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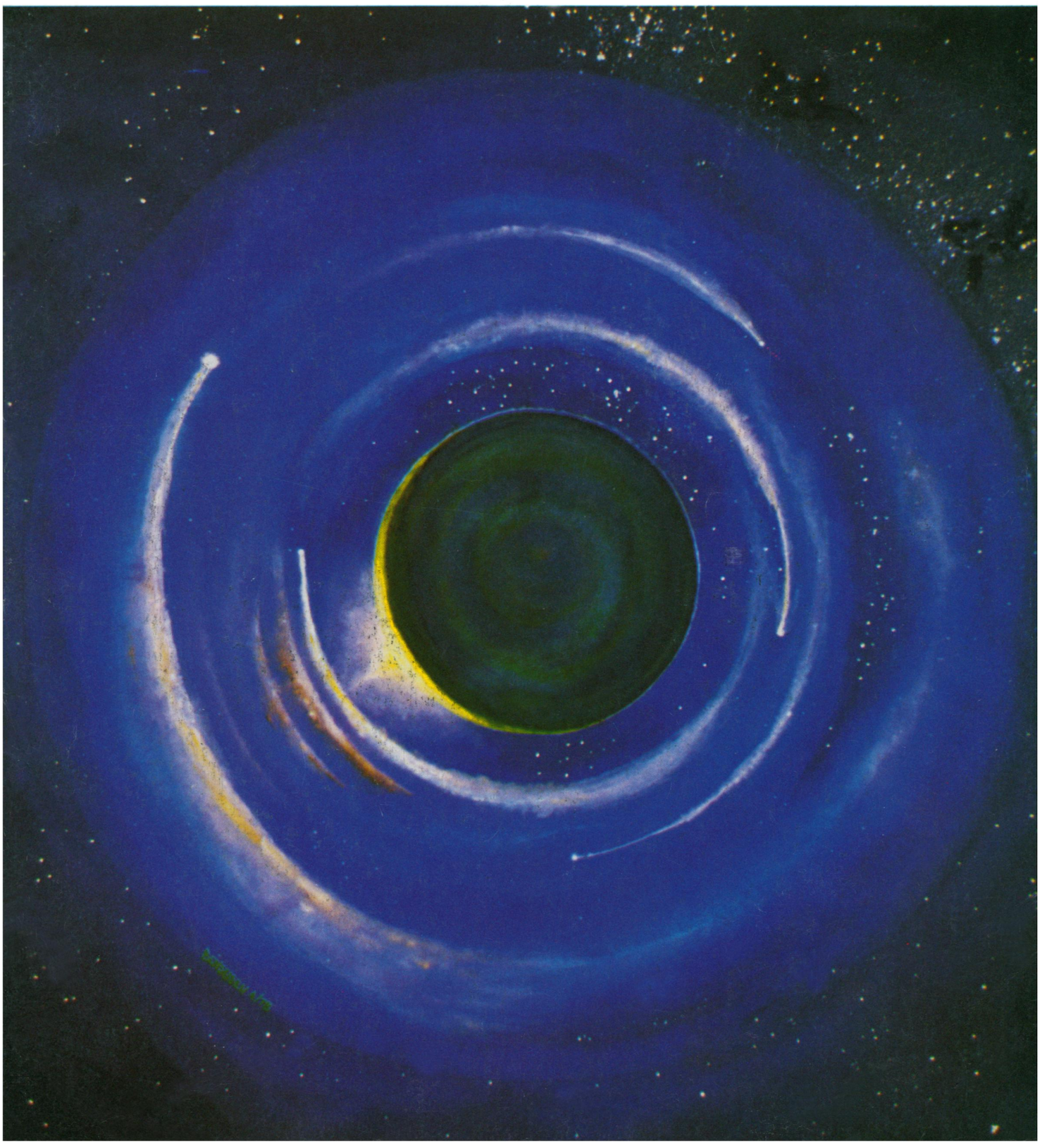

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COVER

Artist's conception of a new model for the rings of Uranus. Individual satellites shed gaseous material in their wakes, which refract starlight. Viewed from Uranus' shadow, the rings might scatter enough sunlight to become visible. See page 1076. [© Sally Bensusen, U.S. Naval Observatory, Washington, D.C.]

