford Univ., Stanford 94305)

28–30. **Photovoltaic** Specialists, 6th IEEE conf., Cocoa Beach, Fla. (F. A. Shirland, Clevite Research Center, 540 E. 105 St., Cleveland, Ohio 44108)

29–30. **Building Research** Advisory Board, research symp., "Performance Concept of Building," New Orleans, La. (R. W. Spangler, Board, Natl. Research Council–Natl. Acad. of Sciences, 2101 Constitution Ave., NW, Washington, D.C. 20418)

29–31. **Immunologic Approaches to Mechanisms of Cutaneous Disease**, New York Univ. Medical Center, New York, N.Y. (Office of Recorder, New York Univ. Post-Graduate Medical School, New York 10016)

29–31. The **Origins of Schizophrenia**, intern. conf., Rochester, N.Y. (J. Romano, Univ. of Rochester School of Medicine, Rochester 14620)

NEW BOOKS

(Continued from page 552)

sky, Eds. Indiana Univ. Press, Bloomington, 1966. 352 pp. Illus. $7.95. Indiana University Studies in the History and Theory of Linguistics. Twelve papers.

The Concept of Identity. David J. de Levita. Translated from the Dutch edition (The Hague, 1965) by Ian Finlay. Mouton, The Hague, Netherlands; Basic Books, New York, 1966. 221 pp. $6.

Crystal Structures. vol. 5, *The Structures of Aliphatic Compounds*. Ralph W. G. Wyckoff. Interscience (Wiley), New York, ed. 2, 1966. 793 pp. Illus. $25.

The Departmental Laboratory Assistant in Biological Science. A book of principles, methods, and techniques. Harold C. Steele. Dorrance, Philadelphia, 1966. 231 pp. $5.75.

The Dream and Human Societies. Based on the proceedings of the international colloquium (Asnieres-sur-Oise, France), June 1962. G. E. von Grunebaum and Roger Caillois, Eds. Univ. of California Press, Berkeley, 1966. 471 pp. Illus. $10. Twenty-five papers.

Developments in Psychoanalysis at Columbia University. Proceedings of the Twentieth Anniversary Conference (New York), October 1965. George S. Goldman and Daniel Shapiro, Eds. Hafner, New York, 1966. 373 pp. Illus. $12.50. Fourteen papers.

Dynamische Biochemie: Grundlagen und moderne Erkenntnisse. Pt. 2. Eberhard Hofmann. Akademie-Verlag, Berlin, 1966. 280 pp. Illus. Paper.

Encyclopedia of Chemical Technology. vol. 11, *Hexanes to Ion Exchange*. Herman F. Mark, John J. McKetta, Jr., and Donald F. Othmer, Eds. Interscience (Wiley), New York, ed. 2, 1966. 913 pp. Illus. $50.

Encyclopedia of Industrial Chemical Analysis. vol. 3, *General Techniques, P–Z. Index to Volumes 1–3*. Foster D. Snell and Clifford L. Hilton, Eds. Interscience (Wiley), New York, 1966. 857 pp. Illus. $45; subscription, $35.

Engine Test Sequences for Evaluating Automotive Lubricants for API Service MS. American Soc. for Testing and Materials, Philadelphia, 1966. 45 pp. Illus. Paper, $1.75.

Experimental Mechanics. vol. 2. Proceedings of the Second SESA International Congress (Washington, D.C.), September–October 1965. Sponsored by Society for Experimental Stress Analysis. B. E. Rossi, Ed. Pergamon, New York, 1966. 537 pp. Illus. $27.50. Sixty-four papers.

Family in Transition: A Study of 300 Yugoslav Villages. Vera St. Erlich. Princeton Univ. Press, Princeton, N.J., 1966. 489 pp. Illus. $12.50.

The Fluid Dynamic Aspects of Space Flight. vol. 1. Proceedings of the AGARD-NATO Specialists' Meeting (Marseille, France), April 1964. Sponsored by the Fluid Dynamics Panel of AGARD. Published for the North Atlantic Treaty Organization. Gordon and Breach, New York, 1966. 416 pp. Illus. $22.50. Fifteen papers.

