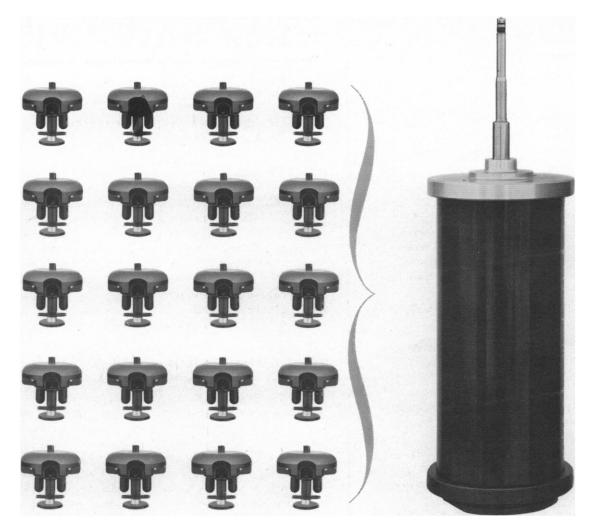
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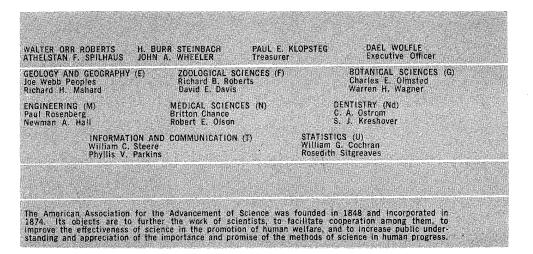


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#### COVER

The structure of the meteorite, which has 16 percent nickel (by weight) is intermediate between a fine octahedrite and an ataxite. The large kamacite plates make up the well-defined Widmanstätten pattern typical of the octahedrites. The interior areas between the kamacite plates of the major pattern are regions of transformed taenite (plessite) which contain a micro-Widmanstätten pattern sometimes found in the ataxites. This micropattern formed late in the meteorite's cooling history (about  $\times$  35). See pages 975 and 976. [J. I. Goldtain and P. Soular NASA1

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in teaching aids to put together and take apart; to teach, to study, and to use

PP,

 in instruments to scrape and slice, to clip and cut and clamp
 in machines to mix and separate; to shake, rotate and incubate

in equipment to collect, dilute; to time and measure and weigh; to view, to type, to count

Wherever biomedical people are learning, practicing, teaching— Clay-Adams quality is there—as it has been for more than half a century.

26 AUGUST 1966

# We approach

# from many angles...

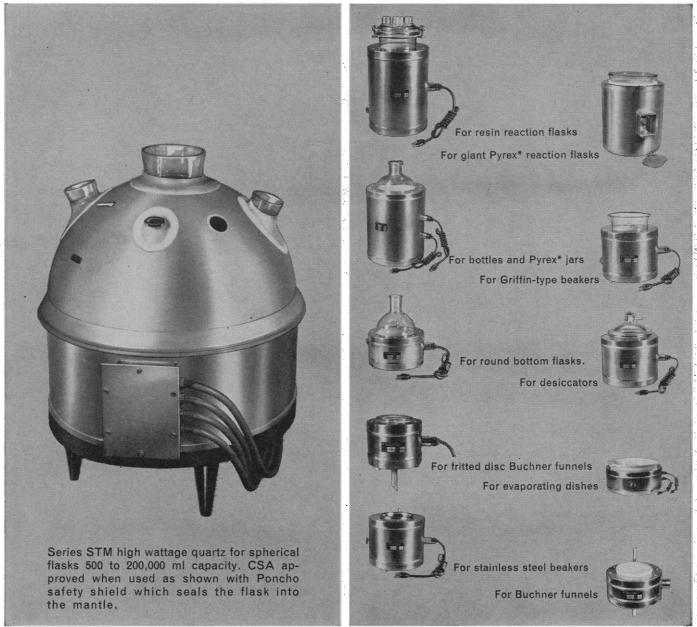
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26 AUGUST 1966

## Adage makes the best computer on the market for signal processing

#### ... it's called Ambilog 200

Ambilog 200 is a computer which combines the best of both analog and digital techniques. Unlike conventional machines which were intended for manipulating numeric data, Ambilog 200 was designed right from the start for signal processing. Signal processing, which encompasses data acquisition, monitoring, editing, analysis, recording, and display, generally requires efficient handling and high-speed processing of analog as well as digital data. Ambilog 200 with its flexible analog/digital interface and powerful hybrid structure is ideal for such applications.

