SCIENCE

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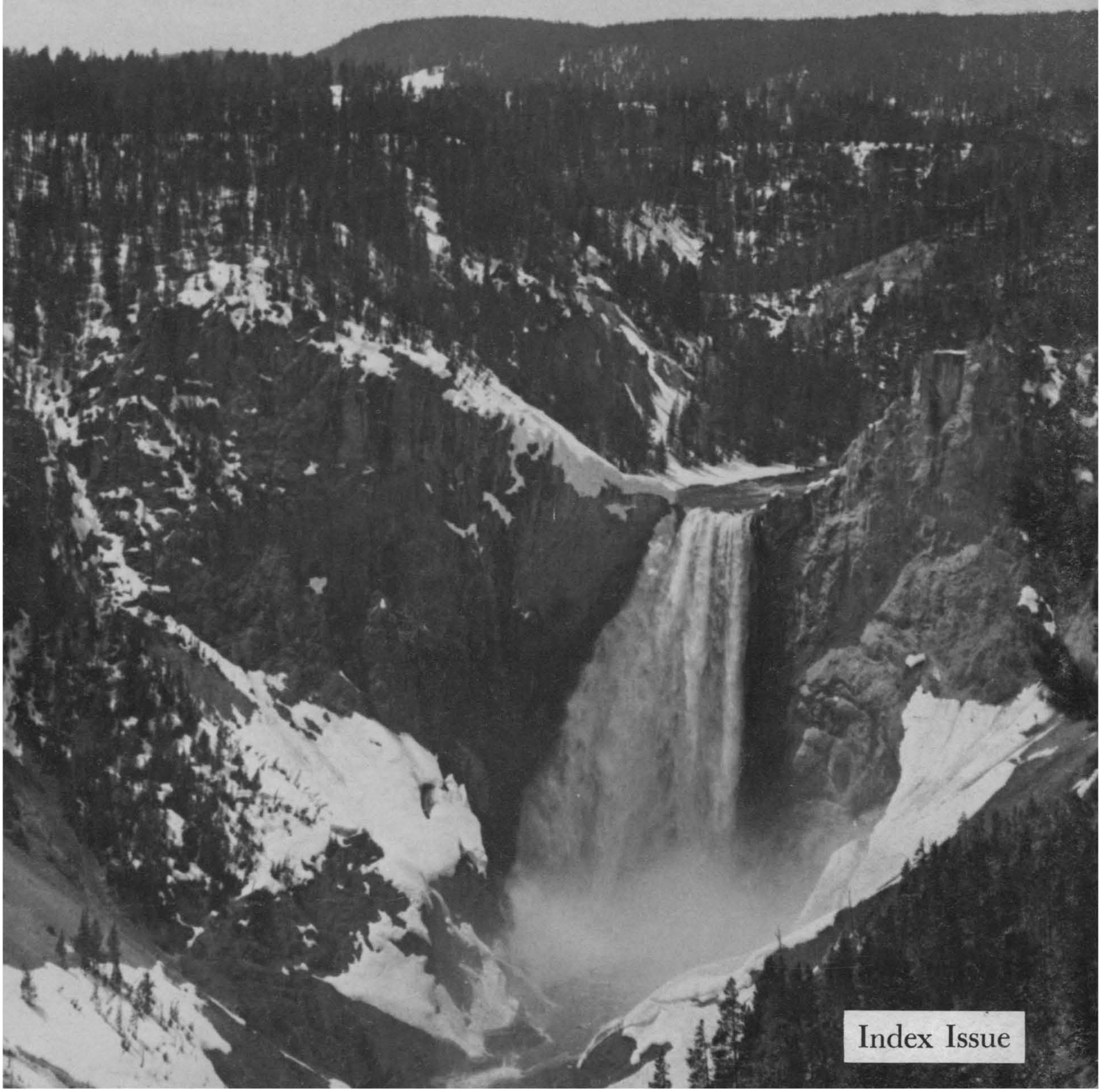
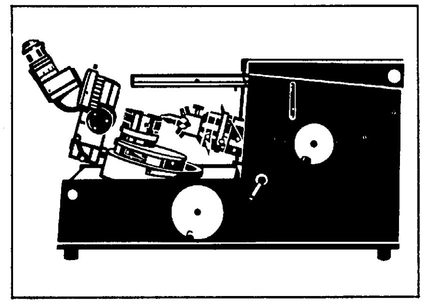
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Index Issue

The Pyramitome
—newest of the LKB microtomes.