Fundamental Concepts of Biology. Gideon E. Nelson, Gerald G. Robinson, and Richard A. Boolootian. Wiley, New York, 1966. 341 pp. Illus. $7.50.

Infinite Series. Earl D. Rainville. Macmillan, New York, 1967. 279 pp. Illus. $7.95.

The Influence of Culture on Visual Perception. Marshall H. Segall, Donald T. Campbell, and Melville J. Herskovits. Bobbs-Merrill, New York, 1966. 286 pp. Illus. Paper, $2.95.

Introduction to Contemporary Algebra. Marvin L. Tomber. Prentice-Hall, Englewood Cliffs, N.J., 1967. 443 pp. Illus. $7.95. Prentice-Hall Mathematics Series.

Ion Exchange: A Series of Advances. vol. 1. Jacob A. Marinsky, Ed. Dekker, New York, 1966. 436 pp. Illus. $16.75. Nine papers.

The Logical Structure of the World: Pseudoproblems in Philosophy. Rudolf Carnap. Translated from the German edition by Rolf A. George. Univ. of California Press, Berkeley, 1967. 390 pp. $8.50.

Low Temperature Oxidation. W. Jost, Ed. Published for the North Atlantic Treaty Organization. Gordon and Breach, New York, 1966. 426 pp. Illus. $22.50. Eleven papers.

Mathematical Theory of Elementary Particles. Proceedings of a conference (Dedham, Mass.), September 1965. Roe Goodman and Irving Segal, Eds. M.I.T. Press, Cambridge, Mass., 1966. 198 pp. Illus. $6. Thirteen papers.

Medical Innovation: A Diffusion Study. James S. Coleman, Elihu Katz, and Herbert Menzel. Bobbs-Merrill, New York, 1966. 268 pp. Illus. Paper, $2.95.

Multi-Sulfur and Sulfur and Oxygen Five- and Six-Membered Heterocycles. Pt. 1. David S. Breslow and Herman Skolnik. Interscience (Wiley), New York, 1966. 632 pp. Illus. $33. The Chemistry of Heterocyclic Compounds Series.

Neurology. Roy R. Grinker and Adolph L. Sahs. Thomas, Springfield, Ill., ed. 6, 1966. 1645 pp. Illus. $33.50.

Nobel Lectures in Physics. vol. 1, *1901–1921*. Published for the Nobel Foundation. Elsevier, New York, 1967. 510 pp. Illus. $85 for set of three volumes.

Nonionic Surfactants. Martin J. Schick, Ed. Dekker, New York, 1967. 1111 pp. Illus. $43.50. Surfactant Science Series, vol. 1. Twenty-eight papers.

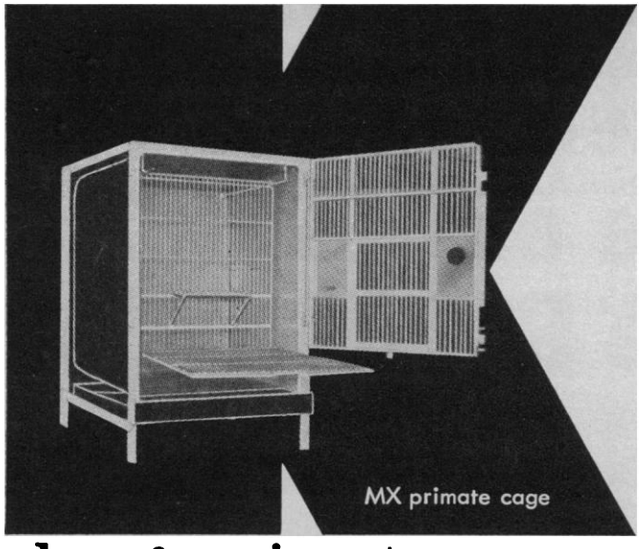
Optics and Spectroscopy. Suppls. 1 and 2. Suppl. 1, *Luminescence* (192 pp.); Suppl. 2, *Molecular Spectroscopy* (180 pp.). S. E. Frish, P. O. Feofilov, and L. S. Sazonov, Eds. Translated from the Russian edition (Moscow, 1963). C. W. Garland, Translation Ed. Optical Soc. of America, Washington, D.C., 1966. Illus. Paper, $15 each volume. 125 papers.