#### **DIGITIZING AND RECORDING**

Multiple inputs, from up to several hundred sources, are routed through multiplexer switches under stored program control. At no penalty in sampling rates over conventional systems, Ambilog 200 converts incoming data to engineering units for recording or monitoring. An analog-to-digital converter performs a complete 14-bit conversion in 4 microseconds for digital storage, recording or outputing.

#### **REAL TIME WAVEFORM MEASUREMENT**

Peak values, axis crossings, ratios of successive differences, and other characteristics of analog signals are measured in real time. Incoming signals are monitored for events of interest, using complex programmed detection criteria. In a typical biomedical application where "floods of data" are generated, the result is a 100-to-1 reduction in the bulk of magnetic tape output records.

#### **RANDOM SIGNAL ANALYSIS**

Parallel hybrid multiplication and summing, 2 microsecond 30-bit digital storage, and a flexible instruction format providing efficient list processing combine to make Ambilog 200 an extremely powerful tool for statistical signal analysis techniques. These include Fourier transformation, auto and cross correlation, power spectrum density analysis, and generation of histograms of amplitude spectra.

#### **ON-LINE DISPLAY**

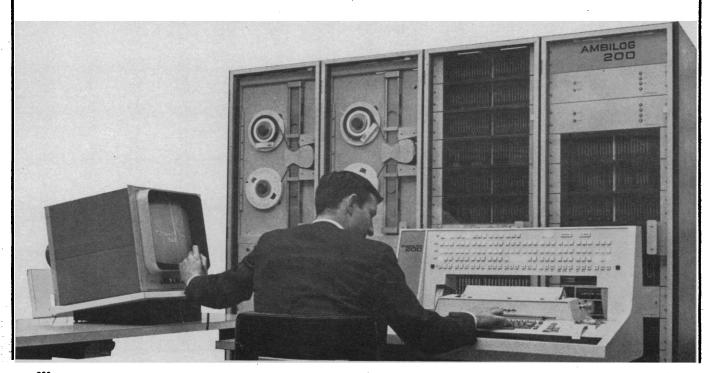
CRT displays of incoming raw data, or of results derived by reduction and analysis, are generated at frame rates of about 30 per second using line-drawing elements. This "quick look" facility helps the user select those processing techniques which best apply to the problem on hand. Display systems include light pen selection of control parameters and processing subroutines to insure close interaction between the analyst and his computing equipment.

#### SOFTWARE

Programming aids for use with Ambilog 200 were designed as well to meet the specialized needs of signal processing tasks. An extensive program library includes an Adage assembly system, Fortran, programs for source language editing and on-line debugging and control, and a wide range of applications programs and subroutines. Comprehensive system documentation, and programming and maintenance training and services, are also available.

Ambilog 200 signal processing systems are currently being used for seismic research, dynamic structural testing, sonar signal analysis, wind tunnel testing, speech research, and biomedical monitoring. For technical reports describing in detail these installations and other signal processing applications, contact M. I. Stein, Product Manager, Adage, Inc., 1079 Commonwealth Avenue, Boston, Mass. 02215, (617) 783-1100.

dàa



# Does more work because it loafs.

#### The quietly reliable B-20 high speed refrigerated centrifuge.

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Key element in any high speed centrifuge is the drive system. Only IEC's B-20 employs a flexible belt-type drive, not a direct drive. It's the same drive used in IEC's advanced ultracentrifuges.

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The B-20 will spin two full liters in an angle rotor; 4 x 250 ml in a swinging level of 46,300g.

These are highlights of the one high speed refrigerated centrifuge that does more work, relieves downtime headaches. Send for Bulletin B-20 for the full story.



26 AUGUST 1966

# ANALOG MONOLOGUE

On Means for Modelling, Measuring, Manipulating, & Much Else

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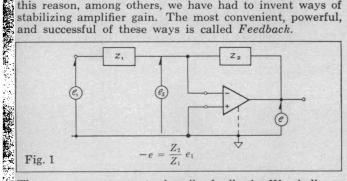
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Surely we are at least thirty years too late to justify the use of electronics — in *measuring* almost any physical or chemical parameter; in *manipulating* the measured data; or in *computing*, *simulating*, or otherwise *predicting* the behavior of a physical system. After three decades, however, the outlines of any discipline become blurred hence this refresher.

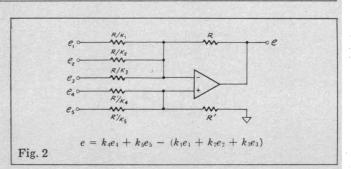
One process is at the root of every contribution electronics ever made to its sister sciences: *Amplification*. There are many ways to characterize this effect, but perhaps the most general is to say that electronic circuits raise the energy level of data — that they are inherently very sensitive — and can be made to respond, with *reliability* (stability) and fidelity (accuracy) to very small changes in the input parameter. If the input is not already an electrical signal, it must be converted to an equivalent electrical parameter, by a "transducer."