LKB IN THE SERVICE OF SCIENCE

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SALES AND SERVICE THROUGHOUT THE WORLD: STOCKHOLM, THE HAGUE, COPENHAGEN, ROME, VIENNA, LONDON

The Egyptians Worked Harder than LKB

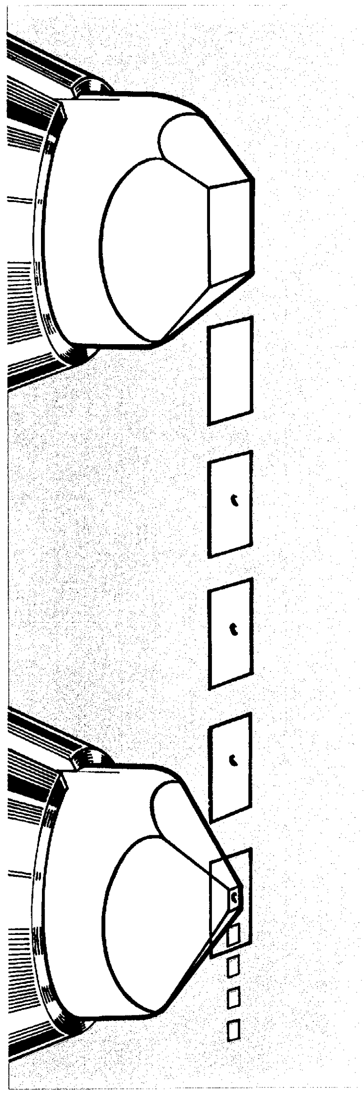
to produce PYRAMIDS — but then they did not have the LKB Pyramitome.

This latest addition to the LKB Ultramicrotomy Laboratory is both Pyramid Maker and Histo-microtome in one instrument, a valuable design combination that is unique on the market today. The Pyramitome cuts plastic specimen blocks into the pyramidshape needed prior to sectioning with a microtome. The combination design of this instrument has the advantage that it provides both large pyramids from which survey sections can be cut and also the sections.

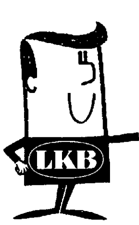
The Pyramitome mechanically shapes pyramids with positively parallel sides, perpendicular to the cutting direction, so furnishing straight ribbons of sections, free from "fringed" edges, that are easily collected from the surface of the trough liquid.

Trimming feed and pyramid shape can be mechanically selected, saving time in busy laboratories.

The Knife-turret accommodates three glass knives, up to 10 mm thick. The knives are set to their working position prior to trimming, as one knife is used so a new knife can be rotated to exactly the same work position. The use of glass knives in the Pyramitome enables completely translucent pyramids to be produced making it easy to view the embedded tissue.



◀ Diagrammatic representation of large survey sections for light microscopy and small ultrathin sections of area of interest for examination in the electron microscope.



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Present and future "classics"... Saunders biomedical texts

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By CLYDE R. GOODHEART, *Institute for Biomedical Research, American Medical Association.*

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432 pages. 154 figures. $10.00. March 1969.

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480 pages. 269 figures. $8.50. May 1969.

Frobisher—
FUNDAMENTALS OF MICROBIOLOGY

By MARTIN FROBISHER, *formerly of U.S.P.H.S.*

Here is the most extensively revised edition of this successful text since its inception 30 years ago. Newly rewritten chapters discuss the practical applications of microbiology in the fields of immunology, antibiotics, sterilization, disinfection, chemotherapy, etc.

629 pages. 441 illust. $9.00. Eighth Edition. Apri 1968.

Villee, Walker & Smith—
GENERAL ZOOLOGY

By CLAUDE A. VILLEE, *Harvard University;* WARREN F. WALKER, JR., *Oberlin College; and* FREDERICK E. SMITH, *University of Michigan.*

This well written and handsomely illustrated text gives the beginning student a sound understanding of zoology. Virtually every chapter in this *New Third Edition* has been rewritten to incorporate new information. Special attention has been given to the chapters on cell physiology, genetics, evolution and ecology. A new chapter on Animal Behavior is included.

