SCIENCE

17 November 1967
Vol. 158, No. 3803

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

How much sample is enough for continuous flow ultracentrifugation?

100 liters? 50 liters? 10 liters?

If you or your colleagues have as little as 10 liters of sample solution—even if only occasionally—that is enough to warrant a Beckman Model L4 Ultracentrifuge.

Look at it this way. To process 10 liters in a big Type 30 rotor would require twenty repetitive runs — 20 setups, 20 cleanups, handling of 20 sets of recovered particles, and time-per-run multiplied by 20. The L4 can do the same job (and more) in a single continuous flow run at flow rates up to 10 liters per hour, depending on the separations being made.

Obviously, it doesn't take many 10-liter runs to justify an L4 — especially since the instrument won't be sitting idle between continuous flow runs. It can also be used for time-saving large scale zonal work (1725 ml per run) as well as for standard preparative work. The L4 will accept most Beckman fixed angle and swinging bucket rotors operating at speeds to 65,000 rpm and forces to 420,000 *g*. The continuous flow and zonal runs can be made at 90,000 *g*, which is enough force to pull down viruses and subcellular particles.

So whether you will be dealing with hundreds of liters of extremely dilute sample solution — or ten liters occasionally — the Model L4 Ultracentrifuge with its multiple capabilities is a vital instrument for your laboratory. For more information write for Data File L4-5.

Beckman® INSTRUMENTS, INC.
SPINCO DIVISION
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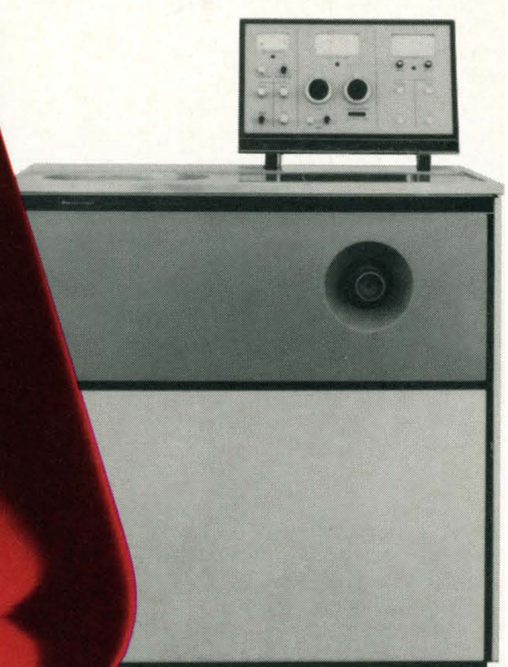

INTERNATIONAL SUBSIDIARIES: GENEVA; MUNICH; GLENROTHES, SCOTLAND; TOKYO; PARIS; CAPETOWN; LONDON; MEXICO CITY

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SCIENCE

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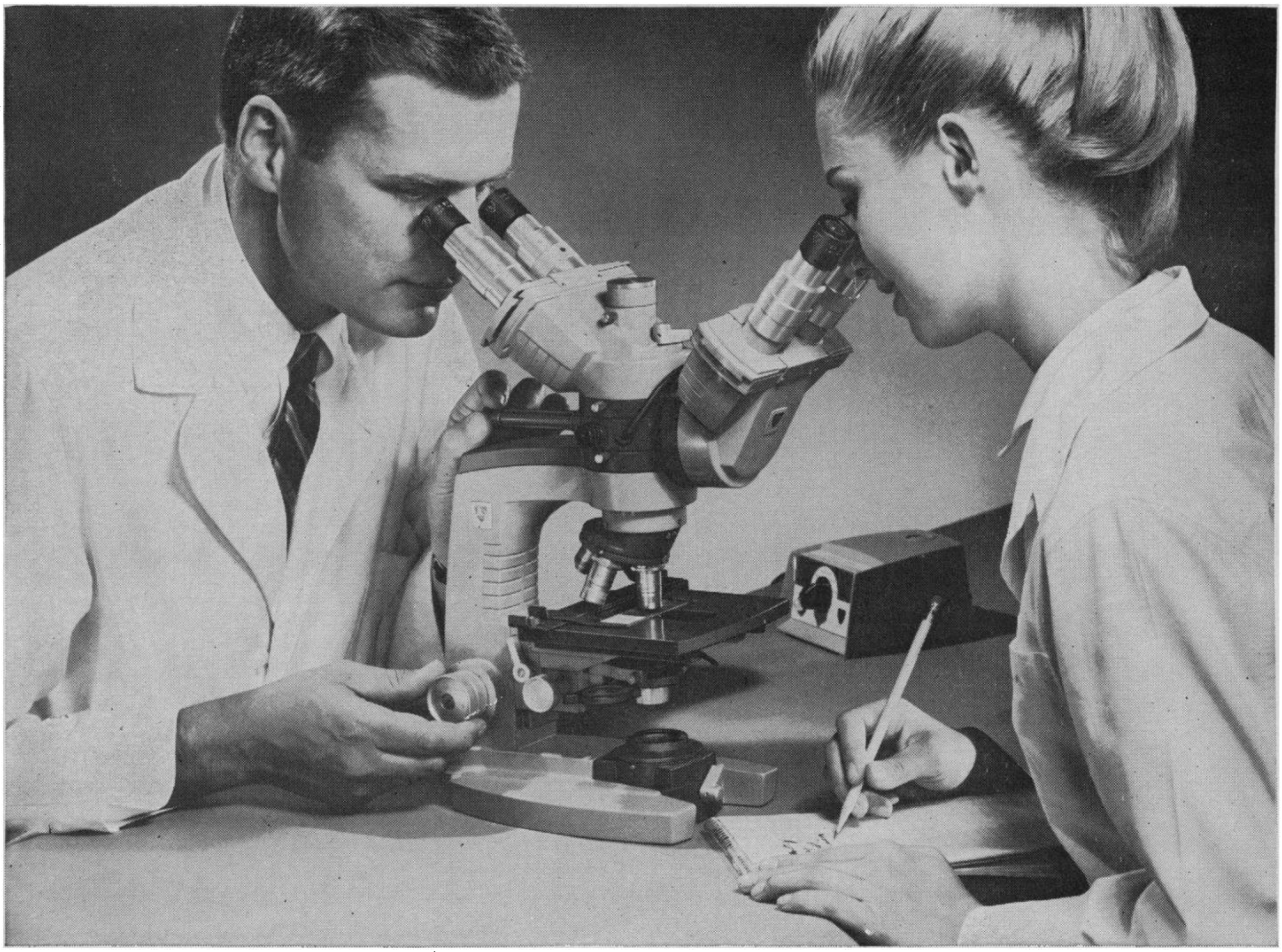
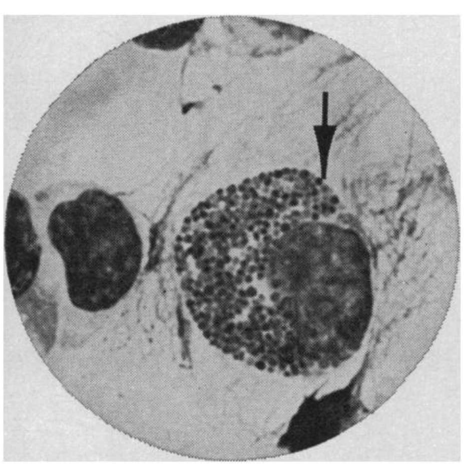
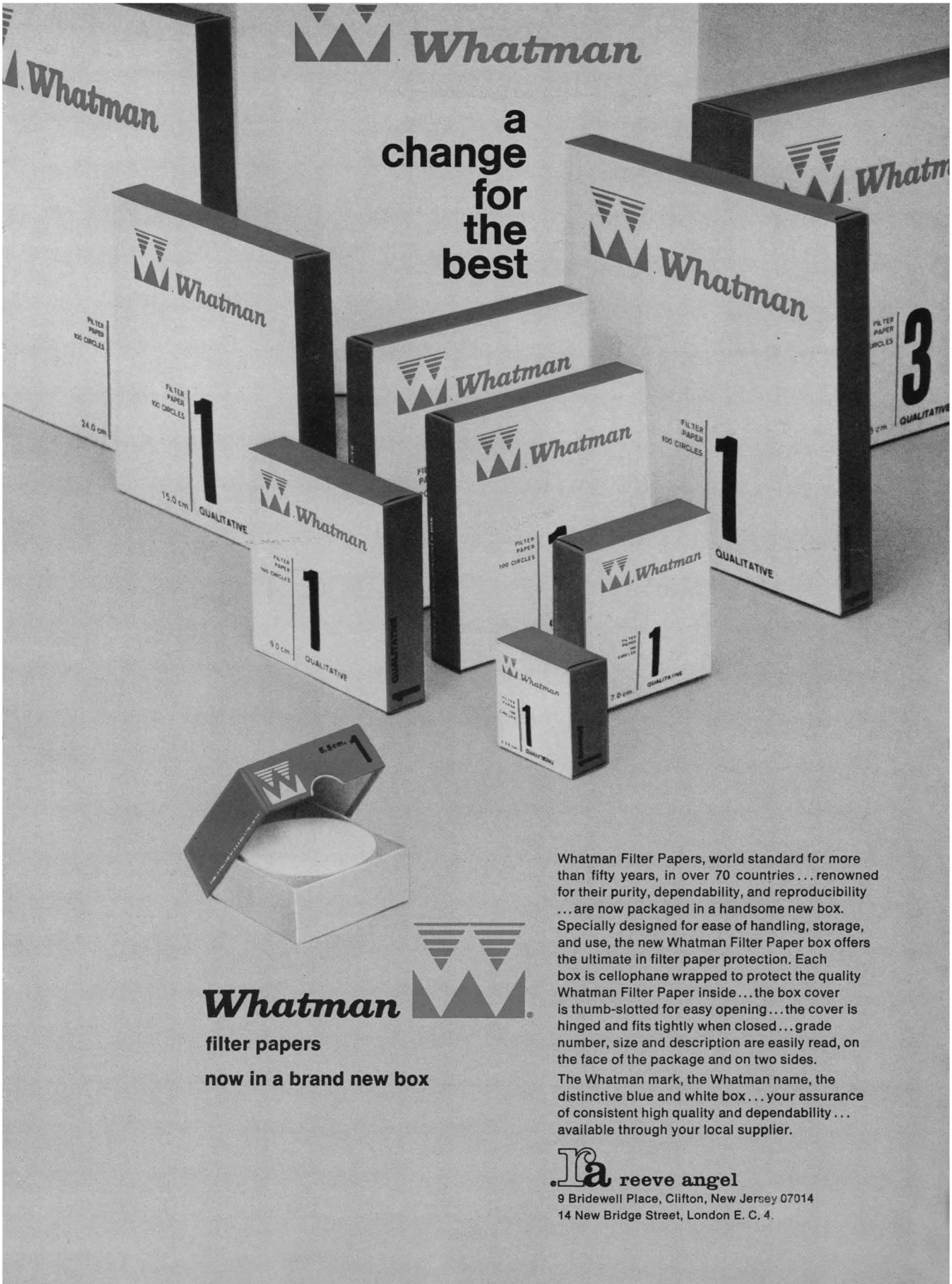
COVER

Various aspects of marine science will be discussed at a symposium, 27–28 December 1967, during the AAAS Annual Meeting, New York City. Topics include oceanographic policies and concepts in the United States, oceanographic programs developing on a national basis, the hypothesis of sea floor spreading, and the sea as a source of man's food supply. See page 950. [B. J. Nixon, Virginia Beach, Virginia]



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Who else in the pH busines

The new HU-11E: the world's highest resolution electron microscope. It also offers the maximum in operating convenience.

The Hitachi-Perkin-Elmer Model HU-11E has a guaranteed resolution of five Angstroms. Better than 1.5 Angstroms has been demonstrated.

And we've made the HU-11E as automatic and as easy to operate as possible. It's easy to align, easy to compensate, easy to focus. So it's easy to take ultra-high resolution micrographs with it.

For instance, we've incorporated a new electromagnetic gun-tilting device that gives you perfect alignment of the electron gun with respect to the condenser lenses. Plenty of brightness is available at direct magnifications to 300,000X.