Palaeoecology of Africa and of the Surrounding Islands and Antarctica. vol. 1, *A Re-issue of Palynology in Africa Reports 1–8 (1950–1963)*. E. M. van Zinderen Bakker, Ed. Balkema, Cape Town, 1966. 274 pp. Illus. R 6.00.

Louis Pasteur: The Man and His Theories. Hilaire Cuny. Translated by Patrick Evans. Fawcett, Greenwich, Conn., 1967. 192 pp. Paper, 60¢. Reprint, 1965 edition.

Physical Principles of Magnetism. F. Brailsford. Van Nostrand, Princeton, N.J., 1966. 284 pp. Illus. $9.75.

The Physiology of Diuretic Agents (*Ann. N.Y. Acad. Sci.* **139**). Edward M. Weyer, Ed. New York Acad. of Sciences,



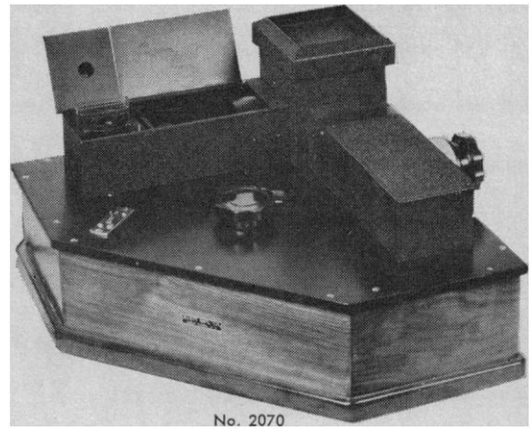
dog & primate cages

Molded seamless construction of rugged fiber glass reinforced plastics... minimum effort required to clean and disinfect...maximum animal comfort... extremely strong doors with fool proof catches...economical to purchase and maintain....For further information write:
Department KS

Kirschner MANUFACTURING COMPANY

Vashon, Washington

THE KLETT FLUORIMETER

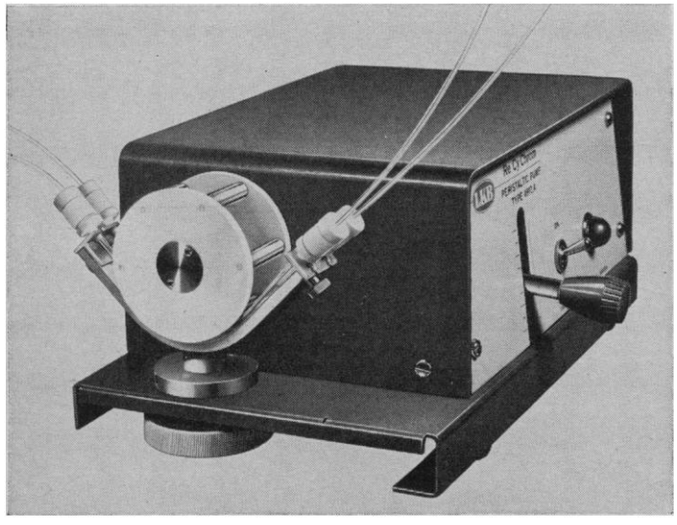


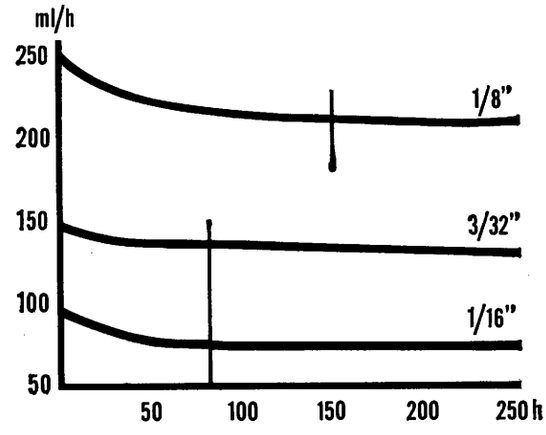
Designed for the rapid and accurate determination of thiamin, riboflavin, and other substances which fluoresce in solution. The sensitivity and stability are such that it has been found particularly useful in determining very small amounts of these substances.