844 pages. 564 figures. $9.75. Third Edition. April 1968.

Guyton—
FUNCTION OF THE HUMAN BODY

By ARTHUR C. GUYTON, *Univ. of Mississippi School of Medicine.*

This *New Third Edition* begins with a greatly expanded section on cell physiology, including new chapters on: *the nerve and membrane potentials* and *muscle physiology.* From this solid base, the text proceeds through composition, structure, and function of the major systems of the body. Special attention is focused throughout the book on the relationship of organ physiology to cell physiology.

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Barnes—
INVERTEBRATE ZOOLOGY

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743 pages. 581 figures. $10.50. Second Edition. June 1968.

Burrows—
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This popular text is available in either a single, combined volume or two separate volumes. Volume One, *The Biology of Microorganisms,* is ideally suited to undergraduate general courses. The second volume, *The Pathogenic Microorganisms,* is designed for undergraduate courses in microbiologic pathogens. *Nineteenth Edition. May 1968.*

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Both in a Single Vol.: 974 pages. 297 illust. $21.00.

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Dr. Gardner's short neurology text gives a well integrated and readable picture of neuroanatomy, neurophysiology, and neurochemistry, organized by functional systems as well as anatomically. This *New Fifth Edition* includes current theories of axon and synaptic transmission and of the functions of tracts.

367 pages. 161 figures. $7.50. Fifth Edition. June 1968.

For further information or 30-day approval copies of these texts, write:

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27 June 1969

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SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Lower Falls on the Yellowstone River in Yellowstone National Park drops 308 feet into the head of a steep-sided canyon. Turbulent eddies are discernible. These eddies increase in length with distance from the brink and generate characteristic earth vibrations on impact. See page 1513. [John S. Rinehart, ESSA Research Laboratories, Boulder, Colorado]

Pollution that assaults the lungs, the digestive tract, the ear ... and how effective instruments can lead to abatement

The Lungs

Until very recently, Molecular Rotational Resonance (MRR) Spectroscopy often seemed like a brilliant scientific breakthrough destined to remain an ivory tower curiosity for lack of a practical application in the real world of quantitative analysis.

In its pristine form, MRR allowed the scientist to look into molecular structure by measuring changes in the absorption of microwave energy which result from transitions between rotational energy levels in a polar molecule. Because differences exist in the composition or geometry of individual molecular species, there is a characteristic MRR spectrum for each molecule. Absorption peaks are unique for each molecule and MRR readily differentiates between them, even in a complex mixture, because of its inherent specificity. In the usual case, measuring the frequency of a single absorption line completely identifies the molecule.

MRR has recently been shown to be a practical quantitative tool too. In a paper published in the *Journal of Chemical Physics* (46, 3698, 1967) the response of the HP 8400B MRR Spectrometer was shown to be linear with concentration from the lowest detectable limit to 100%. More recent work with common air pollutants (SO_2, NO_2, hydrocarbons) has demonstrated that MRR gives a quantitative response for each gas, even in the complex mixtures that are commonly associated with air pollution samples. The actual sensitivity limit for SO_2 has been determined at 3.5 nanograms without using concentration techniques (... this corresponds to a concentration of 11.6 ppb in a one liter sample). To further enhance its usefulness in the quantitative analysis of air pollutants, most MRR experiments are carried out at low pressures—typically 10-15 μ Hg—a condition that greatly reduces the rate at which the pollutants react with each other.

Precisely where the MRR Spectrometer fits into the pattern of analytical chemistry is still being studied. Based on the work reported above, it certainly should be considered for air pollution analysis, especially for calibrating on-site air pollution monitors. Results of experimental work in air pollution and other significant analyses with the MRR Spectrometer are published regularly in *Molecules and Microwaves*, a copy of which awaits your request.

The Digestive Tract

In the days before Rachel Carson's *Silent Spring*, the only popular connection between pesticides and the human digestive tract was benign: one was reassured that large parts of the world would be hungry, even suffer famine, except for the beneficial effect of pesticides on agricultural production. Nowadays, it's more common to hear warnings from respected scientific sources that pesticides constitute a real and present danger to life on this planet because they are ingested as residues in the food we eat and the liquids we drink.

These are not mutually contradictory arguments so much as they are accurate descriptions of both sides of the split personality of pesticides. The only conceivable solution to this very human dilemma is better control of the use of pesticides, and more careful analysis of pesticide residues in foodstuffs.