Beneath the condensers we've added an exclusive new alignment coil. It keeps the beam centered from the lowest to highest magnifications.

There's a new electron gun airlock. If a filament burns out, you don't have to open the column to atmosphere. This is important for cleanliness, especially when you're doing ultra-high resolution work.

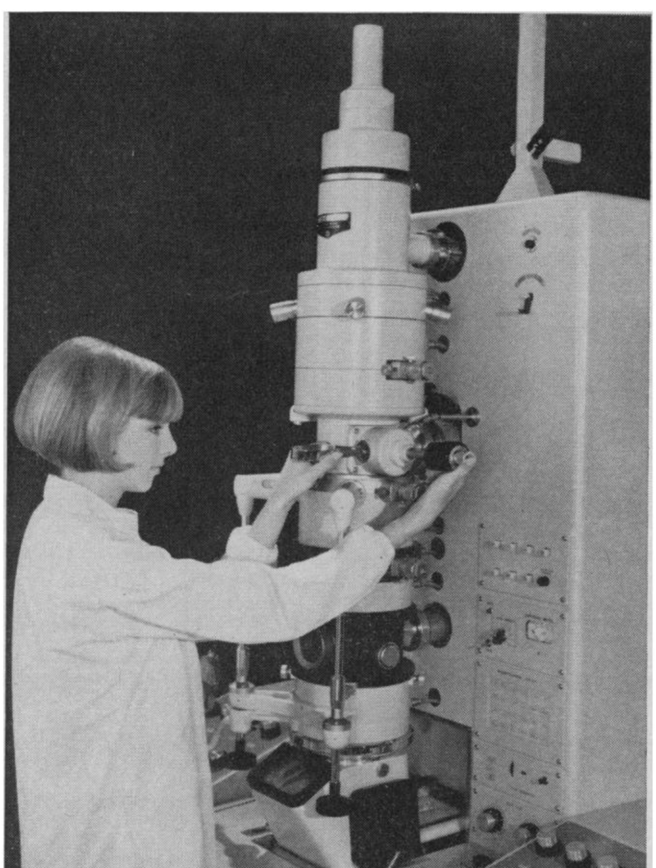
The magnification range is from 1000X to 300,000X direct without disturbing alignment or changing pole pieces. The magnification range is covered in 23 steps—direct reading or continuously. 250X for scanning is available just by flipping a single switch.

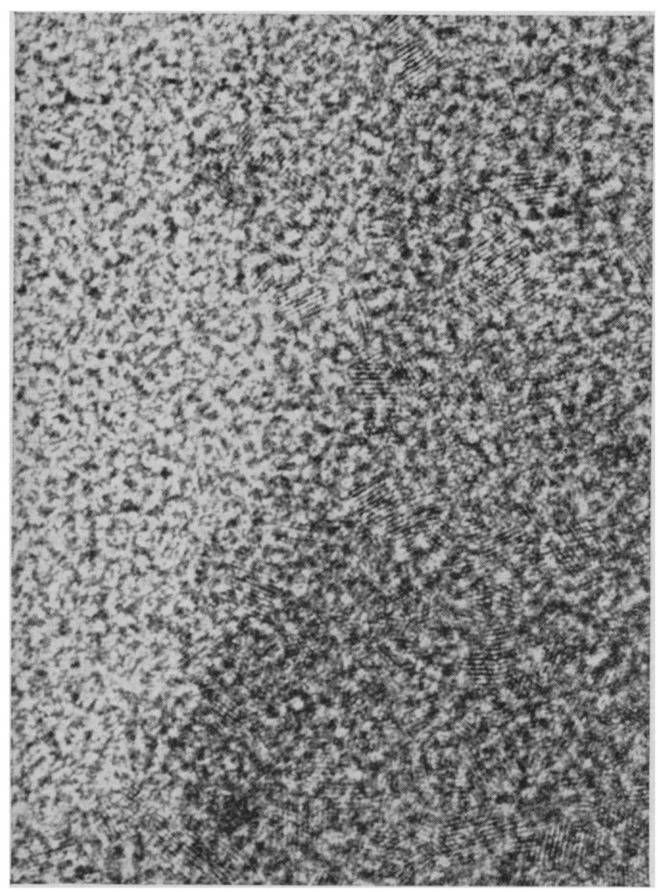
Accelerating voltages of 25, 50, 75 and 100 KV allow you to select the optimum voltage for any type of specimen. Lens currents are automatically changed when the accelerating voltage is changed. Super-stabilized electronics provide stabilities of 1.5 parts per million on the objective lens.

The HU-11E is equipped with a pushbutton vacuum system and a pushbutton camera system. Correct exposures are automatic. It incorporates the very latest in vacuum system design and the best anti-contamination measures, insuring a contamination rate below 0.1A/min.

The HU-11E is for workers who want the ultimate in performance—not just in resolving power, but in convenience features that permit the greatest output of high-quality pictures. We'll be glad to send you complete details. Write to: Perkin-Elmer Corporation, Instrument Division, 723 Main Avenue, Norwalk, Conn. 06852—or your nearest Perkin-Elmer sales office.

PERKIN-ELMER





The electron micrograph taken on the HU-11E shows random lattice images of the (111) plane of UO_2. The (111) plane= 3.15 Angstroms. Point-to-point resolution of 3 Angstroms and less is also clearly evident. The HU-11E was operated at an accelerating voltage of 100 KV and an electron optical magnification of 200,000X. Final magnification is 2,000,000X.

YOUR WAIT

enabled Bausch & Lomb to bring you the most advanced atomic absorption system on the market today. It combines safety, versatility, operational convenience and reliability with superior sensitivity and exceptional performance. Here are just 16 of the reasons why the new AC2-20 Atomic Absorption Spectrophotometer is the best and most contemporary unit available:

For reliability you can really count on . . .

- Use of the finest, high dispersion monochromator with two 1200 lines/mm "Certified-Precision" gratings of highest quality provides superior, linear dispersion; eliminates adjacent interference lines.
- a-c source and detection system (133 Hz) ignores unwanted flame emission, avoids equipment interference and stray light.
- Single pass system utilizes region of highest free atom density where greatest absorbance and homogeneity exist; higher signal-to-noise ratio, too.
- Built-in scale expansion up to 10X.

For unmatched operator convenience . . .

- Three-lamp system with indicator pilot lights, lamp identification, remote switching, easy centering, focusing and interchange.
- Slits and filters easily selected.
- Flowmeters for both fuel and support gas permit reading over entire range, simplify repeatability of settings.
- Direct reading of sample . . . no nulling required.

For maximum safety in atomic absorption

- No flashback in routine operation . . . virtually no danger from burns.
- Designed *from the start* for use with nitrous oxide, and other new gases.
- Teflon* and high-grade stainless steel used throughout.
- Can be ducted to remove toxic fumes and vapors.
- Remote piezoelectric burner ignition.

For outstanding versatility and flexibility . . .

- Instant lamphouse interchange—standard for use of 3 hollow cathode lamps or single lamphouse for 2″ lamps.
- 3-in-1 capability: flame emission, UV-visible and atomic absorption spectrophotometer.
- Can be combined with B&L Concentration Computer and many other readout devices.

. . . And many more features. Send for full specifications and description in our Folder 33-2233. Bausch & Lomb, 20847 Bausch St., Rochester, New York 14602.

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ANALYTICAL SYSTEMS DIVISION

INSTRUMENTATION

AAAS ANNUAL MEETING
26–31 December 1967
New York City

The American Association for the Advancement of Science will hold its 1967 Annual Meeting in New York City, 26–31 December. The New York Hilton (1335 Avenue of the Americas) and the Americana (52nd to 53rd Streets and Seventh Avenue) will be coheadquarter hotels. The City Squire Motor Inn (51st & 52nd Streets) will be used for additional housing.

The AAAS Office, Exposition of Science and Industry, Science Theatre, Visible Directory of Registrants, and the AAAS Information Center will be located in the New York Hilton. Both the New York Hilton and Americana Hotels will have Registration Centers.

Meeting Registration

Print or type registration form.

Enclose check or money order payable to AAAS.

Your cancelled check is your receipt.

This card will be used as a registration form and for insertion in the Visible Directory. Legibility (if handwritten) is important.

Advance Registrations accepted only until 30 November 1967.

Program and badge will be mailed 1 December 1967.

Hotel Reservation

Print or type hotel reservation form.

Reservation requests **must** be sent to the AAAS Housing Bureau in New York City.

Definite arrival and departure hour and date must be indicated.

Room assignments will be made in order received.

Notify Housing Bureau promptly of any change in reservations.

Reservations received after 12 December cannot be assured.

Include Zip Code in your address.

Rates (per day)

Hotel	**Single**	**Double**	**Twin**	**Suites**	**Parking**
New York Hilton	$12	$16	$19	$46	$4.75
Americana	12	16	19	40-up	4.75
City Squire Motor Inn	12	16	19	—	Free

Rooms are subject to a 5-percent city transient room tax.
Hotel reservations will be held only until 6 p.m. unless later arrival time is indicated. There is a charge of $5 for cots.

Tours

See reverse side.

REGISTER NOW

→ MAIL TO: AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
Dept. R, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005

Registration PLEASE PRINT OR TYPE

Date ____

☐ Enclosed is $10 Registration Fee (Program and Convention Badge)
☐ Enclosed is $15 Registration Fee (including spouse) (Program and Convention Badges)
☐ Enclosed is $5 Student Registration Fee (16 years and older) (Program and Convention Badge)
☐ Enclosed is $____ for tours as indicated on reverse side.

Name of Spouse (if registering) ____

Present position ____

Institution or Company ____

Home Address ____

PLEASE PRINT or TYPE

LAST NAME	FIRST NAME	MIDDLE INITIAL	CONVENTION ADDRESS

MAKE HOTEL RESERVATION

→ MAIL TO: AAAS HOUSING BUREAU, 90 East 42nd Street, New York, New York 10017

Hotel Reservation Date ____

Choice of Hotel: First ____ Second ____ Third ____

Room: ☐ Single ☐ Double ☐ Double, twin beds ☐ Suite

Number in party ____ sharing this room will be (list name and address of each person, including your own).

Date and hour of arrival ____ Date and hour of departure ____

Name ____ (Last) (First) (Initial)

Address ____

AAAS TOUR REGISTRATION

Price of tickets is $2.00 each

Number of tickets	
....	Rockefeller University
....	New York Botanical Garden
....	New York Zoological Park (Bronx Zoo)
....	Boyce Thompson Institute for Plant Research
....	Lamont Geological Observatory
....	Aquarium of the New York Zoological Society

Total number of tickets .... Total amount remitted for tours $...............

Please indicate on reverse side total amount remitted for tours.

Tours at the AAAS Annual Meeting

The AAAS is pleased to offer tours to institutions of particular scientific interest for registrants at the Association's annual meeting. Personally conducted tours arranged by officials of each institution will afford the visitor a unique opportunity to see special exhibits, displays, behind-the-scenes operations, and scientific activities of various kinds which are not usually seen by the general public. Attendance at each site is necessarily limited in order to give the visitor full opportunity to see and hear about work in progress. At some locations refreshments will be served by the host institution. Details on the special attractions at each site will be published in later issues of *Science*.

Chartered buses will provide round-trip transportation from the New York Hilton Hotel. Afternoon tours will return to the New York Hilton no later than 6 p.m. **Ticket sales are limited to registrants.** A fee of *$2.00 per person* is charged for each tour to cover transportation costs. Your ticket is your receipt and is required for transportation and admission. Tickets will be mailed with the *Program* and convention badge. Advance registration for tours will not be accepted after 30 November. Tickets for spaces unsold by 30 November will be on sale at the AAAS Tours desk in the main registration area at the New York Hilton, starting 26 December.

Please use the form to register for tours. Indicate the number of tickets you wish to order for each tour and enclose payment of $2.00 for the tickets ordered.

Since attendance at each site is limited, early registration is recommended.