The need for amplification — for high sensitivity — is apparent from first principles. For example, we may restate Heisenberg's Exclusion Principle as follows: "The accuracy of a measurement is a direct function of the observer's ability to make it with a minimum of disturbance to the system observed." If we read "loading", or "burden" for "disturbance", the need for sensitive circuits is apparent. Unfortunately, electronic amplifiers are not ideal. Left to itself, the sensitivity of a simple electronic amplifier circuit will vary so much (in response to both external influences and the instability of its own component parts) as to render it useless for all but the crudest of applications. For this reason, among others, we have had to invent ways of stabilizing amplifier gain. The most convenient, powerful, and successful of these ways is called *Feedback*.



There are many ways to describe feedback. We shall use a simple example. To obtain a particular value of amplification, with a specific degree of stability and fidelity, one first designs an unstabilized amplifier having much higher "raw" amplification than is required; then one interconnects the output and input circuits of the amplifier by means of a more-readily-stabilized electrical circuit, called a feedback loop, or feedback network (see Figure 1) in such a way that this feeding back of output energy reduces the apparent amplification, but gives to that modified amplification characteristic the inherently-higher stability of the feedback network. Thus, we can trade excess amplification of r superior stability — and superior fidelity, by the way. Because this kind of feedback reduces the apparent amplification, it is called "negative" feedback.

The feedback "network" may be as simple as a pair of resistors. The cost of such a circuit is modest, and its data-measurement and data-manipulation capabilities are impressive. . . but it is only the beginning.



By modifying the feedback network, so as to include reactances (capacitors or inductors) as well as resistances, you may create circuits that perform important and useful mathematical operations on a signal; for example one can differentiate or integrate it. Differentiation will convert velocity signals into acceleration, or position into velocity; or, with two differentiators, in cascade, position into acceleration. By integrating, one may reverse the process. There is almost no limit to the ingenious behavioral variations one may create and control, merely by choosing appropriate feedback network configurations. Nowadays, using inexpensive standard "hardware", one may quickly assemble circuits that respond logarithmically, exponentially, or trigonometrically and circuits that multiply and divide too - almost as faithfully as the circuit of Figure 2 adds and subtracts.

Remember — all of this is done with equipments that cost, generally, hundreds of dollars or less, and not the thousands or more one might expect, from their capabilities and potential usefulness.

The kind of amplifier required for performing these operations with accuracy and fidelity is a very special beast, called (naturally) an Operational Amplifier, and we have devoted much of our time and energy over more than 20 years to its development and refinement.

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Fig. 3

standard Philbrick Operational Amplifiers. If you should want to begin serious study of this subject on your own, we suggest that you write for the following items, as a "Starter Set". They are free.

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Correct exposures are automatic. The camera has a built-in electronic flash ring light designed specifically for Polaroid Land films and automatic settings for black and white or color. Just flip a single switch on the camera and perfect lens and shutter settings are guaranteed. (Or, if you prefer, you can make manual settings.)

You can take four kinds of close-ups with the camera. Interchangeable lenses and attachments make it possible to take ¼ to 1, 1 to 1, 2X and 3X pictures. (In our three close-ups of a 15th-century oil by the Master of Moulins,\* you can see the sharpness of detail you get in the close-up images. The close-ups go from one-quarter life-size to twice life-size.)

The camera is compact, designed for pistolgrip, hand-held operation. And it uses Polaroid Land pack films which drop easily into the camera back in seconds.

This remarkable new camera will have a wide range of scientific, industrial and professional applications. (And hobbyists, such as collectors and model makers, will be able to put it to good use on weekends as well.)