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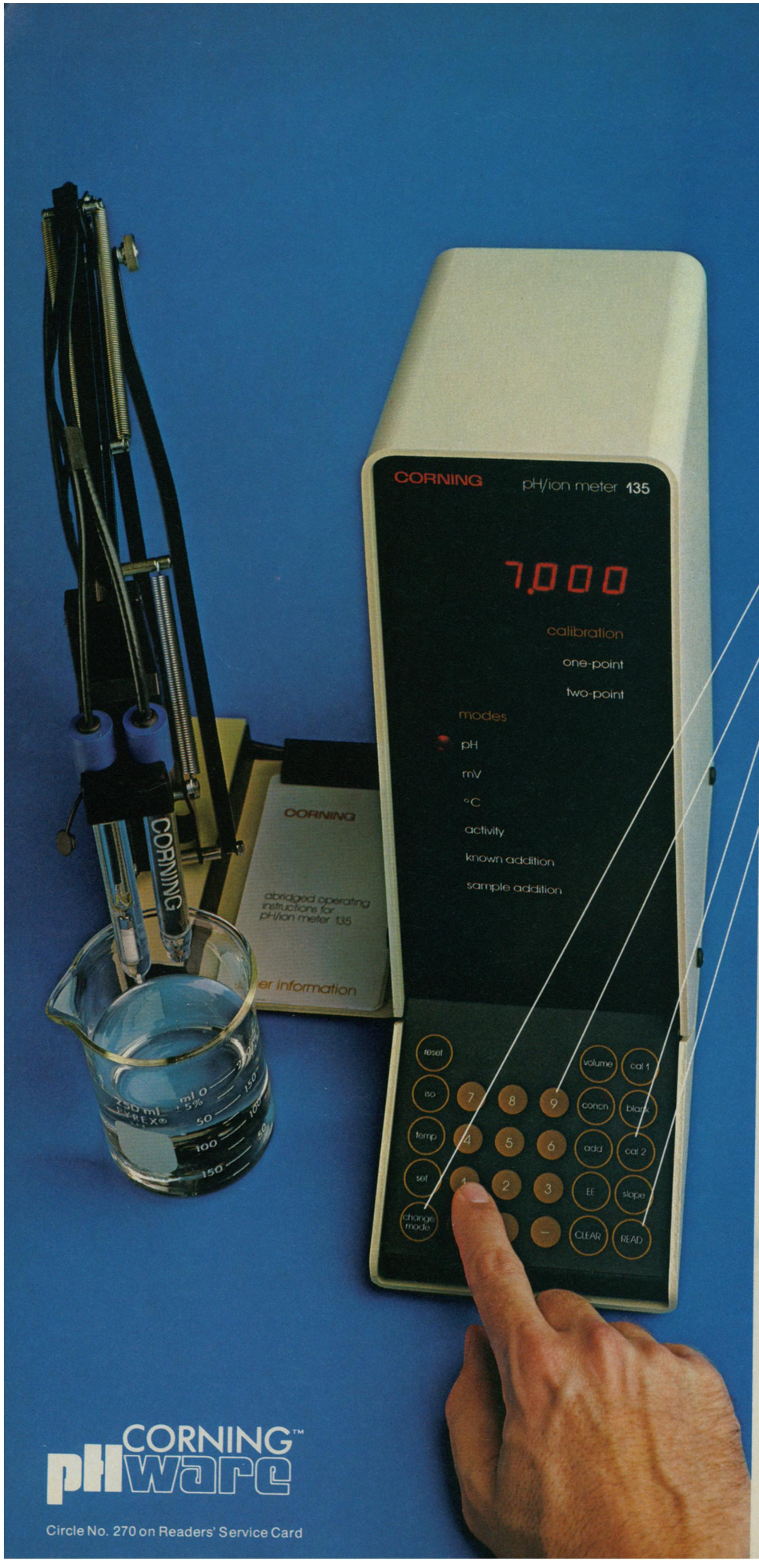

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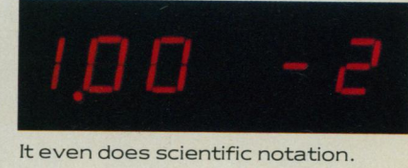

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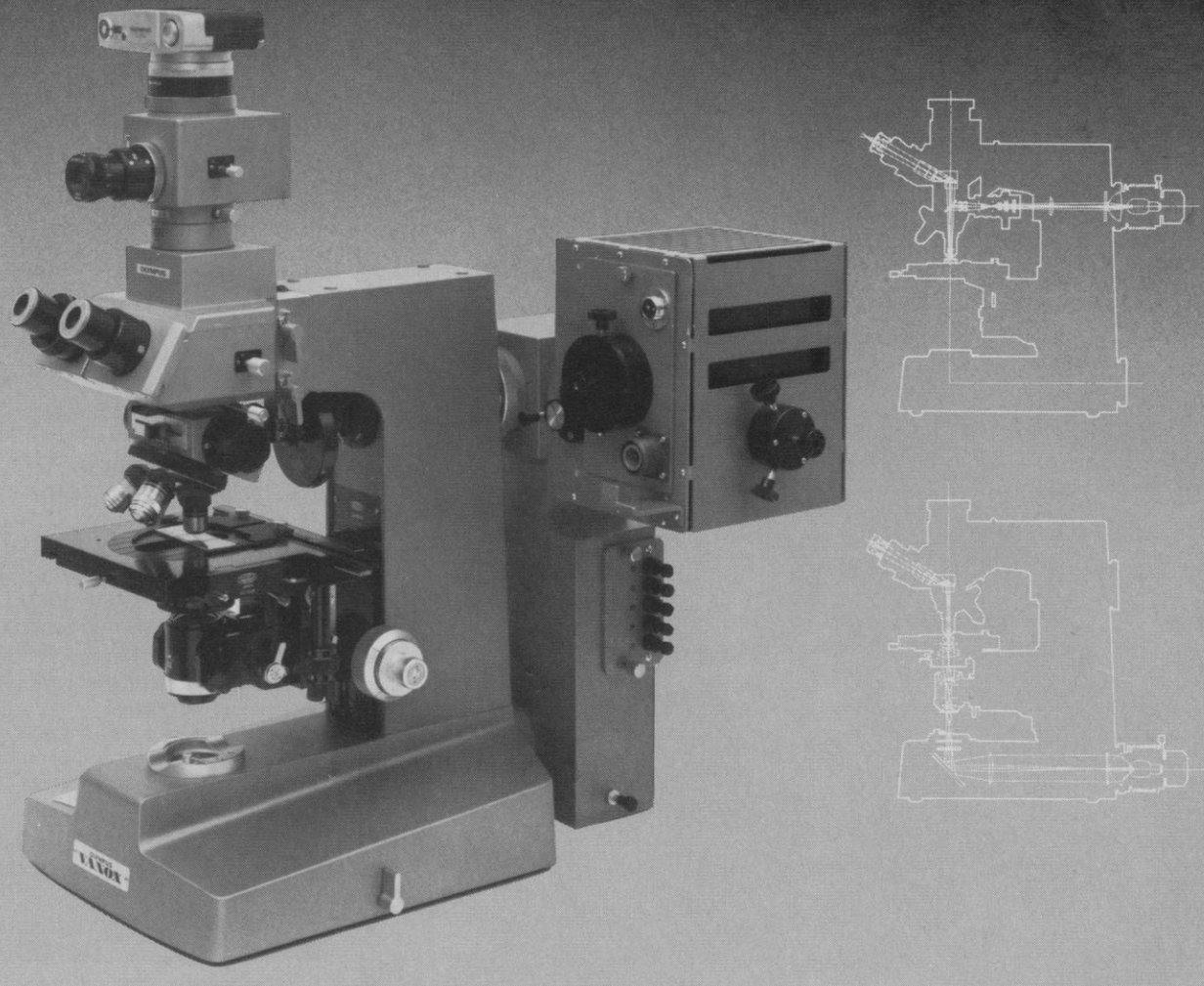