Rockefeller University, 66th and York Avenue (limited to 250), Wednesday afternoon, 27 December

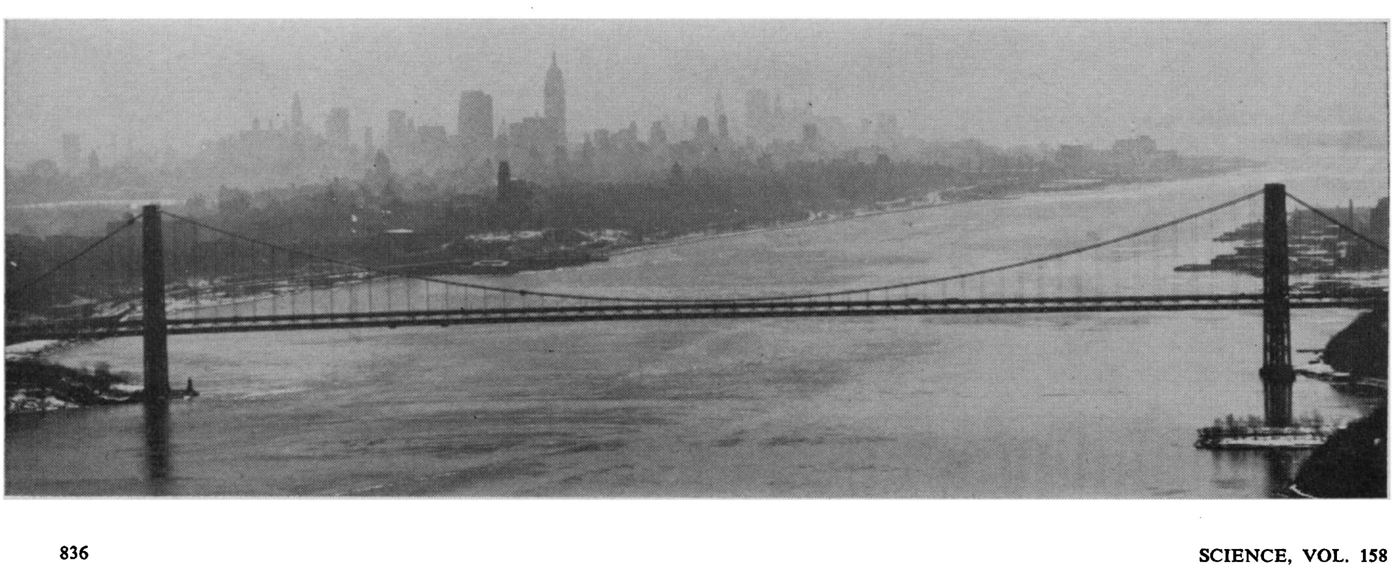
New York Botanical Garden, Bronx Park (limited to 250), Thursday afternoon, 28 December

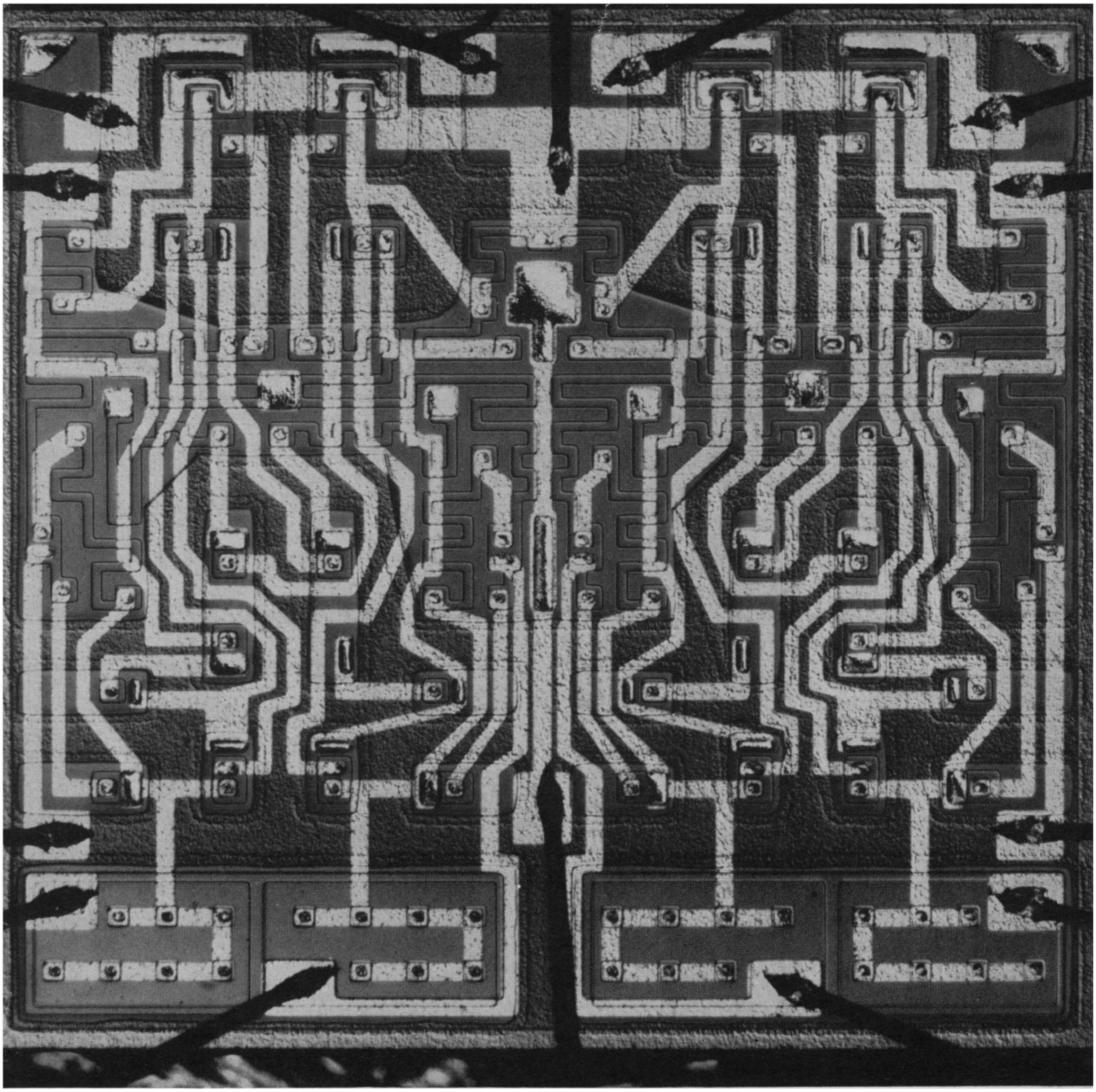
New York Zoological Park (Bronx Zoo), Bronx Park (limited to 150), Thursday afternoon, 28 December

Boyce Thompson Institute for Plant Research, Yonkers (limited to 200), Friday afternoon, 29 December

Lamont Geological Observatory, Palisades (limited to 150), Friday afternoon, 29 December

Aquarium of the New York Zoological Society, Seaside Park (limited to 300), Saturday morning, 30 December





Digital logic circuit, courtesy of Radiation Incorporated (95x enlargement).

Zeiss extends the scope of industry

Actual size of circuit.

In the tiny world of microelectronics, giant strides depend on critical analysis.

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Zeiss is constantly extending the scope of industry . . . research . . . and science.

Doesn't *your* work justify the ultimate in optical performance? *Whatever* your requirements, you can depend on . . .

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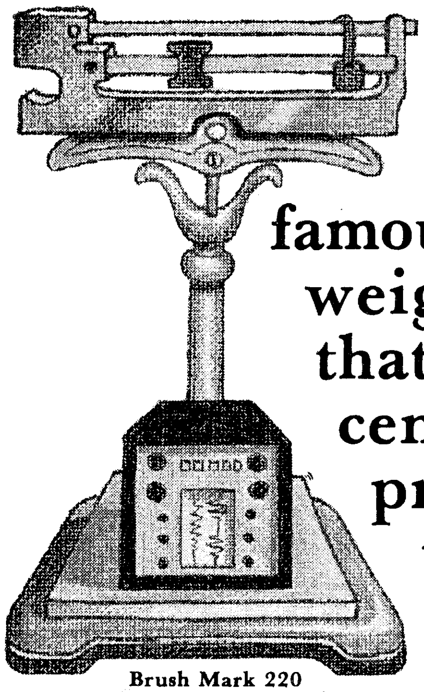
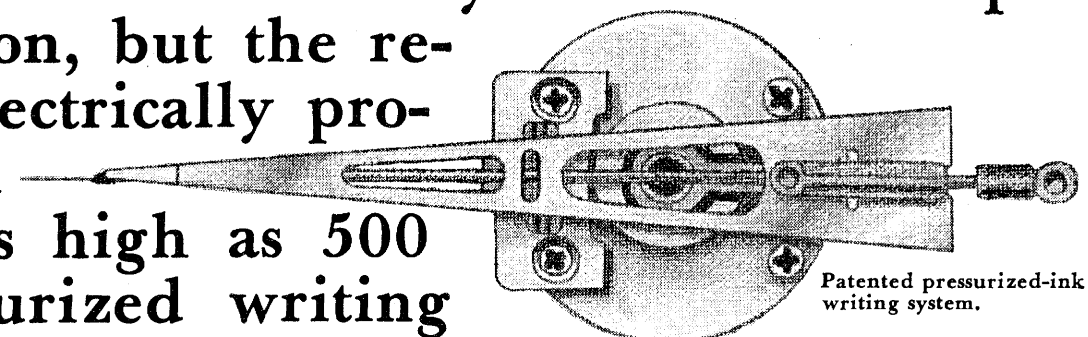
The end of the non-portable portable

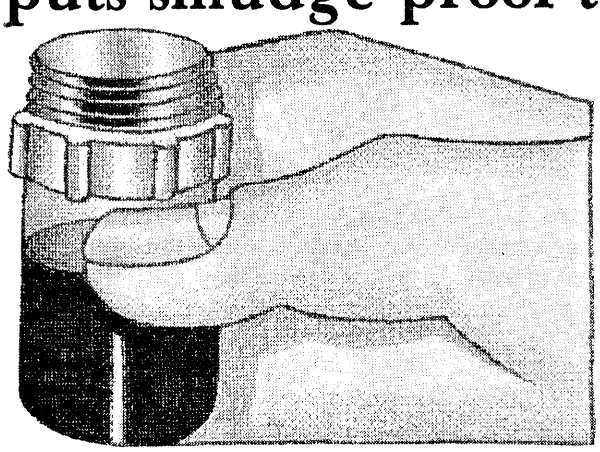


Brush Mark 220 weighs in at 25 pounds.