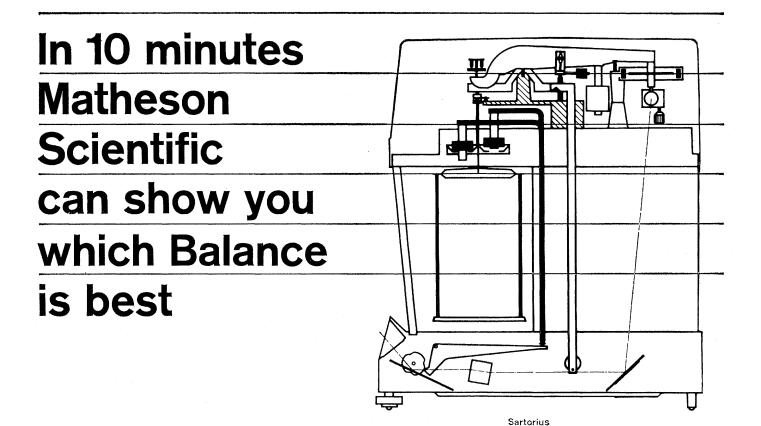
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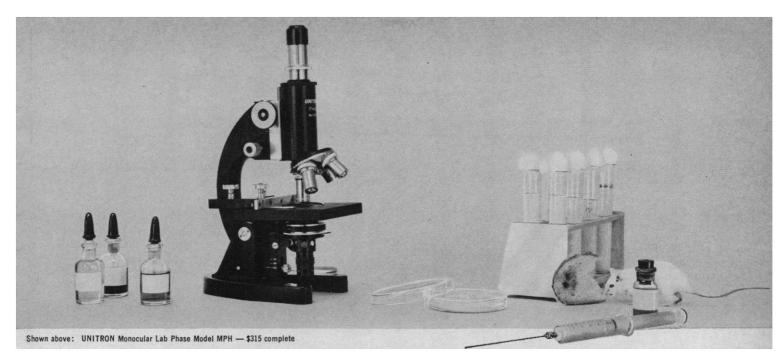
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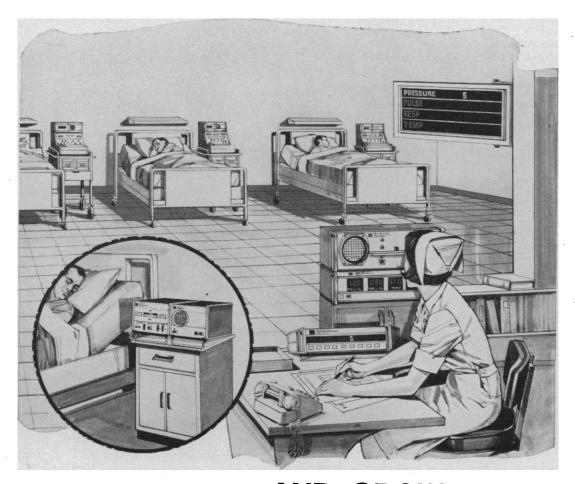
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News about instruments, apparatus and reagent chemicals that make your work quicker, surer, safer and easier.

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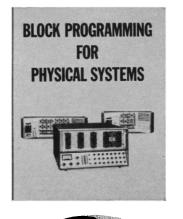
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al courses of study. Yet in most areas of modern astronomy there is already too much effort invested in theoretical research, considering the lack of observational data to test the theories. (Exception: planetary physics.) The authors of the Whitford report have indeed emphasized that astronomy today is data limited. It is dangerous for any field of science to be overladen with theories, which in the absence of checks can freely degenerate into wild speculation and eventually breed dogmas. Only 2 years ago, for instance, the remoteness of quasi-stellar galaxies was accepted dogmatically by most astronomers, and a host of theories were advanced to explain their (apparent) enormous luminosity. Acceptable cosmological theories were identified on the basis of a few spectrum wavelength shift measurements interpreted as Doppler shifts. The remoteness of the quasars is at this time seriously in doubt, so many of the well publicized theories concerning these objects may well be irrelevant.

As Irwin has pointed out, the nation's various programs in space astronomy will be less effective and more costly than necessary unless a large number of experienced observational astronomers are available to plan these programs. I agree that NASA should eventually fund the training observatory construction program, but only after the major expansion of ground-based research facilities is effected and more efficient use is made of current astronomical manpower. Irwin's training observatories will not likely begin to produce observing geniuses until 10 years from now at the earliest, yet strategic planning of space astronomical research is needed now and throughout the intervening years.

PHILIP C. STEFFEY 2402 Third Street, Santa Monica, California 90405

#### How To Police Pollution

As a former chemist for what is now the Federal Water Pollution Control Administration, I would like to comment on certain aspects of the ninth conference on Great Lakes research (24 June, p. 1773).

How can the FWPCA expect to conduct a fair and equitable enforcement program largely based on "informal discussions"? Such a practice could easily lead to flexible enforcement. Although federal water pollution control machinery has been established for over 3 years, there are, as yet, no formal procedures for conducting hearings. I have attended such informal pollution control conferences in the past in which the government has presented an overwhelming amount of "scientific" data by "experts" who gave proof-positive conclusions about the cause, amount and source of pollution. There was no provision for cross-examination, and industry, unprepared to refute such "evidence," was reluctant to argue its side for fear of being cast in the role of an active supporter of pollution.