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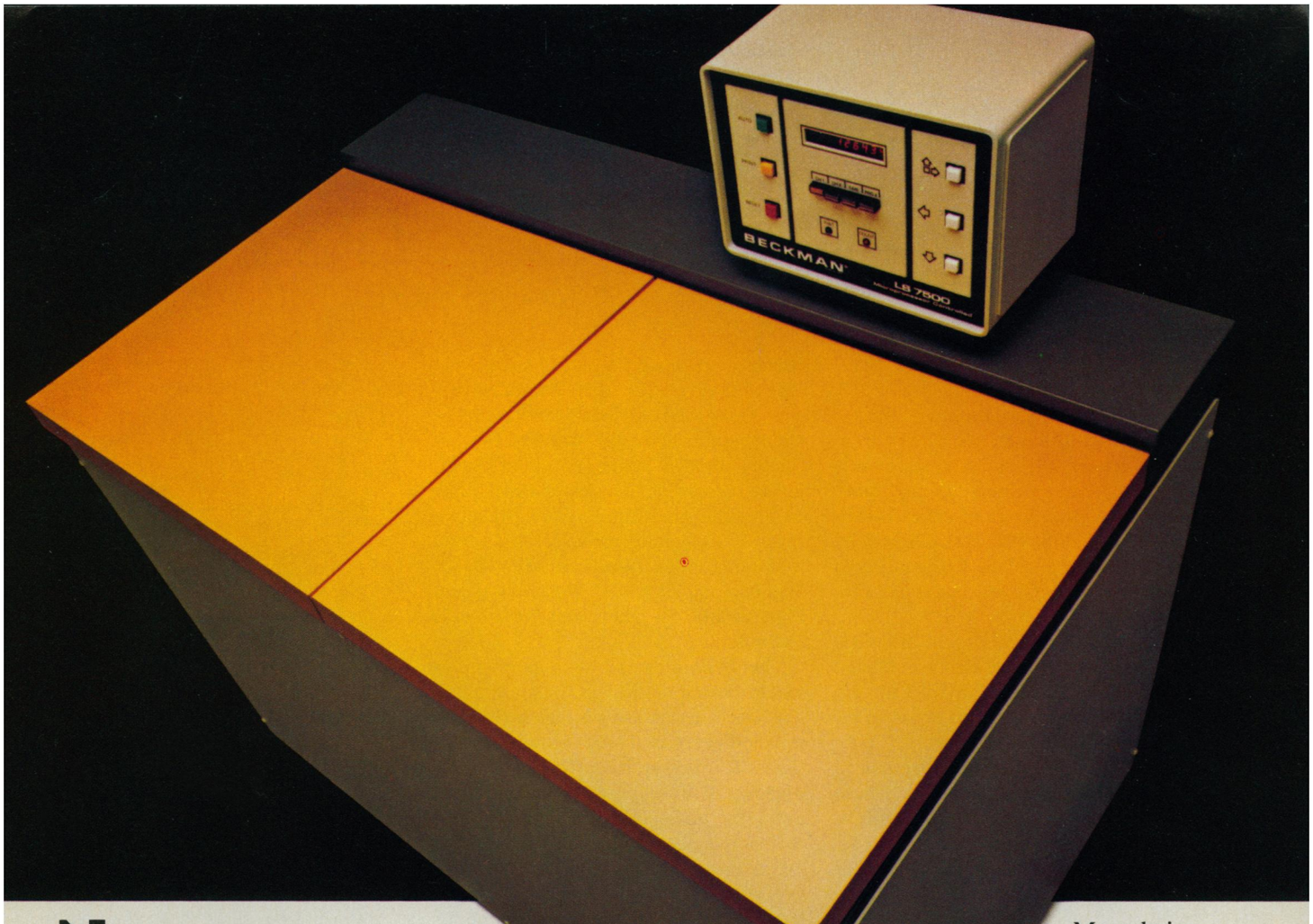