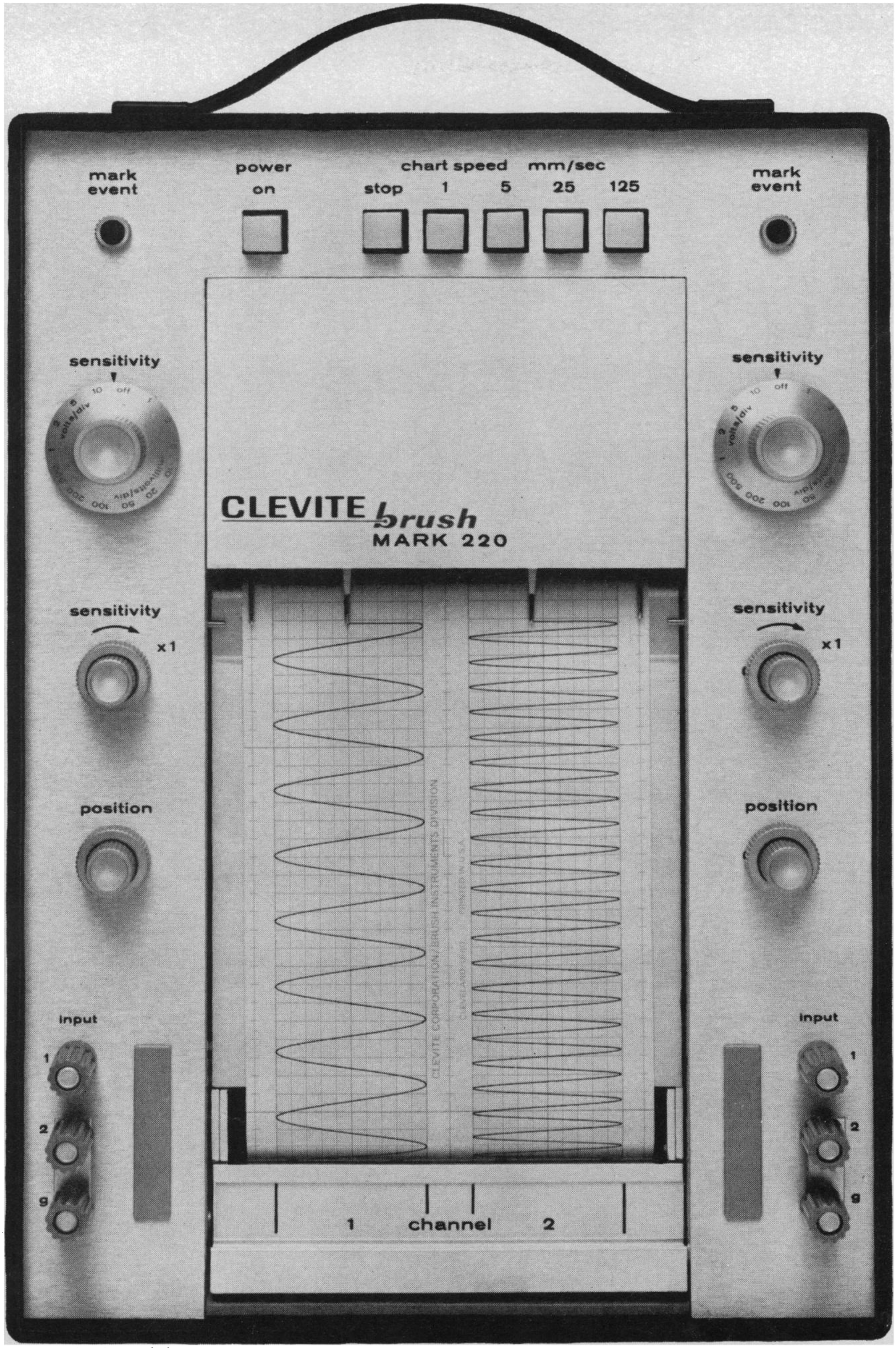
Mark 220 by Brush . . . a brand new recorder with a 25,000-channel pedigree. Behaves like its famous granddaddy, the Mark 200, but weighs only 25 pounds. Delivers traces that are unbelievably sharp, 99½ percent accurate. Solid state electronics provide position feedback pen control . . . no springs, no strings. The new Mark 220 has two channels for analog recording, two for events. Maximum sensitivity is one millivolt per chart division, but the recorder is electrically protected from overloads as high as 500 volts. Pressurized writing puts smudge-proof traces into paper, and there's enough ink in the throw-away cartridge to last for about a thousand miles. Less than $1700 will put you in business with this fine instrument. Call for a demonstration of the remarkable Mark 220, and if you wish to keep the unit . . . we'll swap it for a P.O. number. Clevite Corp., Brush Instruments Division, 37th & Perkins, Cleveland, Ohio 44114.



Patented pressurized-ink writing system.



Throw-away ink cartridge—1000 miles between changes.



Shown 71% of actual size.

The Hasselblad EL
it could be one of the most important research tools you ever buy.

In previous advertisements we have discussed the many and varied applications for which the Hasselblad System can be used in the scientific and industrial field. We would now like to discuss a unique combination of Hasselblad components and some of the rather unique applications to which they can be put.

The camera in question is the Hasselblad EL, an electrically driven 2¼" square, single lens, reflex camera, powered by one or two rechargeable batteries, each battery good for 1000 exposures on a single charge. The film is wound on and the shutter cocked automatically after each exposure. Exposures can be made manually or by remote control, using either long release cables or a radio release.

The Hasselblad EL accepts practically all the accessories that are available for the Hasselblad 500C (the standard body in the the Hasselblad System), including the 120-12 exposure magazine, the 220-24 exposure magazine, and, of particular interest with the EL, the 70mm-70 exposure magazine. The Hasselblad EL also accepts all seven lenses available in the Hasselblad System, from the extreme wide angle Zeiss Distagon of 40mm focal length, 88° angle of view, with maximum aperture f/4, to the Zeiss Tele-Tessar of 500mm focal length, 9° angle of view, maximum aperture f/8.

Listed below are five particular and diverse applications for the EL.

General Instrument Recording

Many Hasselblad EL cameras are already proving their worth, in industrial and research institutions all over the world, as recording devices for the constant surveillance of instrument banks and oscilloscope screens on a 24 hour basis.

By the use of the EL with a lens of the appropriate focal length, and the 70 exposure 70mm film magazine, banks of cameras, using the Hasselblad remote control timer, can make a number of exposures between 2 and 60 intervals for each of 3 time ranges—seconds, minutes or hours.

Thus, many valuable man hours can be saved which would otherwise be wasted making manual photographic records.

Hydraulic Engineering and Fluid Flow Research

The Hasselblad EL is particularly suited to many forms of fluid flow research and in the solving of river current and flow location problems. Banks of up to 20 Hasselblad ELs are suspended over a scale model of the river bed or sections of the ocean floor to be studied. By floating numbers of white polystyrene balls down the model and illuminating them by mercury vapor lamps, a series of tracks is formed on the negatives against the black of the river bed. By computing the distance of the tracks against a speed scale included in the photograph, flow speeds can be calculated.

By using much smaller plastic chips and the same photographic techniques, current patterns are formed at mouths of rivers, in bays and around structures in the river.

Obviously, the remote control features of the Hasselblad make it extremely useful for this kind of work, and the use of either the 70mm-70 exposure, or 220-24 exposure magazine, allows the researcher to make many exposures before bringing the camera down from the roof of the building. And, unless the building has an extremely high roof, (in which case the 80mm-Planar could be used) the 40mm Distagon will allow the maximum area to be covered by each camera.

Materials Testing

Other than the more regular forms of material testing which are usually carried out under ideal laboratory conditions, there are certain times when photographs of fractures or breakages of materials are needed. Yet, the structures are inaccessible to a photographer e.g., the inspection of blast furnaces or large capacity wine storage casks, both containing large quantities of toxic gas. In these instances, the lowering of the EL into the structures to be tested and the operation of the camera by remote control, provides the solution to the problem. Once again, the use of the 70mm magazine is desirable if numerous exposures are required.

Because of the confined space of the structures, the wide angle lenses available for the Hasselblad, the 40mm Distagon, with its 88° angle of view, or the 50mm Distagon, with its 75° angle of view, would be most useful.

Cave Photography & Speleology

A great deal of photography in cave and cavern research and its related sciences, palaeontology, anthropology and prehistory, is being done with the Hasselblad EL.

Working conditions are usually so bad—mud, water and of course, constant darkness—that film changes are not only undesirable but usually impossible. Use of either the 220-24 exposure or the 70mm-70 exposure magazine will reduce the number of film changes to the absolute minimum. Because of the spacial limitations of a cave, a wide angle lens is indispensable. Either the 40mm Distagon, with its 88° angle of view, or the 50mm Distagon, with its 75° angle of view, cannot be bettered.

Aerial Photography

The Hasselblad EL is also ideally suited for many phases of aeronautical research. In most aerial research photography the camera is not handled by a skilled photographer, but usually by a flight test engineer or even, in the case of a single seat airplane, by the pilot himself. These people do not have the time to be concerned with manual operations such as exposing, winding on or changing film.

Flight instrumentation recording by remote control operation of the pre-focused Hasselblad EL allows for the reconstruction of flight conditions at pre-determined intervals during the test flights.

Numerous accessories are available for the Hasselblad EL. These are fully outlined in a 40 page illustrated booklet which we would be happy to send to you on request. If you also have any particular problems of a photographic nature, please address your enquiries to our Technical Director . . . Paillard Inc., 1900 Lower Road, Linden, New Jersey 07036.

HASSELBLAD

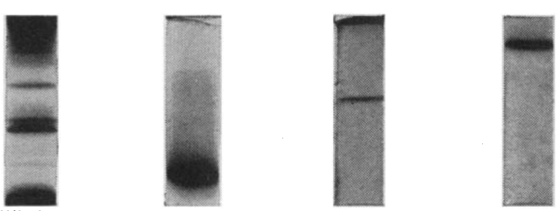
HOW PURE CAN A FRACTION BE?

(PREP-DISC ELECTROPHORESIS GIVES AN ILLUMINATING ANSWER!)

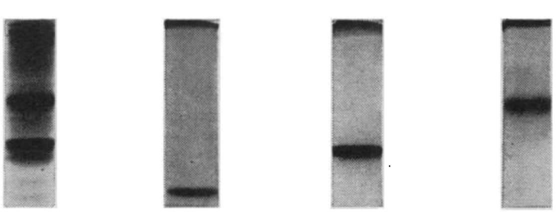
Many researchers have seen analytical Disc Electrophoresis reveal heterogeneity in fractions thought to be pure, prepared by conventional separation techniques. Now, the high-resolution capabilities of the Disc technique can be put to work on the preparative scale to eliminate this heterogeneity in samples of useful size. More than a hundred investigators are already using Prep-Disc for separations of proteins, enzymes, polynucleotides, polypeptides and hormones. Here are just a few of the many materials Prep-Disc is purifying:

isolated insulin
granule proteins
fibrinogen
prothrombin
other blood factors
macroglobulins
α1 and α2 globulins
transferrin
mycobacterum
tuberculosis proteins
milk proteins
histones
ribosomal proteins
glycoprotein
serum lipoprotein
L-asparaginase
pituitary gonadotropins
LDH
denatured collagen
horse spleen ferritin
staphylococcus enzymes
cytochrome
various plant
enzymes and proteins
RNA
tumor tissue proteins
phosphorylases and dehydrases
from bacterial extracts
beta glucuronidase
saliva proteins
mucosal cell extracts
polypeptides (PTH)
body fluid proteins
carbonic anhydrase
placental lactogens
isocitric dehydrogenase
5-carboxymethyl protein
derivatives

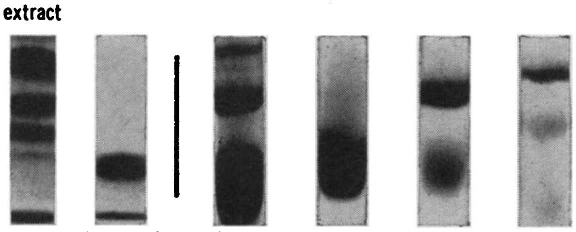
EVIDENCE: Shown here are typical examples, in the form of high-resolution analytical-Disc Electrophoresis patterns, of separated fractions taken from Prep-Disc columns. Each set shows starting material, plus one or more purified components separated from it.



Whole rabbit serum | post-albumin | transferrin | slow alpha

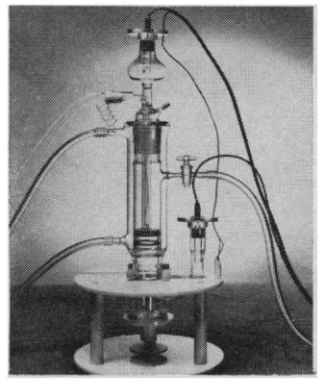


Bacterial cell extract | Fraction 1 | Fraction 4 | Fraction 6



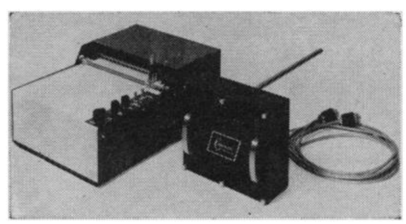
Mucosal cell extract | Fraction 1 | Horse spleen ferritin | Fraction 1 | Fraction 2 | Fraction 3

APPARATUS: The Canalco Prep-Disc equipment offers unique advantages over any other form of large-scale gel electrophoresis apparatus. Included:



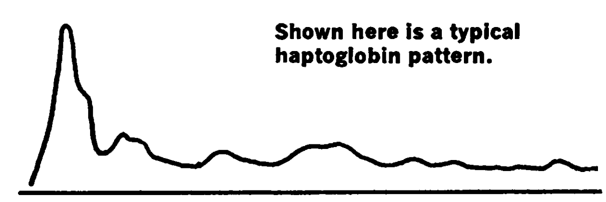
Prep-Disc Apparatus

- a fully visible, externally adjustable elution slit eliminates clogging and optimizes wash-off for highest fraction concentrations;
- you can use either of two tested gel systems for fast (1-4 hour) cuts of both high and low molecular weight materials, and for fine cuts of closely-related materials as well;
- interchangeable gel columns of three sizes allow gel preparation outside the basic apparatus. You can prepare for a run while one is already in progress;
- reversible electrodes (for anodic or cathodic migrating materials) are safety-interlocked with Canalco power supplies;
- pretested Canalco chemicals minimize or eliminate problems of gel shrinkage or swelling and other artifacts;
- you get detailed procedural instructions and the full backup of the Disc Electrophoresis Information Center for continuing guidance and assistance in problem-solving.