Enter the gas chromatograph (GC). While the men engaged in pesticide detection are many and far-flung, instrumentation for this sensitive work falls almost solely on the GC. On this basis, Hewlett-Packard has directed much research effort towards perfecting both instrumentation and technique. Although pesticide detection is still most often recorded in the nanogram range, an HP GC—more than four years ago—separated a laboratory pesticide sample at the picogram level. Most of this chemical detective work is being performed on the HP Model 402 High-Efficiency GC—an instrument perfected especially for this and other biochemical research. HP's pesticide analysts prefer to use this instrument equipped with an electron capture type of detector. The latter employs a radioactive tritium source to produce electrons whose capture by the pesticide molecules is a direct measure of their presence. Recently, HP chemist-designers have perfected a new electron capture detector that employs a radioactive Ni^{63} source that is more stable at higher temperatures thereby holding out a promise of more searching pesticide detection than the older tritium type can accomplish.

Sometimes the inherent difficulty of pesticide analysis is resolved by improvements in technique rather than hardware. HP chemists have developed special techniques for the analysis of pesticide residues in many foodstuffs, and sample extraction techniques for the analysis of bovine and human milk.

If you'd care to pursue this subject in more depth, write for Applications Lab Report 1003, yours on request.

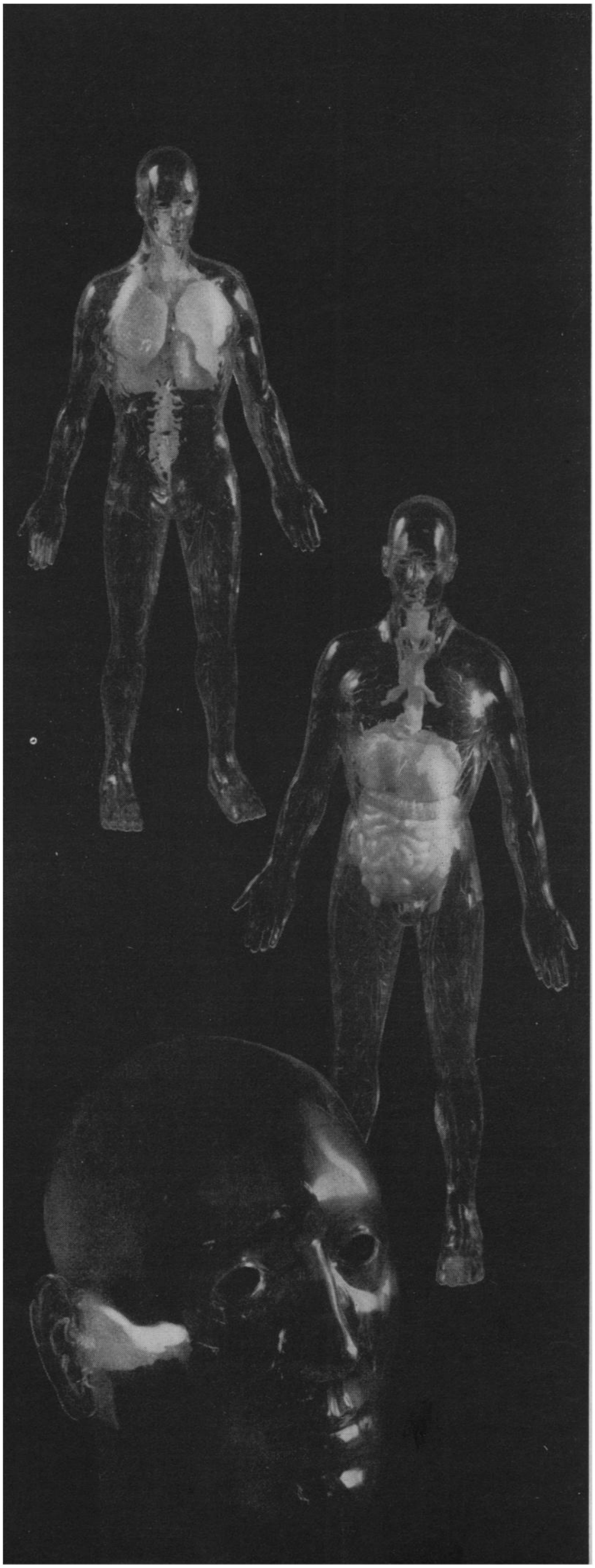
The Ear

Well played by a fine orchestra, Brahms can only be described as beautiful. But reproduced too loud on a cheap phonograph, it's noise. An increasingly widespread and serious form of pollution, noise can make us uncomfortable; prolonged loud noise damages hearing; very loud noises can cause pain, psychosis and even death.