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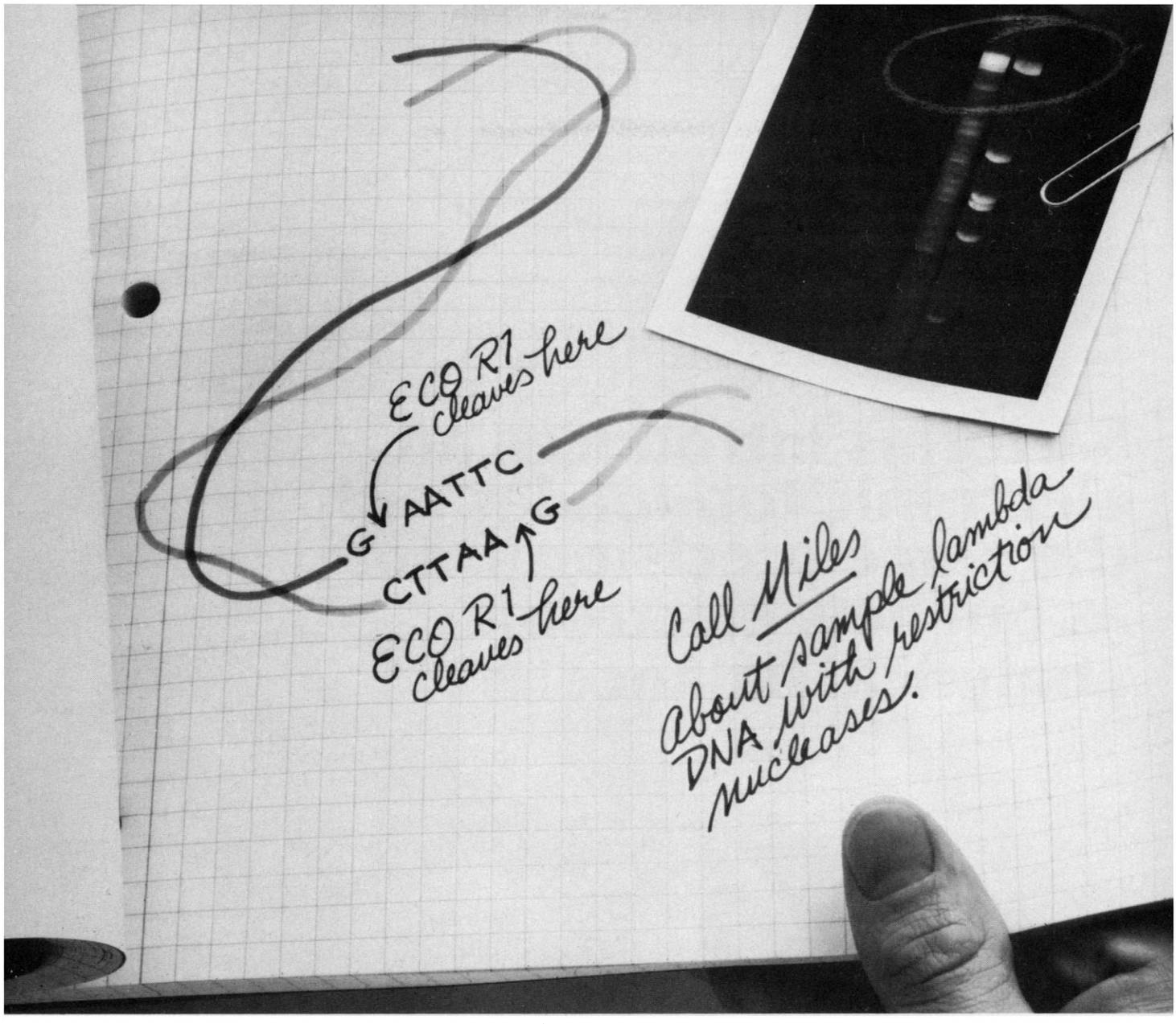

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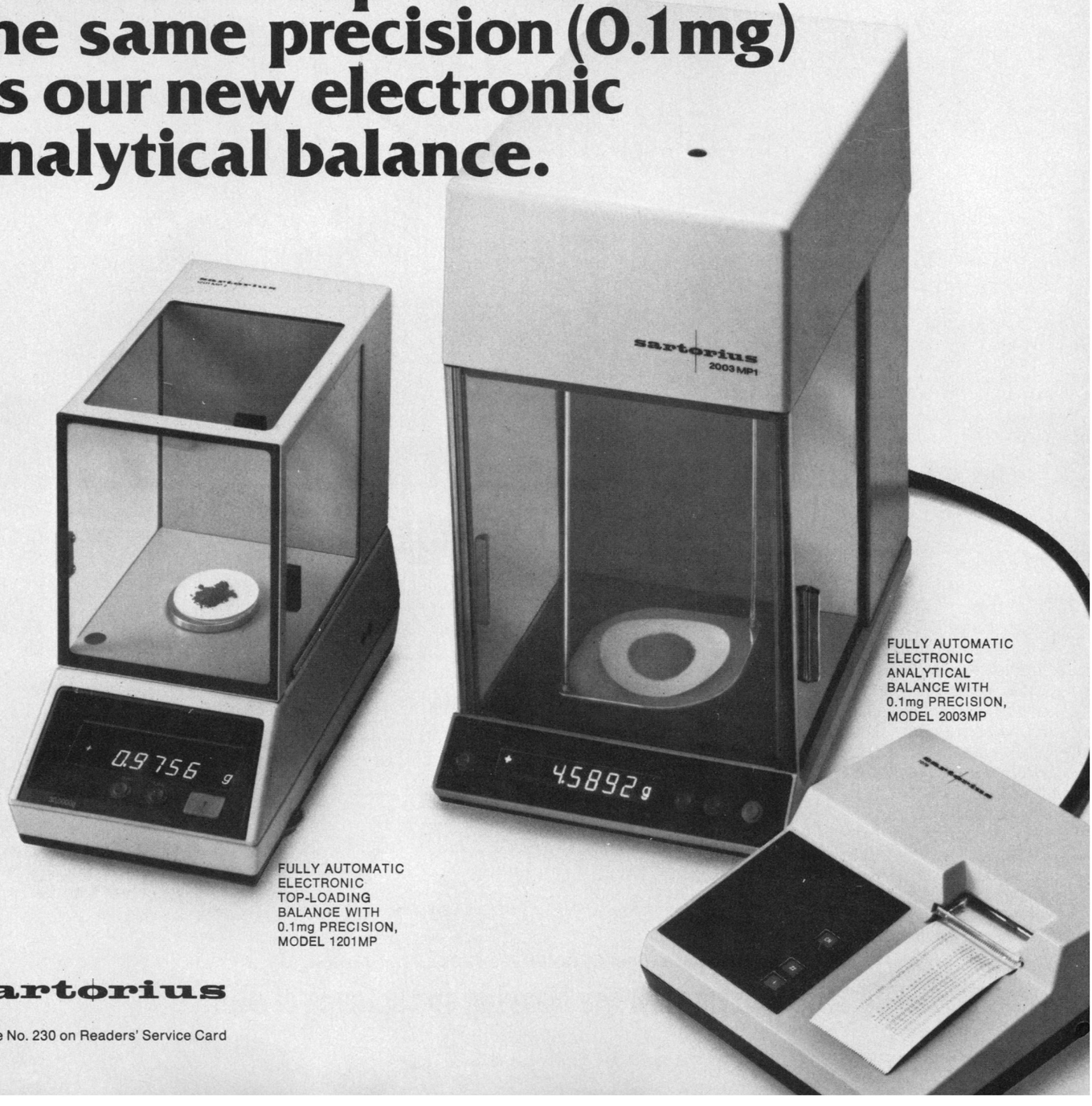

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had met a Margaret Howard in the psychology department at University College in the late 1930's (*4, 6*). Arthur Jensen later said (*15*) that Howard was a faculty member in the mathematics department of the University of London. Cohen never said this, and there is no evidence to support the claim.