WIDE-TRACK FLOW ANALYZER Canalco's Wide-Track flow monitors are a useful adjunct to the Prep-Disc technique, providing a record of fraction elution.

←



Shown here is a typical haptoglobin pattern.

Write today for a detailed bulletin describing Prep-Disc!

CANALCO

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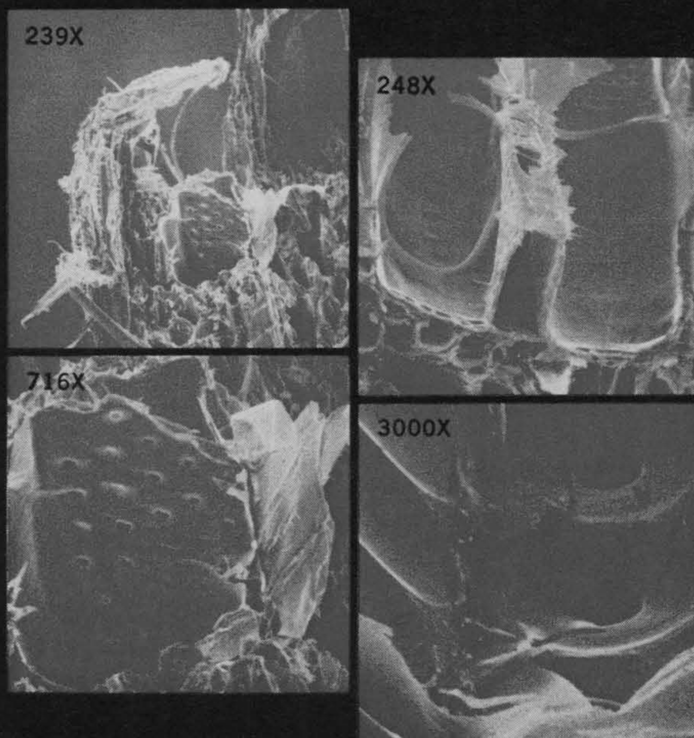

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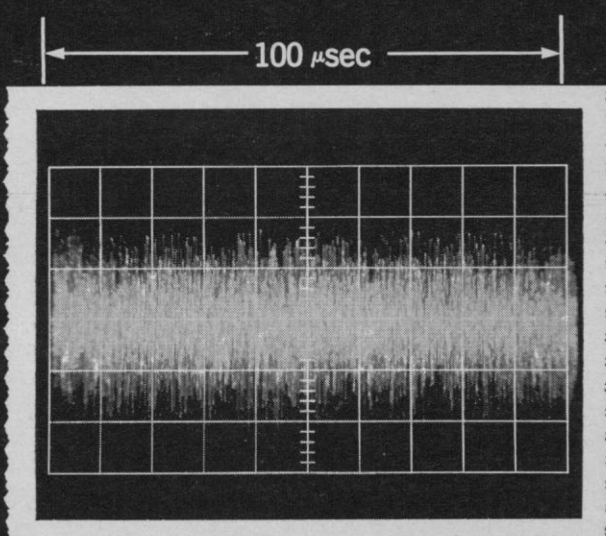


Photo #1—Input to Model TDH-9
SENSITIVITY: 5 V/cm
TIME: 10 μsec/cm
NOISE-TO-SIGNAL RATIO: 10:1

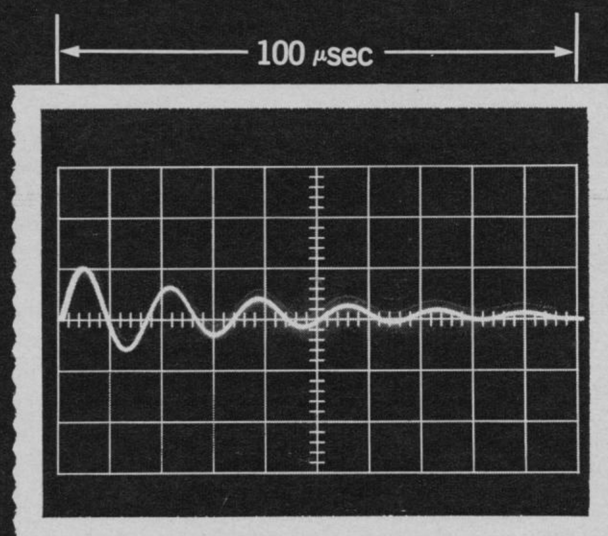
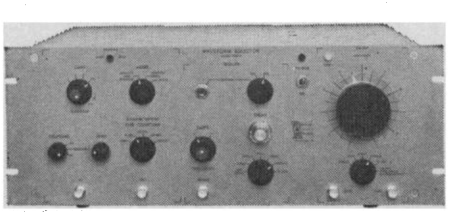


Photo #2—Output of Model TDH-9
SENSITIVITY: 5 V/cm
TIME: 10 μsec/cm



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VICTOR A. ZULLO
Department of Geology, California Academy of Sciences, San Francisco 94118

Upward Spiral of Costs and Dues

The recent announcement by the AAAS Council of an increase of over 40 percent in membership dues raises questions as to how AAAS funds are being spent. Apparently some unspecified additional obligations assumed by the Board of Directors have contributed to the large increase. I believe that a raise of this magnitude should not be made without some attempt to determine the consensus of the membership. (Perhaps some changes, such as placing the table of contents of *Science* on the cover, could even reduce present expenditures.) In any event, perhaps a majority of the membership would agree with me in feeling that every attempt must be made to keep the fee down, and that if there must be a raise, the membership should receive a complete and candid explanation of the options open to the Board, and their reason for raising the fee. I am particularly concerned because AAAS income exceeded expenses by over $100,000 in 1966, the last fiscal year, and this apparently represents an increase over the excess of 1965, which was in turn greater than the excess of 1964. Yet, in 1967, fees are raised over 40 percent.

ERNEST B. HOOK
Division of Medical Genetics, University of Washington School of Medicine, Seattle 98105

The statement that AAAS income exceeded expenses by over $100,000 in 1966 and by smaller amounts in 1964 and 1965 is correct. For 1967 there will be a deficit of the order of $150,000.

The options open to the Board of Directors were to decrease expenditures or to increase income. *Science* represents the principal expense, the principal source of income, and the principal benefit of membership. It therefore serves as the best example of the problem involved in the decision by the Board of Directors to recommend, and the decision by the Council to approve, an increase in AAAS dues and the subscription charge for *Science*. No substantial decrease of expenditures could be achieved without reducing the size of *Science*. Periodic surveys of random samples of the members indicated they do not wish *Science* to be decreased in size.

Since 1958 (the year of the last dues increase) the cost of editing, printing, and mailing *Science* for a year to one member has increased from $12.30 to $24. Income to meet this cost comes from dues, subscriptions, and advertising. Advertising rates have been increased annually since 1958, with the total increase from that year to 1968 being over 200 percent. The pending dues increase will be slightly over 40 percent. Fortunately, scientists' salaries have increased about 60 percent in the 10-year period.

DAEL WOLFLE
AAAS

Chromatography Warning

I wish to draw attention to a serious disadvantage in the use of either black or amber rubber tubing for chromatography. They contain a water-soluble antioxidant which has a maximum optical absorption at 227 mμ. There is also considerable absorption at 260 mμ and 280 mμ, which would invalidate any estimation of the ratio of optical density at these wavelengths. For example, on leaving a sample of distilled water in a piece of unused tubing, the optical density at 280 mμ was greater than 1 after 24 hours. Boiling the tubing in detergent for 1 hour had little effect in reducing this absorption.

At best, use of this tubing for chromatography, and measurement at 280 mμ may slightly raise the background value, but should the flow of the solution be stopped for a time and started again, it is quite possible to obtain a spurious peak owing to a build-up of antioxidant by slow diffusion from the rubber into the solution.

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Reductionism and Real Biology

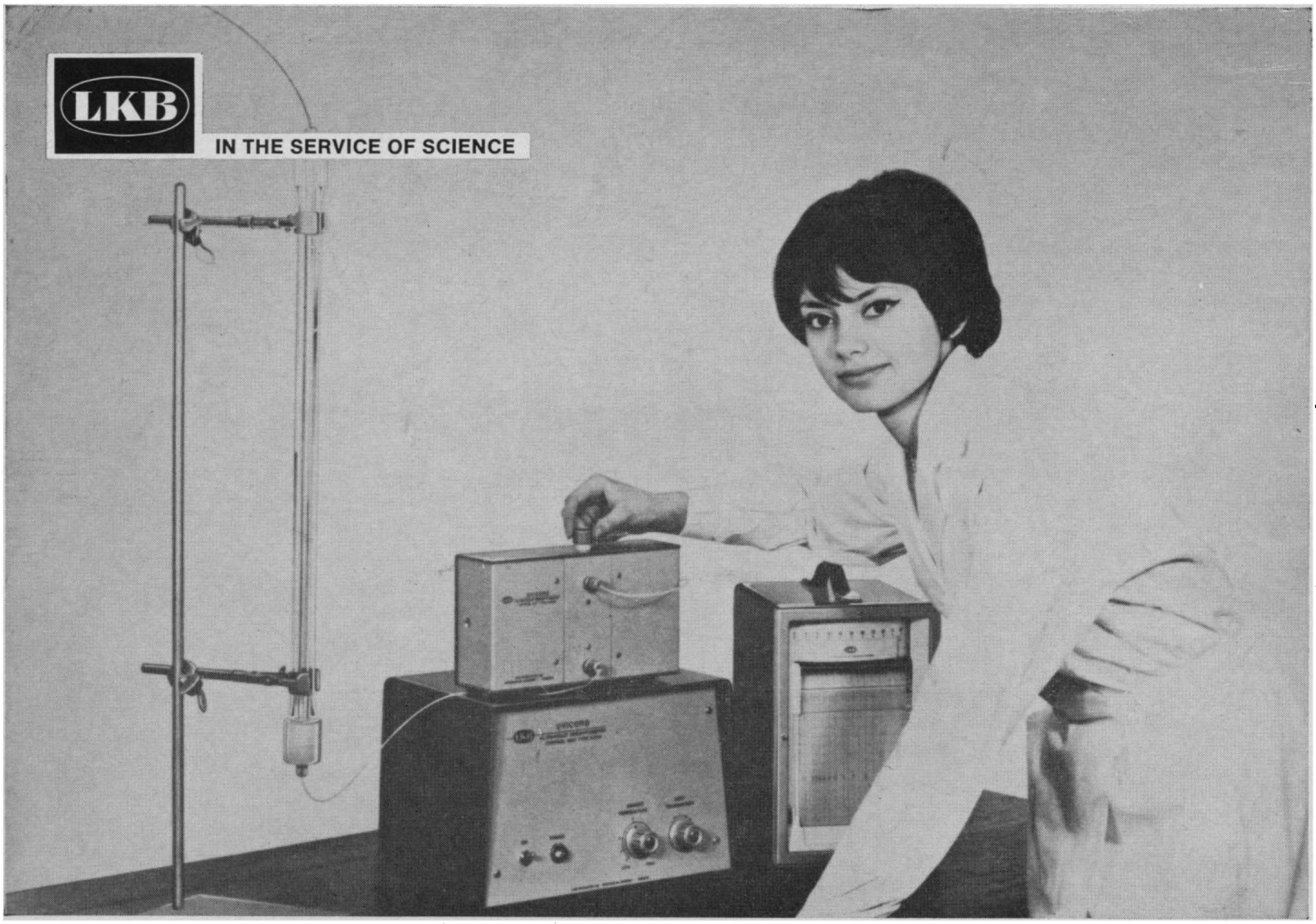
Few things in life are more enraging than being told publicly that one's work "may well be of value," especially if that statement is based on untidy and, in places, self-contradictory arguments. The tone of the little gem proffering all this is, moreover, so insufferably pedantic that my esteem for *Science's* editorial discretion has fallen to a new low (K. F. Schaffner, "Antireductionism and molecular biology," 11 Aug., p. 644).