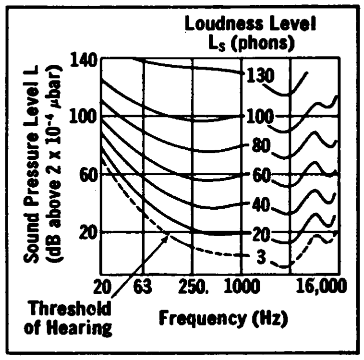
Obviously the time has come to control this form of 20th century environmental pollution. When HP scientists turned their talents to noise measurement, they ran into a very unusual problem. Objectively sound is simply a matter of rapidly changing air pressure, easy to measure with traditional sound level meters. But noise is really not an objective phenomenon: what the ear hears is a subjective sensation of loudness involving complicated physiological and psychological mechanisms.

For an instrument to measure sound as the ear hears it, it must imitate the unique properties of the ear. Take loudness level which is traditionally measured in *phons*. Although the logarithmic phon scale covers the large dynamic range of the ear—120 dB—it does not fit a subjective loudness scale. The trouble is that a noise that sounds twice as loud as another does not measure double the number of phons. So a subjective measure of loudness was developed by international agreement in which the unit is a *sone* and whose scale corresponds closely to the subjective sensation of loudness. For example, the comparison between a jet takeoff and a quiet conversation is 3:1 in phons (120 vs. 40) ... and a much more realistic 60:1 in sones (256 vs. 4).

Neither is the frequency response of the human ear a straightforward thing: the ear responds differently to sounds of different



frequencies and loudness levels. Although there is a small variation from person to person, normal ears agree within a few dB with the plot reproduced here (ISO Recommendation 226).



An even more significant peculiarity of the ear is its response to the pitch and bandwidth of a noise. Broadband sounds, like those of jet aircraft, seem much louder than narrow-band noise of the same sound pressure level. Thus accurate loudness measurements can be made only by taking into account the spectral distribution of the sound and relating it to empirically determined critical bandwidths. This phenomenon has given rise to the *Bark* scale: the audio range comprises 24 Bark, each of which equals the ear's critical bandwidth at a given center frequency.

Probably the most significant difference between objective and subjective measure of loudness occurs when two sounds are presented to the ear simultaneously. If the two sounds are widely separated in frequency, their partial loudnesses simply add to form the total loudness. But if they are not separated by a critical bandwidth, one sound masks the other: the closer together, the greater the influence. The noise analyst expresses this characteristic quantitatively in terms of *loudness density*, in sones/Bark.

The HP 8051A Loudness Analyzer is, in effect, a calibrated electronic ear that takes all of these subjective reactions of the human ear into consideration in measuring loudness based on ISO Recommendation 532 (Zwicker's Method). It listens to sound through a calibrated microphone or tape recorder, automatically produces a continuous spectral analysis and displays it as a plot of loudness density vs. subjective pitch. The instrument also computes and displays the total loudness of the sound, that is the integral of the Zwicker diagram.

The instrument is a great help in noise abatement studies because it shows how noise reduction techniques can be applied most effectively. Its spectral analysis points the finger at the most obvious sound-producing component, suggests what kind of sound-absorbing material may be needed, offers quick *before* and *after* comparisons of noise abatement programs.

A much more complex and versatile instrument for audio spectrum analysis, the recently announced HP 80501A Audio Data Processor combines the equivalent of a Loudness Analyzer with a powerful HP 2115A Digital Computer. The 80501A measures loudness with Kryter, Stevens, TALARM, SAE or dB weightings depending on the choice of standard computer programs. Results are available immediately: for example, the 80501A yields a complete analysis of aircraft noise while the plane is still overhead.