After Cohen's report, I intensified efforts to find evidence of the existence of Howard and Conway—without success. I have written to more than 250 of Burt's former pupils and colleagues whose addresses were available from the British Psychological Association. Among some 100 who replied, none said they remember Howard or Conway. Burt refers to Howard's having mathematical expertise (*16*), but there is no record of a Margaret Howard graduating in mathematics from any university in the British Isles, Ireland, Canada, Australia, New Zealand, or South Africa at the relevant time. A Miss M. A. Howard, of 39 Brunswick Square, London WC1, is listed among the members of the British Psychological Society in 1924 (*17*), but she is not listed in earlier or subsequent lists. No further information about her is available because the records of the society were entirely destroyed by fire in 1946.

Recently Donald G. MacRae of the London School of Economics reported meeting a Miss Howard in 1949 or 1950 (*18*). She delivered to him corrected proofs of a journal article written by Burt. Nevertheless, a mystery remains. Burt told his housekeeper and secretary, Grete Archer, that Howard had emigrated when Archer asked Burt if she could send Howard reprints of the articles Howard had written with Burt (*19*). Burt also said that he did not have her address abroad. Furthermore, Archer says that she typed the papers published under the joint names of Burt and Howard and that Burt himself actually wrote them (*19*). During this period, 1952 to 1963, when Howard was said to be abroad and out of touch, Howard co-authored with Burt three full-length papers and a note and also published a full paper and three book reviews under her name alone (*20*).

By 1969 Burt was apparently in touch with Howard again, according to a letter he wrote to Douglas Pidgeon of the National Foundation of Educational Research (*21, 22*). However, Burt's secretary, Archer, never met Howard, and furthermore no correspondence with Howard and no reference to her in Burt's appointment diaries can be found (*23*). It is extraordinary that someone with such a long career in science cannot be identified with certainty, that no one has come forward who actually knows who she was, and that no documentary evidence can be found for her existence.

Conway's case is even more curious. No one has emerged who knows anything at all about her. She is referred to by Burt in a paper of 1943 (*24*) but did not publish until 1958 and 1959 (*25, 26*), when she appears as sole author of papers in the journal edited by Burt, giving her address as Psychology Department, University College, London. She is referred to again in a paper of 1961 (*27*) and wrote two book reviews in 1959 and 1960 (*28, 29*). University College, London University, and the London Day Training College have no record of Conway. Further checks have proved more difficult because her first name is not known. Arthur Jensen has given her the name Jane (*3*), but I can find no documentary evidence for this forename. Those Miss J. Conways I have traced through records in other British universities have failed to have any connection with Burt.

Again Burt's papers contain no correspondence with Conway nor any record of appointments to see her. Burt told his secretary and others that Conway, like Howard, had emigrated. Archer understood they had emigrated before she joined Burt as housekeeper in 1950. Yet in 1955 Burt reported that Conway was collecting data and undertaking final computations (*30*). Between 1955 and 1958, when her first publication appeared, Conway seems to have doubled the number of separated identical twin pairs from 21 to 42 (*25*). Between 1958 and 1959, the number of twins analyzed appears to increase again by an unspecified number (*26*). By 1966, Burt had further increased the number of his separated monozygotic twin pairs by 11 to a total of 53, by now the largest sample in the world (*31*), although he himself had long before given up field work. This evidence for fraud has been pointed out by Ann Clarke of Hull University (*5, 11*), who with her husband Alan and Michael McAskie first suggested fraud in Burt's work.

The careers of Howard and Conway, outlined here, require explanation before credibility can be given to Burt's work. If these ladies did exist, and this now seems possible at least for Howard, the evidence suggests that they are not the people Burt said they were and that they did not do at least some of the things that he said they did.

I had no difficulty tracing other less-well-known students or associates of Burt's who are mentioned only in footnotes: for example, Miss Richardson, Miss Pelling, and Miss Molteno. Eliza-

beth Virginia Molteno is particularly interesting because Burt acknowledges her help, together with that of Howard and Conway, in finding twins (*24*). I have been in touch with Miss Molteno, now Mrs. Moody, who tells me that she never knew Howard or Conway; but even more curious, she never assisted Burt with his research work as Burt said she did, although she did study in his department and did publish work on twins with R. B. Cattell (*32*). This suggests the mechanism of the alleged fraud: Burt used the name of a real person and attributed work to her that she did not do.

Other evidence of fraud is not lacking. A third lady, M. G. O'Connor, whom Burt describes as an "Irish ex-student of mine" (*33*), cannot be found anywhere in Great Britain or Ireland. She was said by Burt to have assisted him with research on the the alleged decline in ability of London schoolchildren between 1914 and 1965, which was used in an article by Burt associated with an attack on comprehensive (nonselective) schools (*22, 34*).

Finally, crucial references that are supposed to supply details of Burt's experimental method cannot be traced. In the first major summary of his kinship studies (*24*, p. 89), published in 1943, for example, Burt refers to LCC (London County Council) reports, written when he was the LCC psychologist, as the source of his data. In a bibliography (*35*) based on information supplied by Burt and published in 1951, seven of these reports are listed as published by King and Son in the years 1914 to 1930. However, only three of these were ever published (in one volume), according to records of the LCC and King and Son (*36*).