Schaffner's logical troubles start at the beginning of his paper with the well-known error of the excluded middle. To him, the only alternative to absolute reductionism is antireductionism, just as in the early days of Christianity all non-Christians were heathens. Thus he places Glass, Commoner, and Elsasser in the antireductionist camp *by definition*, and proceeds to dress them down. As I understand these men (taking into account the tenor of their entire statements, not just of one less felicitous passage), they are anything but *anti*reductionist. They acknowledge the tremendous strides made by the molecular biologists in reducing the mysteries of genetics to a chemical mechanism, but caution against the overgeneralization that *everything* biological can now be reduced to chemistry. Pure reductionism is a vast generalization based on a not-so-vast amount of evidence. It is a canon of faith and, as such religious assertions go, can neither be proved nor disproved. Thus, some of the arguments intended to demonstrate that there can be no such thing as complete reductionism are indeed a bit quixotic, since they assail a windmill that has not even been demonstrated to be there. The spectacle of Schaffner's counterattack is no less than comic.

Observe some of the slapstick: In order to "clarify the issue" and show where Glass misses the mark, Schaffner pulls John von Neumann out of his holster and lets fly with the big bang of the latter's demonstration that quantum mechanics cannot contain any "hidden parameters" that would turn the stochastic theory into a deterministic one. This profound observation demonstrates then (says Schaffner) that Bentley Glass did not do his homework; he should have presented "an appropriate axiomatization of a true probabilistic theory in biology and demonstrate that the identification of biological entities with physicochemical entities and explanation of the biological entities' behavior on the basis of either causal or statistical laws involving physicochemical terms would entail a contradiction." I wonder if it has occurred to Schaffner that, in order to pull off this feat of reasoning by analogy, it would have behooved him to present "an appropriate axiomatization . . . etc.," so that *he* can at least demonstrate that the two systems being analogized here (quantum mechanics and biology) are indeed isomorphic with respect to the question at issue. If they are not, the whole argument is vacuous. The punch line to this joke comes on the next page, when Schaffner invokes Ashby's notion of homomorphism to propose that there may exist an operator ϕ which would enable one to transform chemical systems to biological ones, and vice versa. If this is not a "hidden parameter," I'd like to be shown one.

And all this time Schaffner, true to form, keeps missing the glaringly obvious point that especially Elsasser is making: biological phenomena may sometimes (and eventually, perhaps always) be explained a posteriori in terms appropriate to lower levels of organization, such as molecular systems; the lower system, however, does not *predict* even the *existence* of the higher one, leave alone its organization.

Schaffner almost puts his foot into it when, again through the medium of Ashby, he points out that an engineer in building a bridge is working with a homomorphism of an "atomic" system (through the magic of operator ϕ). The parable of the engineer has exactly the opposite moral of what Schaffner tries to imply, and is commonly used by adherents of less extreme viewpoints. The engineering fact that an I-beam of given weight will support more load than a square rod of the same weight is not predictable from thermodynamics, because this discipline does not consider the form or *morphe* which a substance can be made to assume. If such considerations are introduced into thermodynamics after the fact, some clever fellow may quite well demonstrate that the engineers have been right all along, which fact is comforting to know, but is wholly irrelevant to either thermodynamics or engineering since neither discipline is enriched by this "discovery." In this context I wonder how much genetic engineering (that is, selective breeding)



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will benefit from molecular genetics, notwithstanding the bright prophesies of the late H. J. Muller.

Schaffner continues: " . . . no evidence has been unearthed in our inquiries . . . that would argue positively and persuasively for the inherent autonomy of biology." What about necessary and sufficient conditions? Life is the necessary *and* sufficient condition for natural macromolecular systems, but macromolecules, though necessary, are not sufficient for life (at least not until someone actually synthesizes life). Similarly, biology implies biochemistry, but not the other way around.

There has been an interesting progression in the titles on the doors of the people who study fractionated life in test tubes. They used to call their work "organic chemistry," but soon found that "physiological chemistry" would be more appropriate, and "biochemistry" even better (more general and easier on the tongue). "Molecular biology," though not quite so euphonic, sounds much more impressive and gives one the illusion of being a biologist instead of a chemist. In the wake of the great successes in genetics, it appeared a simple matter to declare that genetics is central to all of biology, and thus the "molecular" may as well be dropped from the title, leaving Biology, pure and simple. All that remains to be done now is to dispose of what used to be called biology and relegate it to Siberia by insinuating that it has no "real autonomy" (that is, is really illegitimate), and thus has no right to the throne. In fairness it must be said that this is more genteel than outright assassination, but who is going to mind the store in anatomy, embryology, phylogeny, ecology, taxonomy and all the other "classical" fields of biology? Reductionist philosophers maybe? After all, research in these fields may well be of value (heuristically speaking, of course), so *somebody* ought to do it.

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*Deceased 8 October 1967.—ED.

. . . Schaffner points up my contention that the arguments centering around reductionism and quantum mechanical theory involve mainly physical theoreticians—not practicing biologists. . . . Still, we are all *natural* scientists living in the same universe, and hopefully the borders of our sciences will become less and less distinct as we gain a more comprehensive view of our surroundings. Surely, Bentley Glass should have no quarrel with anyone for attempting to provide physical explanations for biological phenomena; this approach is quite commonplace and often successful. But, it is a relatively heavy reliance on the inductive method, coupled with a deeply ingrained appreciation for the comparative and evolutionary approaches to understanding organisms, which largely set the biologist apart from the physical scientists and psychologists. However, one would not be correct in equating differences in ways of looking at natural phenomena with any fundamental autonomy of the various sciences. More effective *two-way* exchanges of data and viewpoints seem desirable. In this regard, academic arguments, such as Schaffner's, have their heuristic value; but it seems to be he, who would attach the title "antireductionist" to others, who gives this term an aura of connotation which would be, I am sure, quite alien to the would-be "attachees." Perhaps those working in the so-called classical areas of biology might be called "nonreductionists" (if any title is really necessary), but I seriously doubt that this labeling would delineate any significant areas of ideological opposition among present-day biologists.

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It seems to me that Schaffner's argument entirely misses the point of the problem. Consider, the following well-known case:

The pituitary gland in vertebrates controls, via adrenocorticotropin, the hormone production of the adrenal glands; the steroid hormones produced by these glands control the activities of enzymes that in their turn control a number of important metabolic reactions of various types of cells. Moreover, when the concentration of the steroid hormones circulating in the blood exceeds a critical level they inhibit the hormone production of the pituitary gland by a characteristic feedback mechanism. In this way a functional complex is built up that obeys a specific set of rules.

Now there can be no doubt that each single step in this functional complex can be "explained" in molecular terms, but I do not think one is warranted to call this set of molecular explanations a reduction of biological phe-

nomena to the level of physicochemical data. The important point is that, no matter how complete our biochemical knowledge, the specific organization of the hormonal-enzymatic system just mentioned could not be deduced from molecular data, just as the grammar of a language cannot be deduced from a knowledge of its alphabet, and a poem by e.e. cummings cannot be deduced from a knowledge of English grammar. To state "research in classical biology may well be of value" is not even an understatement, it is a complete misstatement of the problem, because if this so-called "classical biology," that is, the study of biological systems rather than that of biological elements, did not exist, molecular biology would have no pegs to hang its data on.

Biology is not really concerned with the "reduction" of one set of data to another set of data, but with the study of relationships on different levels of organization. The discovery of relationships on, say, the organismic level may be just as significant as the discovery of relationships on the molecular level, and the fascination of modern molecular biology has nothing to do with the claim sometimes made that all biological phenomena can now be reduced to physicochemical data. Rather it is due to the fact that out of a certain biological stalemate we have become explorers again, that we have learned to make generalizations on a level of organization that practically did not exist just 25 years ago.

WOLFGANG WIESER
Department of Zoology,
University of Innsbruck, Austria

Instead of trying to reduce biological phenomena to the laws of physics and chemistry, perhaps we should reverse our point of view—similar to what the Copernicans did; that is, instead of looking backward in terms of reductionism, look forward in the direction of time's arrow and contemplate the problem from where the story of evolution began, from the interstellar cloud of hydrogen. From this point of view, it becomes immediately clear that every element of the periodic table represents a new *quality* which emerged as a result of changes in *quantity*—of atomic particles, energy levels, or whatever units you wish to use. We are dealing with a principle which states that changes in quantity transforms into changes in quality. Furthermore, if we define quality as the sum of all the properties of an object at whatever levels they are studied, it becomes evident that by choosing the units which have undergone quantitative changes properly, we may associate with the change the emergence of a new quality. In this manner we can keep going up the scale of levels in the whole process of evolution: chemical, biological, and even social.

BENJAMIN DE LEON
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My position can be stated in three points: (i) Current advances in molecular biology have provided strong evidence for the thesis that biological organisms are explicable in terms of chemistry. The evidence is not, however, conclusive. To provide conclusive evidence for the reduction, all biological phenomena (and most likely, biological theories) would have to be obtainable; that is, derivable from the theories of chemistry supplemented by what I have termed elsewhere (*1*) as appropriate "reduction functions." These functions are formally and functionally equivalent to the part which a "transformation" or "operator" plays in effecting reductions. They identify entities of the reduced science with entities or groups of entities of the reducing science (*2*). The recent investigations of C. Yanofsky and his co-workers (*3*) can be seen as attempts to determine some of these reduction functions. (ii) The complexity of organic molecules, especially as regards tertiary structure and its chemical consequences, may never be fully explicable in chemical terms without adding sentences which describe this structure and which function as initial conditions, to the chemical theories appearing in the explanans. This thesis about the role of initial conditions admits of a natural extension to organ systems interconnected by hormonal messengers. Here, as in the previous case, a change in the arrangement would affect the system's behavior, as an interchange of a capacitor and of a resistor in a radio would alter that device's performance. Few, however, would contend that a radio is not explicable in terms of electrical theory. [See Polanyi (*4*) for a contrary view.] (iii) Arguments put forward to demonstrate that chemistry (or physics) cannot ever reduce biology are without foundation. Nevertheless it would be silly to conclude from this assertion that biology (in the classical sense) ought to be given up. In connection with points (i) and (ii) it is clear that "classical" biology has much to do, though I do not think that one can build up a philosophy of "emergent vitalism" or some type of system of "levels of emergence" out of this admission.

With regard to van Bergeijk's letter, it seems to me that we may legitimately take "antireductionist" to mean a person who does *not* believe that physics and chemistry can ultimately explain *all* of biology. There are no biologists who do not acknowledge the utility of *some* chemistry. In line with points (i) and (ii) above, I cannot and need not show an "isomorphism" of the type van Bergeijk asserts I must. It is sufficient on my position to show that the antireductionist has not shown that an "isomorphism" cannot be established. [Actually a simple isomorphism will not do (*1*).] It also seems that a claim in favor of the reductionist position in biology is no more a "canon of faith" than the quantum chemists' claim that quantum mechanics will ultimately be able to account for all of chemistry. I think I have indicated sufficiently well what the role of an operator like ϕ is under point (i) above; van Bergeijk has apparently misunderstood its function—it is certainly not a "hidden parameter." He notes that though "biological phenomena may sometimes (and eventually, perhaps, always) be explained a posteriori in terms appropriate to lower levels of organization . . . the lower system, however, does not *predict* even the *existence* of the higher one, leave alone its organization." This point is essentially the same as the thesis I present in the section of my article under the subhead "Organization and Emergence." Since the point can easily be misconstrued, however, let me refer to point (ii) above, and also note that I stated in my article that the "chemistry of biological evolution . . . [is] a significant exception to this point." For in this area of inquiry, we do wish to provide, at least plausible arguments, as to how the organization of the more complex chemical and biological systems came about. Experiments suggested by the Oparin hypothesis have been fruitful enough to indicate that the argument van Bergeijk is making is not a liability to the reductionist position. In regard to his I-beam example, the actual case is that quantum mechanics accounts for the strength constants of metals, and the addition of a sentence describing the shape of the beam as an initial condition to the quantum physics will entail the correct engineering claim which van Bergeijk refers to. Why he brings in thermodynamics is not clear. Finally, it would seem according to all current theories, and without admitting arguments based on an appeal to ignorance, that the macromolecule(s) of proper organization will be "living"—there is no clear evidence to the contrary.