Our new 116-page Acoustics Handbook does justice to this rather complex subject. For your copy, write to Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

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ANALYTICAL INSTRUMENTS

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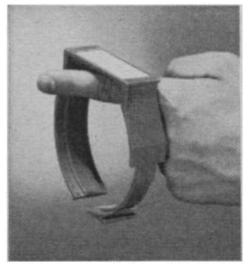
One thousand sixty feet beneath Retsof, N.Y., the International Salt Company operates the world's largest salt mine. There we store a film we believe to be the world's most sensitive medium for integrating and recording a flux of ionizing radiation. More than structural lead, which always carries remnants of its ancestral radionuclides, and more than rock, which must contain at least some K^{40}, the salt is radiologically silent. Retsof salt is strangely devoid of potassium. Down where Geiger counts from cosmic rays come long minutes apart, the hottest thing around is what we introduced ourselves: the carefully selected metal in the panels from which we built our storage room in our rented salt cavern. At least it's not as hot as wood.

Purpose of all this is to vie for favor to KODAK Personal Monitoring Film by the few organizations entrusted to keep utterly reliable tabs on exposure of radiation workers. By storing in the mine, where only the chemical component of density buildup remains to create noise against the signal being measured, we can supply longer runs of radiologically fresh film with the same coating number. Thus, with less calibration, our customers are that much surer of the precision in their reports.

New Recordak magazine



Slip this over a reel of microfilm. Label. Never again need human hands touch the film. No carton, therefore no wrong carton. Extracting the film and then putting it back can be left to the RECORDAK MOTORMATIC Reader, Model MPG, for display of the information content, zipped through at whatever speed suits the searcher. A note to BSM Division, Department WL, Eastman Kodak Company, Rochester, N.Y. 14650 will bring full details. Austere equipment, austerely priced for an austere mood, during which the cost of handling information—the metabolite and product of science—should withstand sharp scrutiny.

Scintillation cocktail committee

The Kodak Research Laboratories were established in 1912, when the dependence of industry on science was still a novel thought. Success having attended the undertaking, vigorous growth has ensued. With the proliferation of scientists, some of them now address themselves to the enhancement of productivity at the bench by the rest of them. Thought is given to such matters as balance between the cost of reagent quality and of time wasted if quality proves unreliable. There is now even a "Kodak Scintillation Committee." With what we pay out in salary for time spent in our many laboratories in a popular pursuit like scintillation counting, it pays to set some standards of our own for basic supplies used.

Since we supply laboratory chemicals to far more workers who are not on our payroll than who are, we should announce here the availability in a new scintillation grade of:

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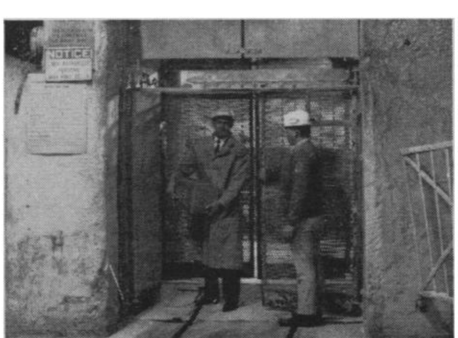
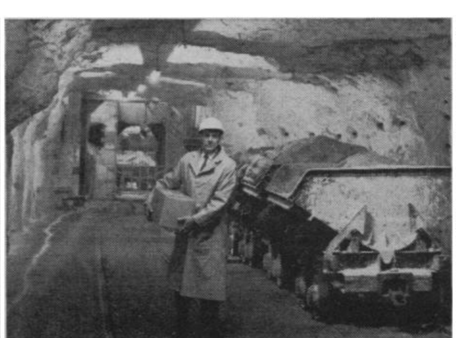
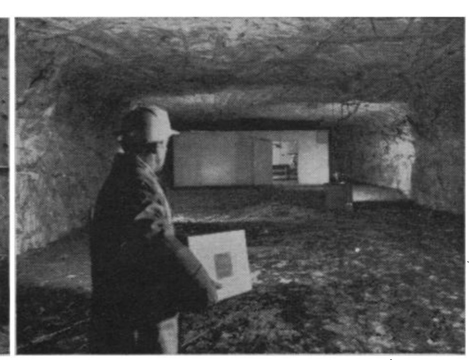
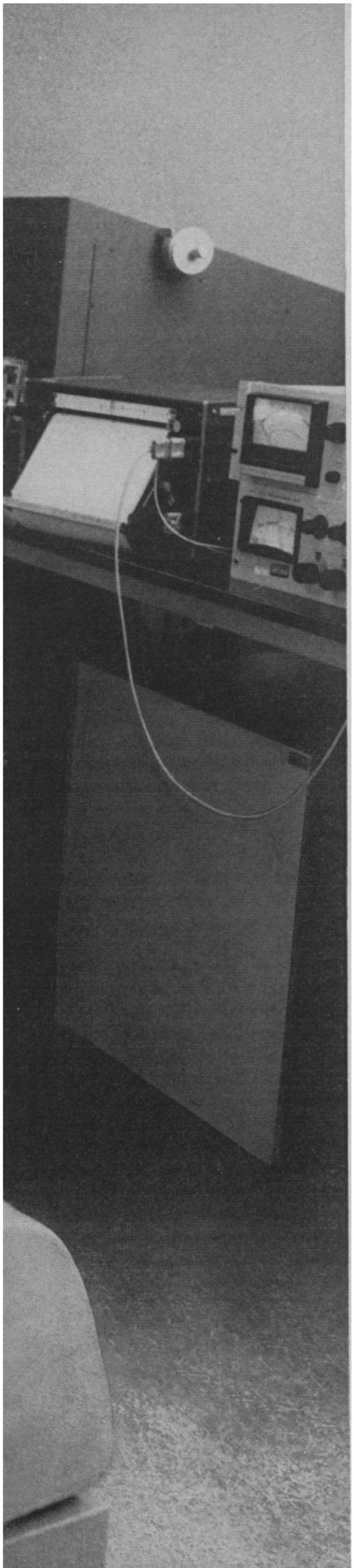