Burt's whole corpus of work must now be suspect. Yet a little more than a year ago, his "classic" book *The Subnormal Mind* was republished (*37*) with a foreword by Hans J. Eysenck praising Burt's work. Elsewhere Eysenck has described Burt's work as "particularly valuable . . . because of the outstanding quality of design and statistical treatment of the studies" (*38*). Jensen described Burt's work as the "most satisfactory attempt to estimate the influence of heredity upon intelligence" (*39*) but later was among the first to point out errors (*40*). Burt's work has also been endorsed by at least three Fellows of the Royal Society: C. D. Darlington, J. L. Jinks, and J. A. Fraser Roberts; and has in addition had the backing of at least one Nobel laureate: William Shockley. And Cohen has described Burt as an "illustrious scholar" and a "polymath of Renaissance dimensions" (*9*). The time has now come to

ask why Burt's work was looked at so uncritically by psychologists and others for such a long time. The answer might tell us something important about the role that power, charisma, and wishful thinking can play in bolstering support for scientific theory.

OLIVER GILLIE

Sunday Times,
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8 June 1979, Volume 204, Number 4397 **SCIENCE**

The Quiet Shops of Academe

Recently, through a chance combination of circumstances, I visited the instrument and machine-shop facilities of eight large universities across the country within a 3-week period. With a few exceptions, the scene was uniformly depressing. Most of the shops were spacious, well lit, and filled with serviceable machinery, but hardly a spindle was turning. A few gray-haired artisans bent to their projects, usually small ones, but the generally low-level of activity was obvious. With no work in the chucks, no partly done projects heaped on the floor waiting their turn, and few young apprentices learning the craft, an important national resource is clearly wasting away.

Two of the eight shops, indeed, were not in such a desperate state. It was easy to see the reasons for the exceptions. A large well-funded oceanographic institution was the mainstay for the busiest of the shops, and youthful machine operators were at work learning the trade. The next busiest was the smallest of the facilities I saw, and two large jobs in its relatively cramped quarters gave an exaggerated air of activity. Of the remaining six, one was moderately active, working close to half capacity, but even there I saw no evidence of young apprentices.

The difficulties of keeping large instrument shops going is no secret, of course, but each of us thinks that his own university has a special problem. The condition is not sporadic, but general. One might argue that the age of carrying out large, innovative projects within the universities is finished, as massive technological growth in all sectors of the economy outruns the university facilities. The university researcher now travels to the great national facilities or else conducts work by reading catalogs, writing specifications, and hooking things together after they are delivered. In fact, this is not the case. The growth of technology has widened enormously the selection of materials and devices that the experimenter can use. There are more possibilities for innovative work in university laboratories, not fewer, and the more creative the work, the higher the likelihood that special devices and jigs will be needed. American science has been characterized by action, by invention, by building, and by the day-to-day involvement of the experimenter with his apparatus. The present necessity of ordering finished instruments instead of engineering one's own has been forced by the financial squeeze on most areas of pure science. Engineering new systems is expensive, and the nation is not willing to pay the price.

Many of us maintain our own more specialized instrumental construction facilities, usually centered on the talents of a few skilled engineers and technicians. This traditional mode serves for many purposes but the system lacks flexibility, and we all experience the need to go outside for specialized jobs, especially for larger projects, or when the small groups have a fluctuation of too much work. This often means that new ideas are not followed up. The costs of going outside may be beyond our budgets, or the time delay unacceptably large, especially when the work must be done in an industrial shop, and we simply take another direction. The process is strongly reinforcing, and as the ability to place jobs in the university shop goes down, so does its financial base; the rates go up, and even fewer are willing or able to use it facilities.

The fundamental structure of federal research funding, as set up by Congress and as administered by the agencies, is responsible for the weakening state of technological and scientific innovation. A national resource is being allowed to waste away through national policies that show no signs of changing. Once that resource is gone, it will not be easy to rebuild. More seriously still, the conditions that foster new ideas in the laboratory will atrophy as well, with a longer time lag. That spirit of doing new things has a long history of careful nurture, and once gone it will be far more elusive to recapture.—BERNARD BURKE, *Department of Physics, Massachusetts Institute of Technology, Cambridge 02139*

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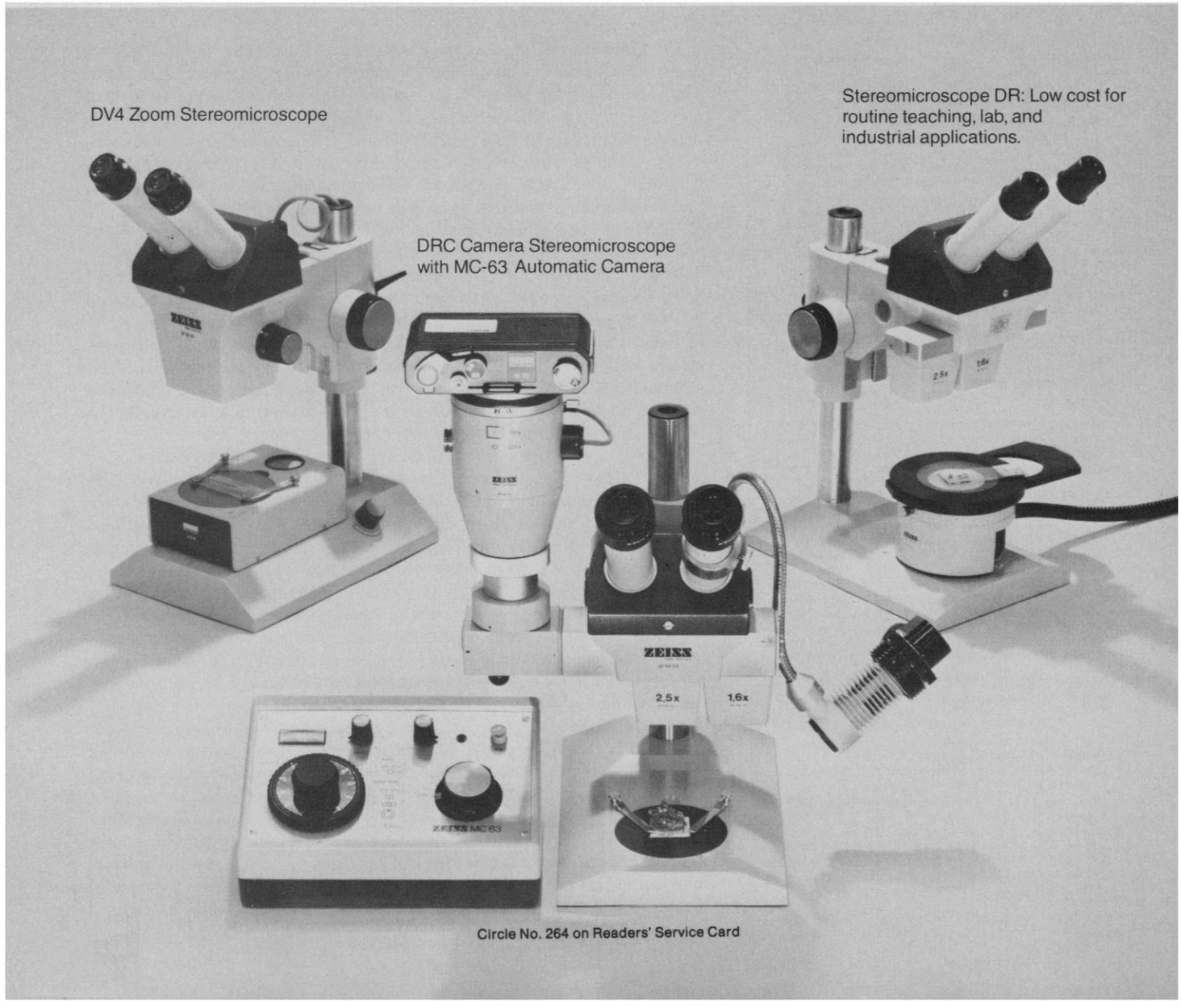