Finally, I disagree that it is "hazardous to swim, fish [in], or even get water spray in the face" from lake water bearing Salmonella bacteria. This is a half-truth, at best. Certainly no one would advocate swimming in grossly polluted water or would support the willful insult to the human body by unnecessary exposure to any harmful agent. Salmonella are ubiquitous microorganisms, as we know from the reported difficulty controlling them in hospitals. The alleged hazard to a fisherman or boating enthusiast by the presence of Salmonella in surface waters can only be labeled conjectural.

WILLIAM S. COX 2350 Beecher Circle, S.W., Atlanta, Georgia 30311

#### Simplifying the Formula

The discussion (Letters, 1 April and 8 July) of N. O. Calloway's proposal (Letters, 31 Dec.) for distributing the ages of experimental animals has been made unnecessarily complicated. If Ais the age of the youngest animal to be used, and B is the age of the oldest animal to be used, and n + 1 is the number of animals to be used, the problem is simply that of inserting n - 1 geometric means between A and B. This requires merely determining Rsuch that

$$B = AR^{n}$$

Then

$$\log R = \frac{\log B - \log A}{n}$$

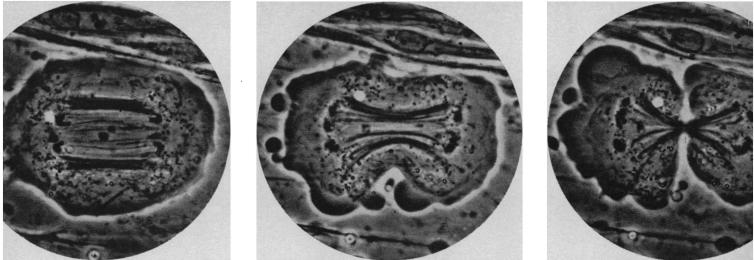
and the n + 1 ages are

 $A, AR, AR^2, \ldots AR^n$ .

IRVING ADLER

North Bennington, Vermont

SCIENCE, VOL. 153



 18:44 hrs.
 19.23 hrs.
 19.34 hrs.

 Anaphase: bivalents of homologous chromosome pairs moving to opposite poles during spermatogenesis in Pales ferruginea (Tipulidae).

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#### The National Bureau of Standards

The recently issued 1965 Technical Highlights of the National Bureau of Standards<sup>\*</sup> is an excellent report. The document, which contains 113 pages of text and 90 pages of appendixes, provides convincing evidence that NBS is serving essential functions and that it is responding to new needs. Appropriations for NBS of \$33 million and total expenditures of \$69 million are more than amply justified.

For 65 years the National Bureau of Standards has been the nation's central measurement laboratory. It has had responsibility for developing and maintaining the National Standards of Measurement. This is no small task. In addition to the six basic international qualities of length, mass, time, temperature, electrical current, and luminous intensity, there are some 36 derived quantities for which standards are needed. With developments such as the maser and laser, new methods of obtaining better accuracies become available. This requires continual updating of standards. Scientific developments such as ability to obtain higher pressures, a better vacuum, and new and purer materials have correspondingly increased the need for additional standards.

In response to the challenges of the times, NBS has become the focus of scientific and technical competence, covering the entire spectrum of the physical sciences. The accuracy with which measurement standards can be reproduced and disseminated limits the reliability and accuracy of all exchanges derived from standards. NBS must provide leadership in the science of measurement. This requires a staff of high-caliber scientists. The Bureau's scientific activity has been particularly distinguished in atomic and molecular physics, chemical physics, thermodynamics, theoretical physics, crystallography, analytical chemistry, polymers, metallurgy, and cryogenics.

During 1965, NBS research leading to publication of about 1000 scientific papers was conducted. Among the accomplishments was development of a thallium-beam clock, which may be more accurate by an order of magnitude than the cesium-beam clock. A second achievement was the use of a laser to make automatic length measurements. The accuracy obtained was 1.8 parts in  $10^9$ . A third accomplishment was the discovery of superconductivity in the semiconductor strontium titanate. A new purification technique affords, for the first time, the possibility of obtaining absolutely pure and perfect crystals.

In addition to its responsibilities with respect to standards, NBS has long had other functions, such as conducting tests for other government agencies and advising them on scientific and technical problems. NBS is now to establish a central and major government resource in the automatic-data-processing field. It is also to serve as the focal point within the federal government for stimulating the application of science and technology to the economy.

A recently added responsibility of very great importance is the operation of a National Standard Reference Data System. What is involved is the massive effort required to produce the modern equivalent of the old International Critical Tables. The past achievements of NBS augur well for the able performance of the new tasks. Establishment of an effective National Standard Reference Data System would provide major benefits to science, technology, and industry throughout the world.