MEMORY DATA
MEMORY ADDRESS
OVERFLOW
FETCH



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DIGITAL COMPUTERS

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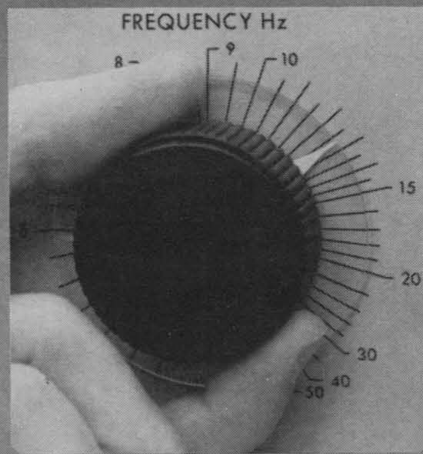
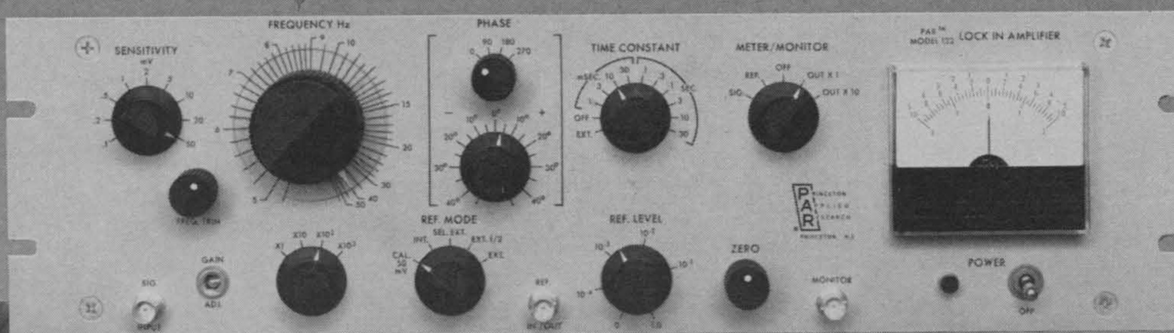
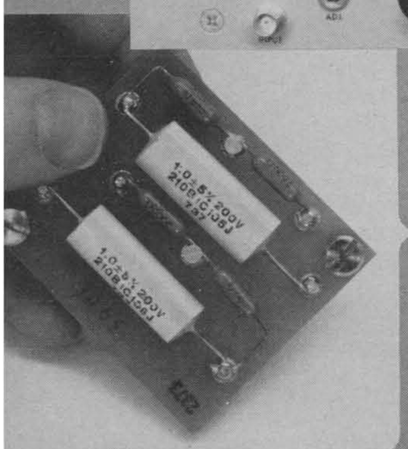
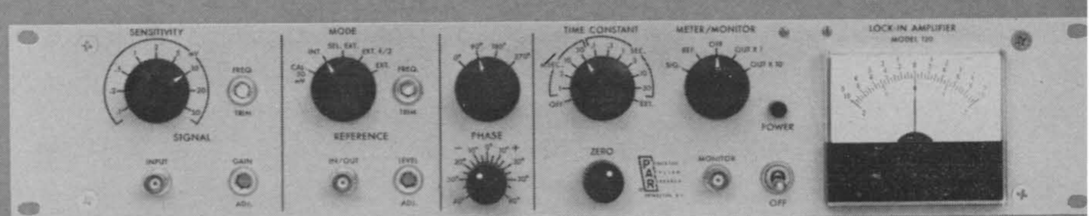