In Chernetski's letter, I note that there are important scientific and philosophical problems about reductionism that will eventually have unambiguous answers; namely, whether chemistry (and physics) is in fact fully adequate to explain all of biology. Classical biologists might currently be called nonreductionists if it is kept in mind that ultimately their work will be viewed as having assisted in establishing either the reductionist or antireductionist thesis.

With respect to Wieser's comments, I believe that my discussion under point (ii) indicates what my position is on the explanation of the hormonal-enzymatic system to which he refers.

Finally, to turn to De Leon's suggestions, permit me to note that the word "quality," from both scientific and philosophical points of view, is notoriously obscure. Nevertheless I have no doubt, if we assume the "big bang" theory without cyclical reoccurrence of the fireball, that novel combinations and new "qualities" have appeared. The question at issue is whether a physical theory—which is essentially a timeless entity somewhat like a number—could account for these novelties, such as nuclear physics plus quantum mechanics accounts for the periodic chart *and* for the density, hardness, melting points, color, and acidity of many elements and compounds. To date, I do not think that the word "level" has ever been given a precise operational definition. At this point I am inclined to simply reassert the theses made partly under the subhead "Organization and Emergence" in my article, and partly under point (iii) above.

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1. K. F. Schaffner, *Phil. Sci.* **34**, 137 (1967).
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PDP-8/I

17 November 1967, Volume 158, Number 3803

SCIENCE

Meeting World Food Needs

This year has been favorable for the world's food crops. India has enjoyed an especially good monsoon. Thus the long-term aspects of the war on hunger can be contemplated in a relatively crisis-free atmosphere. A valuable stimulus to thinking about the struggle is a new book* issued by Iowa State University, which includes chapters by many of this country's leading experts on world food problems. Some of the contributors make optimistic predictions of long-term success. Others are less cheerful, and they advance very good reasons. One conclusion to be drawn from reading the book is that United States policy toward the underdeveloped countries has not been well formulated.

The bases for optimism are twofold. Birth control campaigns are meeting with partial success, and there is some improvement in agricultural practices. A Rockefeller Foundation program conducted in Mexico is noteworthy. This program has developed varieties of wheat especially suitable for cultivation in Pakistan and other tropical and subtropical countries. Pakistan is also making effective use of additional products of modern technology, including nitrogenous fertilizer.

As compared with the magnitude of the problems, however, progress so far is small. The world's population continues to increase at the rate of about 70 million per year. In the underdeveloped countries the death rate is dropping and half of the population is below the age of 15. As those already born reach sexual maturity, a further enhancement of population growth could occur. In many regions the birth rate is in the range 40 to 50 per 1000. For the long-term, the rate must be brought down to about 15 per 1000.

The potential for increasing the available food supply seems great. Use of improved grains, fertilizers, and pesticides could enlarge the food supply of the underdeveloped countries by as much as a factor of 4. N. S. Scrimshaw states that "in developing countries where there is little or no insect or rodent control either in the field or during storage, more than half of the food produced is lost before it reaches the consumer." The amount of food lost in this way is many times the total U.S. production.

Achieving the possible increase in food supply is not a simple matter. Development of high-yielding varieties suitable for growth in many tropical regions has not been achieved. Fertilizers and pesticides are costly. Improvement of agricultural practices is slow in countries where the farmers are illiterate. Worse still, there are few to instruct them in such practices. The so-called intellectuals disdain any connection with farming.

The role of the United States government in the war on hunger has not been well thought out. Supplying food to the needy has been a humanitarian effort. However, a side effect of this disposing of surplus commodities has been to discourage production of food in the recipient nations by depressing prices, and to attenuate local responsibility and initiative. Our government has spent billions of dollars in supplying food from the United States, but only a small fraction of this sum has been spent on helping the recipients to help themselves.

The war on hunger will continue for a long time. With our surpluses disposed of, we should abandon the quixotic goal of growing crops to meet most of the world's food shortages. We should formulate new policies—including massive support for birth control—designed to assist in many ways those who make an effort to help themselves.

—PHILIP H. ABELSON

* *Alternatives for Balancing World Food Production Needs* (Iowa State University Press, Ames, 1967).

procedure, presented evidence that the membrane conductance measured in the presence of potassium as the only internal and external cation is independent of ionic concentration from 550 m*M* to 100 m*M*, thus supporting the notion that the membrane has negative charges in the so-called potassium channel. Similar results were obtained with sodium as the only internal and external cation. The steady state conductance ratio, G_K to G_{Na}, was shown to be equal to 8 for concentrations of 550 m*M*.

J. E. Rose (Madison, Wisconsin) discussed the discharge characteristics of single auditory nerve fibers of the squirrel monkey. In a response to a tone of low frequency the discharges of a fiber are spaced at intervals which group around integral multiples of the period of the stimulating tone regardless of the frequency or intensity of an effective stimulus.

R. Santolaya (Mendoza, Argentina) examined the neurons in the gigantocellular nucleus of the medulla oblongata of the rat with electron microscopy. Three types of synaptic complexes were described: axodendritic, axosomatic and axoaxonic. Some axosomatic synapses exhibit the *en passant* modality. The amount and varieties of synapses in the neurons studied lead one to conclude that important temporospatial phenomena will occur in their mechanism of stimulation.

W. V. Slack (Madison, Wisconsin) discussed the use of the Laboratory Instrument Computer (LINC) to interview patients directly regarding their medical symptoms. A program dealing with the symptoms of allergy (presently being researched at the University of Wisconsin) was translated into Spanish and used to interview two patients from the University of Chile Hospitals. In addition, the use of the LINC to interview physicians directly regarding their findings on patient examination was described and demonstrated.

B. Weiss (Rochester, New York) gave two formal lectures and two sets of demonstrations devoted to the experimental analysis of behavior. The first lecture and set of demonstrations outlined the principles of behavior and their applications to investigations of the behavioral effects of drugs. The second lecture discussed the application of digital computers to the experimental analysis of behavior. The second set of demonstrations employed the LINC and an actual experiment with pigeons.

Its aim was to show how a computer might be programmed and interfaced for behavioral studies.

I. C. Whitfield (Birmingham, England) discussed the mechanisms in the auditory pathway concerned with the treatment of steady-state and time-dependent stimuli. The auditory cortex appears to be relatively unessential to the recognition of steady tones, whereas it is essential for the discrimination of temporal sound patterns. This is linked to the observation that in the cat, many neurones in the primary auditory cortex either do not respond to tonal stimuli at all, do so insecurely, or else respond indiscriminately to a very wide range of such stimuli. Many of these neurones respond, on the other hand, to changes of frequency and furthermore are responsive only when the change is in a particular direction.

Whitfield also discussed the effects of electrical stimulation of some centrifugal pathways in the auditory system on the thresholds of single neurones in the cochlear nucleus and described both increases and decreases in excitability produced by such stimulation. Some examples of the pharmacology of the centrifugal process were given in the form of a demonstration.

C. N. Woolsey (Madison, Wisconsin) presented new experimental data on the relations of the visual field to visual areas I and II of the cerebral cortex of the cat. This study extended the original work of Talbot and Marshall and of Talbot on the visual system of the cat by defining, for each cortical point examined in VI and VII, that portion of the visual field related to it. In general, cortical points related to central vision are activated from smaller field areas than points related to peripheral vision, and the fields for points in VII are larger than those for points in VI for the same parts of the visual field. The importance in single unit, visual cortical studies of considering where the cell is situated within the cortical localization pattern was emphasized.

C. N. Woolsey also read two lectures which had been prepared for delivery by E. V. Evarts (Bethesda, Maryland), who unfortunately was unable to attend. The first of these dealt with unit activity in the pyramidal tract during conditioned hand movement in the monkey. The second was concerned with the question of whether movements or muscles are represented in the cortex. The results of these studies on the activity of the pyramidal tract during learned behavior gave an exciting view of what may be accomplished in the performing animal with the unit recording method.

In addition to the papers described above, the following presentations were made: H. Adrian and W. Lifschitz (Santiago), "Functional organization of the auditory system"; O. Gutiérrez (Santiago), "Chromatic information and retina"; M. Palestini (Santiago), "Neurophysiology of sleep"; Teresa Pinto (Santiago), "Cortical functions in instrumental learning"; and A. Rojas (Santiago), "Functional organization of the visual cortex of the rat."

An important aspect of the seminar was a course on the use of the LINC computer in biological research offered by J. E. Rose (Madison, Wisconsin) and demonstrations with a LINC which was taken to Chile for the seminar from Washington University, St. Louis (C. Molnar).

Funds for the seminar were provided by grants from the U.S. Public Health Service (MH07345) and from IBRO-UNESCO. Expenses of non-Chilean participants were defrayed by a grant from WHO.

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Cancer Dissemination

The slow progress in clinical chemotherapy of malignancies, based largely on the lack of specificity of present drugs and the overlapping characteristics of tumor and normal tissues, prompted the convening of a meeting on cancer dissemination. It was felt that the invasiveness of tumor cells, leading to metastatic growth, might offer an opportunity for selective chemotherapy since this process does not occur with normal tissue. The meeting, held at the Istituto di Ricerche Farmacologiche "Mario Negri," Milan, Italy, 23 June 1967, was sponsored by the International Union against Cancer (UICC); Silvio Garattini, director of the "Istituto "Mario Negri" and chairman of the Committee on Experimental Chemotherapy of the UICC, was the organizer. A working party was attended by about 50 cancer scientists from 12 countries.

Under the topic of in vitro tests available for studying tumor cells, J. A. Forrester (Max Planck Institute, Munich) discussed the physical chemistry of cell adhesion and described his work employing the technique of electrophoresis of whole cells. The adhesiveness of the tumor cells is related to the charge density of the cell surface and the stiffness of the membrane. The enhanced surface charge of certain tumor cells, compared to the normal homologs of these cells, is believed to lead to increased stiffness of the cell membrane, to impair the ability of the cells to form adhesions, and thus to play a role in the leakage of tumor cells into other tissues. L. Morasca (Istituto "Mario Negri") described his method for counting visible tumor cells adhering to glass, based on the destruction of nonviable cells by trypsinization. A. F. Hermens (Radiobiological Institute, Rijswijk) discussed a plating technique developed to estimate viability of tumor cells. This procedure has allowed him to conclude that lymph nodes were relatively inefficient in filtering out tumor cells, but that most of the escaped tumor cells do not give rise to metastases. Similarly, J. Kvetina (Istituto "Mario Negri") used perfused livers to measure clearance of tumor cells from blood. Although cells were rapidly transferred to the liver, the number of malignant cells recovered in that organ was relatively low. J. Leighton (University of Pittsburgh) described the use of collagen-coated cellulose sponges as a matrix for organ culture. This technique allows the study of the invasiveness of tumor cells and the stepwise delineation of the growth-inhibitory effects of various agents. Leighton suggested that tumor cells destroyed normal cells by interposing themselves between the normal cells and the source of nutrient.