It is to be hoped that Congress will provide sufficient funds for effective implementation of this much-needed data system, and that the evident quality of the overall NBS effort will be as highly regarded in Congress as it is among knowledgeable scientists and engineers.

#### -PHILIP H. ABELSON



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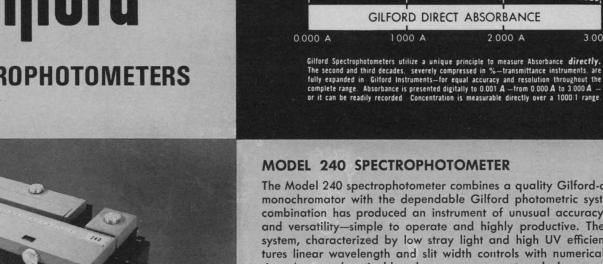
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Anfinsen, C. B., Rumley, M. K., and Taniuchi, H.: Acta Chem. Scand., 17, S270 (1963).

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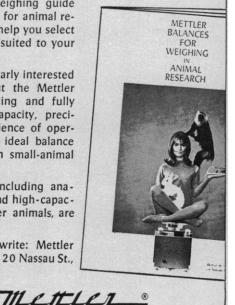
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The Aetiology of Compressed Air Intoxication and Inert Gas Narcosis. P. B. Bennett. Pergamon, New York, 1966. 132 pp. Illus. \$6. International Series of Monographs in Pure and Applied Biology. Analecta Medico-Historica. vol. 2,

Safavid Surgery. C. Elgood. Pergamon, New York, 1966. 105 pp. Paper, \$5. Annual Review of Piant Physiology.

Annual Review of Piant Physiology. vol. 17. Leonard Machlis, Ed. Annual Reviews, Palo Alto, Calif., 1966. 535 pp. Illus. \$8.50. Twenty papers on the following topics: Cell Structure and Function (1 paper); Mineral Nutrition (2 papers); Nitrogen Metabolism (3 papers); Photosynthesis (1 paper); General Metabolism (2 papers); Water Relations (2 papers); Absorption and Translocation (1 paper); Growth and Development (5 papers); and Special Topics (2 papers).

Antifertility Compounds in the Male and Female. Development, actions and applications of chemicals affecting the reproductive processes of animals, insects and man. Harold Jackson. Thomas, Springfield, Ill., 1966. 232 pp. Illus. \$8.75.

Aspects moléculaires de l'adattation et de la phylogénie. Marcel Florkin. Masson, Paris, 1966. 266 pp. Illus. Paper, F. 50. Avian Myology. J. C. George and A. J. Berger. Academic Press, New York, 1966.

512 pp. Illus. \$18. Biochemical Aspects of Amphibian Development. Elizabeth M. Deuchar. Wiley, New York, 1966. 216 pp. Illus. \$4.50.

**Biochemical Preparations**. vol. 11. Andreas C. Maehly, Ed. Wiley, New York, 1966. 159 pp. Illus. \$8.

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The Biologic Basis of Schizophrenia. Jon L. Karlsson. Thomas, Springfield, Ill., 1966. 99 pp. Illus. \$4.75.

**Biological Chemistry**. Henry R. Mahler and Eugene H. Cordes. Harper and Row, New York, 1966. 890 pp. Illus. \$16.50. **Biologie de la reproduction animale**:

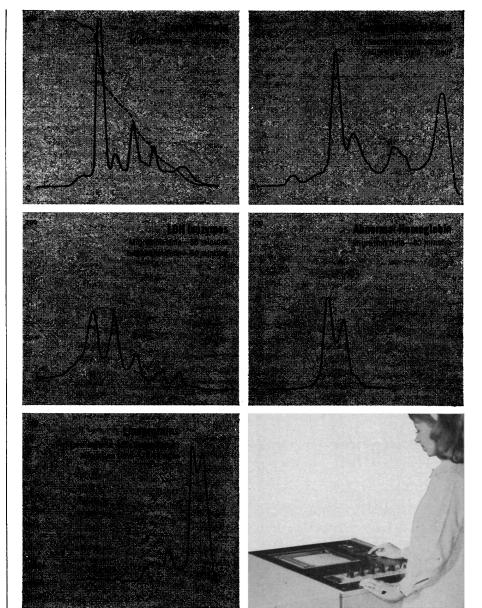
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The Brain Vascular System. Harry A. Kaplan and Donald H. Ford. Elsevier, New York, 1966. 240 pp. Illus. \$12.

**British Rust Fungi.** Malcolm Wilson and D. M. Henderson. Cambridge Univ. Press, New York, 1966. 402 pp. Illus. \$17.50.