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PRODUCTS and MATERIALS

Laboratory Freezer

Model 8332 operates down to −75°C. Its capacity is 3 cubic feet. The interior is constructed of stainless steel and has 5-inch, foamed-in-place urethane insulation. Integral controls feature a ring-back alarm system with self-charging nickel-cadmium batteries. The lid is counterbalanced. Forma Scientific. Circle 808.

Centrifuge for Blood Components

Model J-6B is a large-capacity, refrigerated centrifuge for the preparation of blood components. It can accommodate up to six blood bags per operation or it can process large numbers of radioimmunoassay tubes or microtitration plates. Five large-volume rotors are available for the J-6B. A chart accompanies the instrument to indicate appropriate method, temperature, rotor, speed, force, time, and brake setting for various blood bank and plasmapheresis methods. Beckman Instruments, Spinco Division. Circle 810.

Data Acquisition System

System 3500 is suitable for multichannel analysis, multichannel scaling, signal averaging, transient recording and general CAMAC acquisition and control. Various modules may be added to the system based on the user's needs. The system can accept eight simultaneous inputs from any combination of modules with data transfer of 1 microsecond per module. LeCroy Research Systems. Circle 814.

Newly offered instrumentation, apparatus, and laboratory materials of interest to researchers in all disciplines in academic, industrial, and government organizations are featured in this space. Emphasis is given to purpose, chief characteristics, and availability of products and materials. Endorsement by *Science* or AAAS is not implied. Additional information may be obtained from the manufacturers or suppliers named by circling the appropriate number on the Reader Service Card (on pages 1030A and 1126A) and placing it in the mailbox. Postage is free.

—RICHARD G. SOMMER

Blood Chemistry Analysis

Chemcode is a microcomputer-controlled photometric system for clinical chemistry. The system may be set up to run up to 16 routine tests and there are four open channels that may be programmed for special operations. Tests may be performed for substrate concentration or enzyme activity by end-point, kinetic, or fixed-point mode. Results are available in seconds for up to 60 or more kinetic tests or for about 250 end-point tests per hour. Digital readout includes test factors, absorbances, and results and a printout documents test parameters and results. An audio signal, a readout, and a red printout indicate errors. Bio-Dynamics/bmc. Circle 785.

Volumetric Collection for Liquid Chromatography

The Minipuls peristaltic pump interfaces with fraction collectors to collect uniform volumes from liquid columns. The pump produces output signals that divide the constant flow into volume increments. Based on the flow rate, each signal corresponds to a particular delivered volume. The collector counts these increments and changes receptacles when the appropriate sample volume is reached. Gilson Medical Electronics. Circle 809.

Radiopharmaceutical Analyzer

The QA analyzer rapidly determines the percent of bound radionuclide with a direct readout. Analysis is accomplished in 30 seconds with ±3 percent repeatability. The operator places a chromatographic test strip on a stainless steel positioner, selects the appropriate counting range and presses the start button. Maximum rate is 300,000 counts per minute. Accuracy is ±3 percent at 1,000 counts; ±1 percent at 10,000 counts; and ±0.5 percent at 50,000 counts. New England Applied Research. Circle 812.

Spectrometer

The XL-200 is a superconducting, Fourier-transform, nuclear magnetic resonance system. It features a low-loss Dewar unit that surrounds a magnet system which can operate over 3 months on a single fill of 25 liters of liquid helium. The system features data processing and microprocessor control including programmable operation. The probe is constructed in two sections: the upper barrel houses the spinning mechanism, tachometer sensor, and sample tube ejector; the lower barrel is removable. It accommodates the samples of various sizes or frequency ranges. Varian Instrument Group. Circle 811.

Optical Scanner

Model 502 Image Analysis System provides resolution of 0.2 micrometer per pixel over a 50-micrometer field. This yields a grid of 256 by 256 pixel images. Each pixel is digitized to a gray scale of eight binary bits. The system is microprocessor-controlled. It uses oscillating mirrors and photomultiplication and detection to achieve a signal-to-noise ratio better than 46 db. An *x-y* stage is included and provision is made for various image-processing algorithms. Stahl Research. Circle 813.