Concerning the subject of leakage of cancer cells, P. Strauli (Institut de Pathologie, Zurich) classified the processes of penetration of organs by the tumor cell as either by invasion or infiltration, depending in part on the cohesion of tumors. A. de Lemos Bastos (Instituto Portugues de Oncologia, Lisbon) described his studies on the leakage of secretory granules from tumor cells after supravital and vital staining by quinacrine. Evidence for the lysosomal nature of the intravital stained bodies was presented.

Various organs differ in their susceptibility to metastatic growth. R. Rosso (Istituto "Mario Negri") discussed the dissemination of tumor cells to lung and liver after their intracerebral injection. Efforts were made in the quantitation of circulating cancer cells by different methods of measurement. J. Leighton (University of Pittsburgh) reported on inoculation of chick embryos with tumors of varying malignancy. Whereas highly malignant rodent ascites cells produced extensive metastases in liver, lungs, kidney, chorioallantois, and brain, tumors of lower malignancy (for example, HeLa) produced no metastases except in the brain. In addition to the potential usefulness of this system for assaying relative malignancy of differing populations of neoplastic or transformed cells, this technique also provides the opportunity of studying the effects of drugs on metastasis formation with highly malignant cells in portions of the chorioallantoic membrane, the remaining membrane with its metastasis serving as a control. G. C. Easty (Chester Beatty Institute, London) reported that non-strain specific tumors injected into chick embryos grew in a number of organs, whereas most strain-specific tumors grew only in the brain, in spite of the relatively small share of tumor cells received by that tissue at the initial stage of intravascular dissemination. In general, the distribution of thymidine-labeled tumor cells in various organs was not related quantitatively to the sites of subsequent tumor growth. The inoculation of a single cell of rat ascites hepatoma into the rat resulted in metastases at characteristic sites and to predictable extents, according to Y. Sakurai (Cancer Institute, Tokyo). Other authors (K. Karrer, University of Vienna; S. R. Humphreys, NIH) reported preliminary studies on tumor metastasis to the lung and the effect of drugs on the formation of metastasis in vivo.

Unfortunately too little time was available for consideration of the topics of immunological responses of tumor cells, or the use of carcinostatic drugs. It was the consensus of the participants that an important beginning had been made in the examination of the problem of cancer dissemination, and that this complex subject is now ready for examination in greater depth. The Committee on Chemotherapy of the UICC is planning to stimulate further interest and exchange of information at a conference in about 2 years in the hope that more attention will be paid to the topic of prevention of tumor dissemination and the chemotherapy of primary versus metastatic tumor growth.

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Calendar of Events

National Meetings

November

27–29. American **Astronautical** Soc., natl. mtg., New York, N.Y. (N. Levin, Guidance and Control, Plant 35, Grumman Engineering Corp., Bethpage, N.Y. 11714)

27–29. **Computer Programming Management** Realities, New York, N.Y. (American Management Assoc., 135 W. 50 St., New York 10020)

27–30. **Entomological** Soc. of America, annual mtg., New York, N.Y. (R. H. Nelson, ESA, 4603 Calvert Rd., College Park, Md.)

27–1. **Chemical Industries**, New York, N.Y. (International Exposition Co., 200 Park Ave., New York 10017)

28. American Soc. of **Therapeutic Radiologists**, Chicago, Ill. (J. A. Del Regato, Penrose Cancer Hospital, Colorado Springs, Colo. 80907)

29–30. Society for **Industrial and Applied Mathematics**, fall mtg., Santa Barbara, Calif. (H. B. Hair, 33 S. 17 St., Philadelphia, Pa. 19103)

29–1. **Wire and Cable** Symp., Atlantic City, N.J. (J. Spergel, USAEC, Fort Monmouth, N.J. 07703, attn: AMSEL-KL-EE)

30–2. **Plastic and Maxillofacial Trauma** Symp., Washington, D.C. (L. C. Cramer, Temple Univ., Health Sciences Center, 3322 N. Broad St., Philadelphia, Pa. 19140)

30–3. American **Anthropological** Assoc., annual mtg., Washington, D.C. (C. Frantz, 1530 P St., NW, Washington, D.C. 20005)

December

1–2. American Assoc. of **Physicists in Medicine**, annual mtg., Chicago, Ill. (J. R. Cameron, Dept. of Radiology, University Hospital, Madison, Wis. 53706)

1–2. Association for **Research in Nervous and Mental Disorders**, annual mtg., New York, N.Y. (The Association, 700 W. 168 St., New York)

1–3. Academy of **Psychosomatic Medicine**, Houston, Tex. (E. Dunlop, 150 Emory St., Attleboro, Mass. 02703)

1–5. American Soc. of **Mechanical Engineers**, winter annual mtg., and Energy Conversion Exposition, New York, N.Y. (The Society, 345 E. 47 St., New York 10017)

2–7. American Acad. of **Dermatology and Syphilology**, 26th annual mtg., Chicago, Ill. (S. E. Huff, 1636 Church St., Evanston, Ill.)

3–5. **Pollution** Seminar, Tampa, Fla. (O. E. Bufe, Suite 12, 1056 Delta Ave., Cincinnati, Ohio 45208)

3–6. American Soc. of **Hospital Pharmacists**, 2nd annual clinical midyear mtg., Washington, D.C. (The Society, Dept. of Education and Training, 4630 Montgomery Ave., Washington, D.C. 20014)

4–6. **Chemical Research, Radiation and the Structure of Matter** Conf., Houston, Tex. (H. Eyring, Univ. of Utah, Salt Lake City)

4–6. **Missiles Systems**, Monterey, Calif. (American Inst. of Aeronautics and Astronautics, 1290 Sixth Ave., New York 10019)

5. American **Industrial Hygiene** Assoc., trisection mtg., Cherry Hill, N.J. (E. E. Christofano, Delaware Valley Section–AIHA, Hercules Inc., Wilmington, Del. 19899)

5–7. American **Astronomical** Soc., Philadelphia, Pa. (G. C. McVittie, Univ. of Illinois Observatory, Urbana)

5–7. **Mathematical Sciences Communications** Problems Conf., Providence, R.I. (American Mathematical Soc., P.O. Box 6248, Providence 02904)

5–7. **Vehicular** Conf., New York, N.Y. (J. R. Neubauer, 1013 Lakeshore Dr., Collingwood, N.J.)

6. Society of **Cosmetic Chemists**, annual mtg., New York, N.Y. (H. Isacoff, % IFF, Inc., 521 W. 57 St., New York 10019)

6–8. **Electric Furnace Steel** Conf., Chicago, Ill. (Executive Secretary, American Inst. of Mining, Metallurgical and Petroleum Engineers, 345 E. 47 St., New York 10017)

7. **Care of Persons Living with Heart Disease**, conf., New York, N.Y. (Conference Planning Committee, New York Heart Assoc., 10 Columbus Circle, New York 10019)

7–9. **Wire and Cable** Symp., Atlantic City, N.J. (J. Spergel, ASAEC, Fort Monmouth, N.J. 07703. Attn: AMSEL-KL-EE)

8–9. **Biological Interfaces**: Flows and Exchanges, symp., New York, N.Y. (Miss J. Newkirk, New York Heart Assoc., 10 Columbus Circle, New York 10019)

8–9. **Weathercasting**, 2nd conf., Tampa, Fla. (K. C. Spengler, 45 Beacon St., Boston, Mass. 02108)

10–13. American Acad. for **Cerebral Palsy**, annual mtg., San Francisco, Calif. (J. D. Russ, 1520 Louisiana Ave., New Orleans, La. 70115)

11–12. American **Chemical** Soc., Div. of Industrial and Engineering Chemistry, 33rd annual symp., Cambridge, Mass. (The Society, 1155 16th St., NW, Washington, D.C. 20036)

11–15. **Operating Metallurgy**, 3rd annual conf., Chicago, Ill. (J. V. Richard, Secretary, Metallurgical Soc. of AIME, 345 E. 47 St., New York 10017)

13–15. American Soc. of **Agricultural Engineers**, winter mtg., Detroit, Mich. (J. L. Butt, Executive Secretary, The Society, 420 Main St., St. Joseph, Mich. 49085)

15–17. American **Psychoanalytic** Assoc., fall mtg., New York, N.Y. (Mrs. H. Fischer, 1 E. 57 St., New York)

18–20. American **Physical** Soc., Pasadena, Calif. (W. Whaling, California Inst. of Technology, Pasadena 91109)

18–20. Nature of **Excited States**, symp., Riverside, Calif. (Symposium of Nature of Excited States, Dept. of Chemistry, Univ. of California, Riverside 92502)

26–31. American Assoc. for the **Advancement of Science**, 134th annual mtg., New York, N.Y. (W. G. Berl, AAAS, 1515 Massachusetts Ave., NW, Washington, D.C. 20005)

26–31. American **Meteorological** Soc., mtg., New York, N.Y. (K. C. Spengler, 45 Beacon St., Boston, Mass. 02108)

26–31. **Ecological** Soc. of America, New York, N.Y. (S. I. Auerbach, % Ecology

Section, Health Physics Div., ORNL, Oak Ridge, Tenn.)

26–31. Society for **General Systems Research**, New York, N.Y. (M. D. Rubin, Mitre Corp., Bedford Mass.)

27–28. Association for **Symbolic Logic**, annual mtg., Boston, Mass. (J. F. Thomson, Room 14N-430, Massachusetts Inst. of Technology, Cambridge 02139)

27–29. American **Marketing** Assoc., natl. conf., Washington, D.C. (E. G. Johnson, 230 N. Michigan Ave., Chicago, Ill. 60601)

27–30. American **Statistical** Assoc., 127th annual mtg., Washington, D.C. (The Association, 810 18th St., NW, Washington, D.C. 20006).

27–30. Institute of **Mathematical Statistics**, 30th annual mtg., Washington, D.C. (G. E. Nicholson, Dept. of Statistics, Univ. of North Carolina, Chapel Hill 21515)

27–30. **Linguistic** Soc. of America, annual mtg., Chicago, Ill. (A. A. Hill, Box 8120, University Station, Austin, Tex. 78712)

28–29. **Industrial Relations Research** Assoc., 20th annual mtg., Washington, D.C. (D. B. Johnson, Social Science Bldg., Univ. of Wisconsin, Madison 53706)

28–30. **Econometric** Soc., annual mtg., Washington, D.C. (Administrative Assistant, The Society, Box 1264, Yale Station, New Haven, Conn.)

29. **Scientific Research** Society of America, New York, N.Y. (D. B. Prentice, 155 Whitney Ave., New Haven, Conn.)

International and Foreign Meetings

December

1–7. International Congr. of **Pediatrics**, 12th, Mexico City, Mexico. (L. Benavides, president, Hospital Infantil de Mexico, Dr. Marquez 162, Mexico 7, DF, Mexico)

2–8. Pan African Congr. on **Prehistory and Quaternary Studies**, 6th, Dakar, Senegal. (Secretary General, 6th C.P.P.E.Q., % I.F.A.N., B.P.206, Dakar, Senegal)

3–5. American Soc of **Hematology**, annual mtg., Toronto, Ontario, Canada. (J. F. Mustard, Blood and Vascular Disease Research Unit, Univ. of Toronto, Toronto 5)

3–6. International **Air Safety** Seminar, 20th annual, Williamsburg, Va. (Flight Safety Foundation, 468 Park Ave. S., New York 10016)

4–7. **Solidification in Metals and Alloys**, conf., Brighton, England. (Iron and Steel Inst., 4 Grosvenor Gardens, London, S.W.1)

4–8. International **Air Transport** Assoc., 23rd mtg., Manila, Philippines (Philippine Air Lines, IBM Building, 5, Pl. Ville Marie, Montreal 2, Quebec, Canada)

4–8. **Isotopes and Radiation in Entomology**, symp., Vienna, Austria. (Intern. Atomic Energy Agency, Karntner Ring 11, Vienna 1, Austria)

4–8. Prospects and Problems of **Nuclear Power Applications in Developing Countries**, study group meeting, Santiago, Chile (Intern. Atomic Energy Agency, Karntner Ring 11, Vienna 1, Austria)

4–14. Application of **Science and Technology for the Development of Asia**, conf., Castasis, Asia. (United Nations Educational, Scientific, and Cultural Organization, Pl. de Fontenoy, Paris 7, France)

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(Continued from page 900)

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