KLETT SCIENTIFIC PRODUCTS

PHOTOELECTRIC COLORIMETERS • BIO-COLORIMETERS
GLASS ABSORPTION CELLS • COLORIMETER NEPHELOMETERS • KLETT REAGENTS • COLONY MARKER AND TALLY

Klett Manufacturing Co., Inc.
179 EAST 87TH STREET, NEW YORK, N. Y.





Typical variations in capacity with new Tygon tubing

PumpAbility Plus

PLUS Steady flow over long periods
PLUS Rugged, Compact, Versatile, Reliable design
PLUS Flow rates from 0 to 390 ml/hr/channel
PLUS Extremely high flow constancy (fluctuations less than 0.1 % per 24 hrs after initial run in)
PLUS Roller change from 6 to 12 to give minimal pulsations even at slowest speeds.

THE LKB PERISTALTIC PUMP
For Liquids (Corrosive and Highly Volatile)—Emulsions—Slurries—Gases
For the Laboratory and the Process Plant

Write for our illustrated leaflet giving full details of the Peristaltic Pump

LKB

LKB INSTRUMENTS INC • 12221 PARKLAWN DRIVE • ROCKVILLE Md 20852

OTHER HEADQUARTERS FOR SALES AND SERVICE

SWEDEN
LKB-Produkter AB
Box 76,
Stockholm—Bromma 1

UK
LKB Instruments Ltd.
LKB House, 137 Anerley Road,
London, S.E. 20

NETHERLANDS
LKB-Produkten N.V.
Zeekant 35,
The Hague

DENMARK
LKB Instrument A/S
Amagerbrogade 34,
Copenhagen S

New York, 1966. 539 pp. Illus. Paper, $7. Twenty-five papers presented at a conference held in March 1966.

Poisonous and Venomous Marine Animals of the World. vol. 1, *Invertebrates*. Bruce W. Halstead. U.S. Government Printing Office, Washington, D.C., 1965. 1030 pp. Illus. $50 for set of three volumes.

Political Anthropology. Marc J. Swartz, Victor W. Turner, and Arthur Tuden, Eds. Aldine, Chicago, 1966. 319 pp. $8.95. Seventeen papers.

Principles of Continua with Applications. L. Albert Scipio. Wiley, New York, 1967. 288 pp. Illus. $10.95.

Principles of Ideal-Fluid Aerodynamics. Krishnamurty Karamcheti. Wiley, New York, 1966. 654 pp. Illus. $20.

Les Problèmes Météorologiques de la Stratosphère et de la Mésosphère. Colloque Franco-Belge sous la Présidence de Marcel Nicolet (Paris), March 1965. Presses Universitaires de France, Paris, 1966. 486 pp. Illus. Paper, F 48.

Problems in Differential Equations. J. L. Brenner. Freeman, San Francisco, ed. 2, 1966. 182 pp. Paper, $2.50.

Problems in Engineering Soils. P. Leonard Capper, W. Fisher Cassie, and J. D. Geddes. Barnes and Noble, New York, 1966. 191 pp. Illus. Paper, $3.50; cloth, $5.75.

Progress in the Science and Technology of the Rare Earths. vol. 2. LeRoy Eyring, Ed. Pergamon, New York, 1966. 372 pp. Illus. $15. Eight papers.

Pumping of Liquids. F. A. Holland and F. S. Chapman. Reinhold, New York, 1966. 412 pp. Illus. $20.

Radar Techniques for Detection Tracking and Navigation. Proceedings of the Eighth Symposium of the AGARD Avionics Panel (London), September 1964. W. T. Blackband, Ed. Published for the North Atlantic Treaty Organization. Gordon and Breach, New York, 1966. 616 pp. Illus. $37.50. Thirty-one papers.

Radiation Processes in Plasmas. G. Bekefi. Wiley, New York, 1966. 391 pp. Illus. $15.75.

Radio Telescopes. D. V. Skobel'tsyn, Ed. Translated from the Russian edition (Moscow, 1965). Consultants Bureau (Plenum), New York, 1966. 179 pp. Illus. Paper, $22.50. The Lebedev Physics Institute Series, vol. 28. Seventeen papers.