LOW COST LOCK-IN AMPLIFIERS FROM PAR







Princeton Applied Research Corporation manufactures the most sophisticated and versatile phase sensitive detectors available for the measurement of low-level signals buried in noise. But P.A.R. can also provide slightly less remarkable instruments for remarkably less money.

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For more information about Lock In Amplifiers, or for answers to specific application problems, write or call Princeton Applied Research Corporation, P. O. Box 565, Princeton, N. J. 08540. Telephone: (609) 924-6835.

PRINCETON APPLIED RESEARCH CORPORATION

27 June 1969, Volume 164, Number 3887

SCIENCE

A Tribute to Frederick Seitz

At the end of this month Frederick Seitz will conclude seven vigorous years as President of the National Academy of Sciences. He assumed that office at a moment when the Academy was deeply engaged in a searching review of its own role in national affairs. In the aftermath of World War II the prestige of science in the public mind had continued to mount, and there was a widening recognition that henceforth science must become an important element in the shaping of national policy. By its charter and traditions, the National Academy was constituted to provide advice to government on scientific matters as well as to honor individual achievement. Now, however, in what was clearly to be a new era for the influence of science, how was the Academy to fulfill its functions and meet its responsibilities?

In 1962 the membership of the Academy was by no means unanimous on the issues of activism and relevance—on how and how far it should move into the public arena. But the overwhelming majority gave to the new president a mandate not only to continue but to extend the active role in national affairs so effectively initiated by his predecessor, Detlev Bronk.

Dr. Seitz brought to this task the breadth of view and experience that were imperative—a most distinguished career of research in solid state physics and an intimate knowledge of industry as well as academic institutions. He had acquired during the war years an understanding of the character and needs of military research. And as Science Advisor to the North Atlantic Treaty Organization, he had developed his own perspective of international science.

Over the past 7 years the Academy has substantially expanded its advisory services to government. Acting through an exceedingly able Committee on Science and Public Policy, it has sponsored studies on the current status and future needs in a number of fields. It has prepared special reports to the Congress on the relation of basic research to national goals and of applied science to technological progress. Through the National Research Council the Academy has directed attention to problems of pollution, water management, drugs, nutrition, transportation, and urban development. At the same time there has been a notable increase of activity in international scientific affairs. The Soviet–U.S. exchange has been extended and new programs established with Czechoslovakia, Yugoslavia, and Poland. There is participation in a growing number of worldwide scientific programs, including the International Hydrological Decade, the International Biological Program, the World Weather Watch, and the Global Atmospheric Research Program.

Again, in harmony with the central theme of service to the nation, the NAS collaborated with the engineering community to establish under the same charter the National Academy of Engineering so that the highest resources of that profession might be added to the attack upon the great technological problems that confront society.

Together with Joseph Henry, George Hale, and Detlev Bronk, Seitz has been a builder. During his presidency the endowment has been doubled, and with the handsome new auditorium now taking form, the house of the Academy will at last be completed.

These are only highlights of a record of achievement to which many have contributed but to which Fred Seitz gave outstanding leadership. As the first full-time president, he dedicated all his energies to the task and carried out his responsibilities with courage and wisdom. With the recent changing attitude of the Congress and the country toward science, the need for an independent voice becomes ever more important. We owe Fred Seitz our best thanks for adding to the stature and the usefulness of the National Academy of Sciences in these difficult times.

—J. A. STRATTON, *Chairman of the Board, Ford Foundation*

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