**Carcinoma of the Alimentary Tract: Etiology and Pathogenesis.** Walter J. Burdette, Ed. Univ. of Utah Press, Salt Lake City, 1965. 243 pp. Illus.

La Chimie Quantique Appliquee à l'Etude du DNA et du RNA. Andree Goudot. Gauthier-Villars, Paris, 1966. 187 pp. Illus. Paper.



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Fortschritte der Zoologie. vol. 17. Max Hartmann, Ed. Fischer, Stuttgart, Germany, 1966. 439 pp. Illus. \$30. General Biology: The Science of Biol-

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Genetics of Sexuality in Higher Fungi. John R. Raper. Ronald, New York, 1966. 291 pp. Illus. \$12.

Glycoproteins: Their Composition, Structure and Function. Alfred Gottschalk, Ed. Elsevier, New York, 1966. 644 pp. Illus. \$35. Thirteen papers.

Hagan's Infectious Diseases of Domestic Animals: With Special Reference to Etiology, Diagnosis, and Biologic Therapy. Dorsey William Bruner and James Howard Gillespie. Cornell Univ. Press, Ithaca, N.Y., ed. 5, 1966. 1123 pp. Illus. \$15.

Handbook on the Common Marine Isopod Crustacea of Georgia. Robert J. Menzies and Dirk Frankenberg. Univ. of Georgia Press, Athens, 1966. 101 pp. Illus. Paper, \$2.50.

The Harvey Lectures. Delivered under the auspices of the Harvey Society of New York, 1964-1965. Series 60. Herman N. Eisen and others. Academic Press, New York, 1966. 332 pp. Illus. \$9.50. Nine lectures: "The immune response to a simple antigenic determinant" by Herman N. Eisen; "The biological significance of uric acid" by Alexander B. Gutman; "Biosynthesis of the sympathetic neurotransmitter, norepinephrine" by Sidney Udenfriend; "The fine structure of striated muscle and its functional significance" by Hugh E. Huxley; "Bio-chemical aspects of metamorphosis: Transition from ammonotelism to uretelism" by Philip P. Cohen; "The compara-tive anatomy of a gene" by S. E. Luria; 'The emperor's new clothes, or an inquiry into the present status of tumor viruses and virus tumors" by Hilary Koprowski; "The nerve growth factor: Its mode of action on sensory and sympathetic nerve cells" by Rita Levi-Montalcini; and "Gluconeogenesis: Pathways and hormonal regulation" by Henry A. Lardy.

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Introduction to Applied Entomology. L. H. Rolston and C. E. McCoy. Ronald, New York, 1966. 214 pp. Illus. \$5.

Introduction to Biochemistry. vol. 1, Metabolism of Carbohydrates, Proteins, and Fats. A. J. S. McMillan. Pergamon, New York, 1966. 180 pp. Illus. Paper, \$4.95. Commonwealth and International Library.

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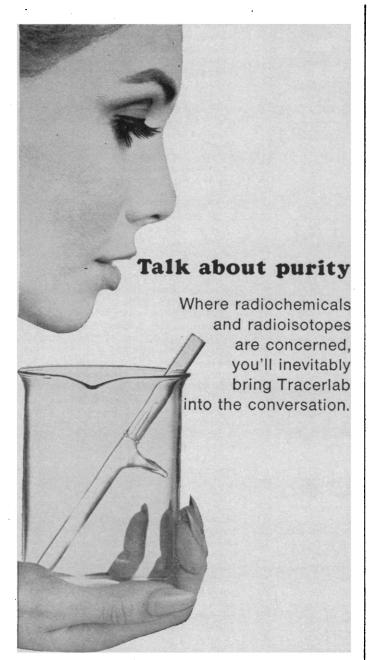
Kidney and Electrolytes: Foundations of Clinical Diagnosis and Physiologic Therapy. Norman Deane. Prentice-Hall, Englewood Cliffs, N.J., 1966. 212 pp. Illus. \$9.

A Laboratory Manual of Analytical Methods of Protein Chemistry. vol. 4. P. Alexander and H. P. Lundgren, Eds. Pergamon, New York, 1966. 245 pp. Illus. \$8.50. Six papers: "The estimation of thiol and disulphide groups" by S. J. Leach; "Micro techniques for amino acid analysis and peptide separation base on high-voltage electrophoresis" by S. Blackburn; "Estimation of specific proteins in mixtures by a gel precipitation method" by D. A. Darcy; "Thermal polycondensation of  $\alpha$ -amino acids" by S. W. Fox and K. Harada; "The amino acid composition of selected proteins and polypeptides" by W. H. Ward; and "Dielectric measurements of proteins" by D. Rosen.