Literature

Programming System is the topic of SAS-79, an expanded software operating package. SAS Institute. Circle 791.

Special Glass Tubing catalogs a line of precision laboratory materials. Vitro Dynamics. Circle 792.

Pipettes and Laboratory Disposables details an extensive line of scientific products. Centaur Sciences. Circle 794.

Humidity Measuring is devoted to the Rotronic line of probes, displays, recorders, and accessories. Kaymont Instrument. Circle 815.

Microwave Power describes a line of power supplies and test equipment for biology and medicine. Cober Electronics. Circle 816.

Photoinvertoscopes features two inverted, transmitted-light microscopes, models IM 35 and ICM 405, for tissue culture, limnologic, and other biologic applications. Carl Zeiss. Circle 817.

Cytology, Histology and Pathology Tools includes centrifuges, slide stainers, microtome knife sharpeners, tissue processors, and other devices. Shandon Southern Instrument. Circle 819.

BOOKS RECEIVED AND BOOK ORDER SERVICE

(Continued from page 1075)

Current Topics in Microbiology and Immunology, 80. W. Arber and 12 others, Eds. Springer-Verlag, New York, 1978. iv, 172 pp., illus. $34. *To order circle 613 on Reader Service Card.*

Detection of Optical and Infrared Radiation. R. H. Kingston, Springer-Verlag, New York, 1978. viii, 142 pp., illus. $18.80. Springer Series in Optical Sciences, vol. 10. *To order circle 624 on Reader Service Card.*

Earthquake Resistant Building Design and Construction. Norman B. Green. Van Nostrand Reinhold, New York, 1978. xii, 172 pp. *To order circle 602 on Reader Service Card.*

Ecologic Human Biology in Japan. Eiji Takahashi. Medical Information Services, Tokyo, 1978. xii, 218 pp., illus. ¥ 5500.

Effects of Ionizing Radiation on DNA. Physical, Chemical and Biological Aspects. J. Hüttermann, W. Köhnlein, R. Téoule, and A. J. Bertinchamps, Eds. Springer-Verlag, New York, 1978. xxii, 384 pp., illus. $43. Molecular Biology, Biochemistry and Biophysics, 27. *To order circle 648 on Reader Service Card.*

Electronic Structure of Nobel Metals, and Polariton-Mediated Light Scattering. Contributions by B. Bendow and B. Lengeler. Springer-Verlag, New York, 1978. vi, 116 pp., illus. $24. Springer Tracts in Modern Physics, vol. 82. *To order circle 625 on Reader Service Card.*

Elements of System-Dynamics Simulation. A Textbook with Exercises. Th. J. Ferrari. Halsted (Wiley), New York, 1978. vi, 90 pp., illus. Paper, $11.95.

Endocrine Control in Neoplasia. Rameshwar K. Sharma and W. E. Criss, Eds. Raven, New York, 1978. xiv, 378 pp., illus. $32. Progress in Cancer Research and Therapy, vol. 9.

Energy and the Chemical Sciences. Papers from a symposium, Norman, Okla., May 1977. S. D. Christian and J. J. Zuckerman, Eds. Pergamon, New York, 1978. xiv, 144 pp., illus. $19.50. *To order circle 626 on Reader Service Card.*

Energy Conversion Engineering. Richard C. Bailie. Addison-Wesley Advanced Book Program, Reading, Mass., 1978. xviii, 538 pp., illus. $19.50. Energy Science and Technology, No. 1. *To order circle 627 on Reader Service Card.*

Few Body Systems and Nuclear Forces I. Papers from a conference, Graz, Austria, Aug. 1978. H. Zingl, M. Haftel, and H. Zankel, Eds. Springer-Verlag, New York, 1978. xx, 442 pp., illus. Paper, $18.50. Lecture Notes in Physics, vol. 82. *To order circle 628 on Reader Service Card.*

Geometrical Probability and Biological Structures. Buffon's 200th Anniversary. Proceedings of a symposium, Paris, June 1977. R. E. Miles and J. Serra, Eds. Springer-Verlag, New York, 1978. xii, 340 pp., illus. Paper, $13.50. Lecture Notes in Biomathematics, vol. 23. *To order circle 629 on Reader Service Card.*

Die Gewebe des Menschen und der Säugetiere. Ein Atlas Zum Studium für Mediziner und Biologen. Radivoj V. Krstić. Springer-Verlag, New York, 1978. xii, 402 pp. Paper, $29. *To order circle 603 on Reader Service Card.*

The Golden Age of Theoretical Ecology: 1923–1940. A Collection of Works by V. Volterra, V. A. Kostitzin. A. J. Lotka, and A. N. Kolmogoroff. Francesco M. Scudo and James R. Ziegler, Eds. Springer-Verlag, New York, 1978. xii, 492 pp. Paper, $21. Lecture Notes in Biomathematics, vol. 22. *To order circle 604 on Reader Service Card.*

Greenhouse Management. Joe J. Hanan, Winfred D. Holley, and Kenneth L. Goldsberry. Springer-Verlag, New York, 1978. xiv, 532 pp., illus. $47. Advanced Series in Agricultural Sciences 5. *To order circle 630 on Reader Service Card.*

Group Psychotherapy. Theory and Practice. Hugh Mullan and Max Rosenbaum. Free Press (Macmillan), New York, and Collier Macmillan, London, ed. 2, 1978. xiv, 418 pp., illus. $17.95.

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Hydrogen in Metals I. Basic Properties. G. Alefeld and J. Völkl, Eds. Springer-Verlag, New York, 1978. xvi, 426 pp., illus. $49. Topics in Applied Physics, vol. 28. *To order circle 632 on Reader Service Card.*

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In the Spirit of Enterprise. From the Rolex Awards. Gregory B. Stone, Ed. Freeman, San Francisco, 1978. xxii, 360 pp., illus. $6.95.

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