Radioisotopes for Aerospace. Pt. 2, *Systems and Applications*. Proceedings of the First Symposium on Radioisotope Applications in Aerospace (Dayton, Ohio), February 1966. Sponsored by U.S. Air Force, U.S. Atomic Energy Commission, and Instrument Soc. of America. John C. Dempsey and Paul Polishuk, Eds. Plenum Press, New York, 1966. 476 pp. Illus. Pts. 1 and 2, $37.50. Twenty-seven papers.

Religion and Politics in Haiti. Harold Courlander and Rémy Bastien. Institute for Cross-Cultural Research, Washington, D.C., 1966. 99 pp. Illus. Paper, $2; cloth, $3.

The Remarkable Sine Functions. A. I. Markushevich. Translated from the Russian edition (Moscow, 1965) by Scripta Technica. Leon Ehrenpreis, Translation Ed. Elsevier, New York, 1966. 110 pp. Illus. $6.50.

Report of the Education Commission,

1964–1966. Education and national development. Ministry of Education, Government of India, New Delhi, 1966. 706 pp. Illus. Paper, $3.60.

Albert Schweitzer. Conférences du Congrès International des Écrivains-Médecins (Debrecen, Hungary), 1966. Hermann Baur and others. Kultura, Budapest, 1966. 211 pp. Paper, $2.40. Twenty papers.

The Search for Order, 1877–1920. Robert H. Wiebe. Hill and Wang, New York, 1967. 349 pp. $5.

Selected Papers on the Transfer of Radiation. Donald H. Menzel, Ed. Dover, New York, 1966. 275 pp. Illus. Paper, $3. Six papers published between 1905 and 1930.

Soil Organic Matter: Its Nature, Its Role in Soil Formation and in Soil Fertility. M. M. Kononova. Translated from the Russian edition (Moscow, 1963) by T. Z. Nowakowski and A. C. D. Newman. Pergamon, New York, ed. 2, 1966. 544 pp. Illus. $15.

The Sound and the Sea. A guide to northwestern neritic invertebrate zoology. Charles J. Flora and Eugene Fairbanks. Pioneer Printing Company, Bellingham, Wash., ed. 2, 1966. 467 pp. Illus. $8.50.

The Strawberry: History, Breeding, and Physiology. George M. Darrow. Holt, Rinehart, and Winston, New York, 1966. 463 pp. Illus. $15.

Strength Under High Transient Loads. Kh. A. Rakhmatulin and Yu. A. Dem'yanov. Translated from the Russian edition (Moscow, 1961) by A. Hananel and A. Baruch. T. Pelz, translation Ed. Israel Program for Scientific Translations, Jerusalem; Davey, New York, 1966. 348 pp. Illus. $14.

The Stress Corrosion of Metals. Hugh L. Logan. Wiley, New York, 1966. 320 pp. Illus. $13.95.

Structural Adhesives Bonding. A symposium (Hoboken, N.J.), September 1965. Michael J. Bodnar, Ed. Interscience (Wiley), New York, 1966. 503 pp. Illus. Paper, $15. Applied Polymer Symposia, No. 3. Thirty-two papers.

Structural Matrix Analysis for the Engineer. John Robinson. Wiley, New York, 1966. 364 pp. Illus. $11.95.

The Structure of Inorganic Radicals. An application of electron spin resonance to the study of molecular structure. P. W. Atkins and M. C. R. Symons. Elsevier, New York, 1967. 290 pp. Illus. $21.75.

Studies on the Anatomy and Function of Bones and Joints. F. Gaynor Evans, Ed. Springer-Verlag, New York, 1966. 163 pp. Illus. $12. Ten papers given at a symposium on Joints and Bones for the Eighth International Congress of Anatomists (Wiesbaden, Germany), August 1965.

Studies on Chemical Structure and Reactivity. J. H. Ridd, Ed. Wiley, New York, 1966. 300 pp. Illus. $8.25. The volume is presented to Sir Christopher Ingold; includes 14 papers.

Summable Series and Convergence Factors. Charles N. Moore. Dover, New York, 1966. 113 pp. Paper, $1.50. Reprint, 1938 edition.

System Analysis by Digital Computer. Franklin F. Kuo and James F. Kaiser, Eds. Wiley, New York, 1966. 454 pp. Illus. $8.95. There are 12 papers.