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Maternity Nursing. Elise Fitzpatrick, Nicholson J. Eastman, and Sharon R.

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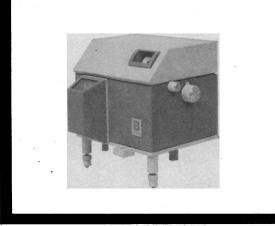
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Mechanisms in Bioenergetics. Efraim Racker. Academic Press, New York, 1965. 271 pp. Illus. Paper, \$3.45; cloth, \$6.50. Advanced Biochemistry Series, edited by Anthony San Pietro.

Methods in Hormone Research. vol. 5, pt. C, Steroidal Activity in Experimental Animals and Man. Ralph I. Dorfman, Ed. Academic Press, New York, 1966. 356 pp. Illus. \$13. Six papers: "Effects of steroids on the central nervous system" by Dixon M. Woodbury and Antonia Vernadakis; "The relation be-tween the structure and physiological activity of progestational steroids" by Tamotsu Miyake and Wendell H. Rooks, II; "Anti-gonadotropic steroids" by Ralph I. Dorfman and Fred A. Kincl; "The treatment of human malignancies with steroids" by Albert Segaloff; "Com-"Comparative objective regressions resulting from steroid treatment in women suffering from breast cancer" by Albert Segaloff; and "Androgens" by Ralph I. Dorfman.

Methods of Biochemical Analysis, vol. 14. David Glick, Ed. Interscience (Wiley), New York, 1966. 571 pp. Illus. \$15. Nine papers: "Methods for estimating magnesium in biological materials" by Nancy W. Alcock and Iain MacIntyre; "Microbiological assay of vitamin B<sub>12</sub>" by Helen R. Skeggs; "Fluorimetric analysis of corticoids" by Robert H. Silber; "Preparation and analysis of basic proteins" by N. O. Lindh and B. L. Brantmark; "The determination of nucleic acids" by H. N. Munro and A. Fleck; "Determination of amino acids by ion exchange chromatography" by S. Jacobs; "Separation and determination of amino acids and peptides by gas-liquid chroma-tography" by Boris Weinstein; "Newer developments in determination of bile acids and steroids by gas chromatography" by A. Kuksis; and "Gel electrophoresis in buffers containing urea" by M. D. Poulik.

Microfunghi della cellulosa e della carta attivita' e inquadramento sistematico: il genere "Chaetomium". Giorgio Mazzucchetti. Ente Nazionale per la Cellulosa e per la Carta, Rome, 1965. 376 pp. Illus. Paper.

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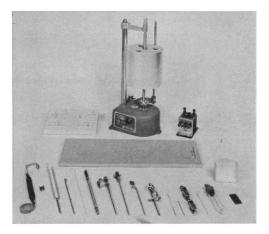
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Organic Foundations of Animal Behavior. Joseph Altman. Holt, Rinehart,

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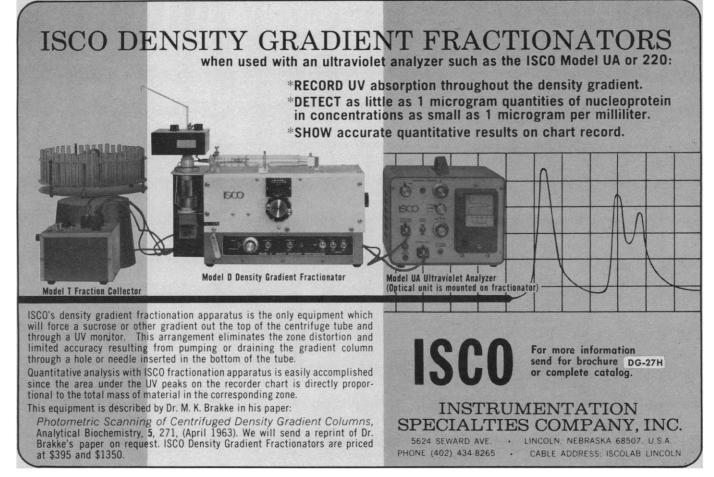
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and Winston, New York, 1966. 544 pp. Illus. \$12.95.

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Physical Techniques in Biological Research. vol. 3, pt. A. Cells and Tissues. Arthur W. Pollister, Ed. Academic Press, New York, ed. 2, 1966. 422 pp. Illus. \$13.50. Six papers contributed by Thomas F. Anderson, R. Barer, Arne Engström, Mark E. Gettner, H. Holter, Leonard Ornstein, Fritz Ruch, Allen W. Wachtel, and E. Zeuthen.

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