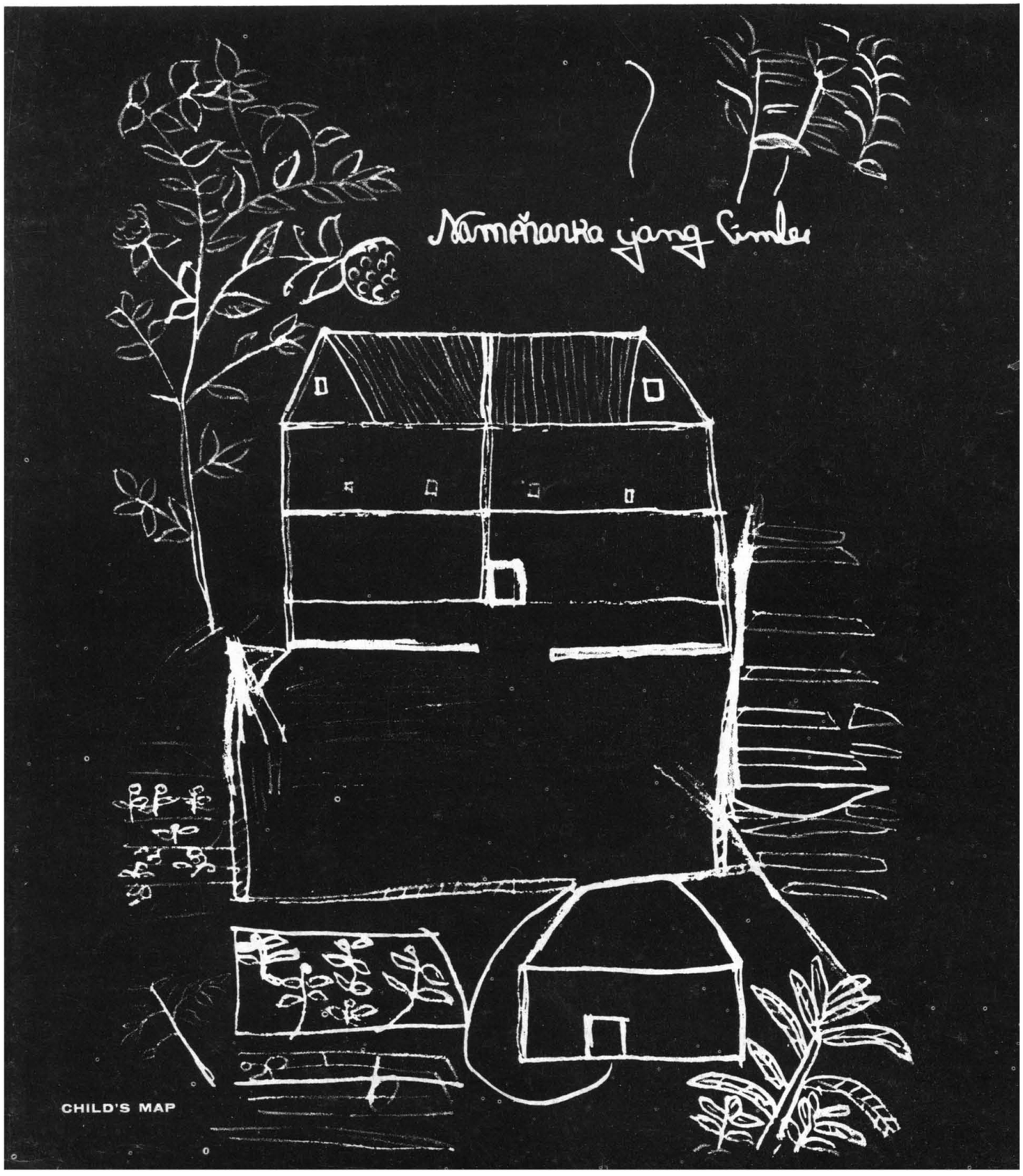
SCIENCE

10 February 1967

Vol. 155, No. 3763

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



CHILD'S MAP

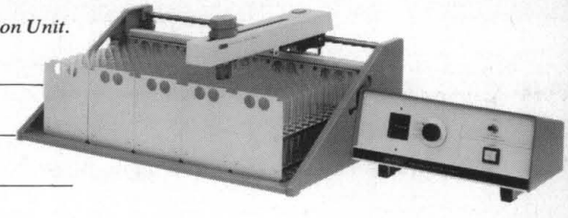
If this drop is radioactive, pathogenic, or valuable, don't let it fall between the tubes. Get a Beckman Fraction Collector

—the one that doesn't spill sample between tubes. The delivery head of the Beckman Model 132 Fraction Collector closes—and stays closed—until it is properly positioned over each successive tube. This took a little doing in the design department, but samples being what they often are, it's a feature of value to careful investigators.

The Beckman Collector has a number of other such practical, but relatively sophisticated advantages. Not the least of them is the method of keeping the collector and its contents cool. You place the entire Fraction Collector in a handy-sized Refrigeration Unit whose design is equally oriented to the investigator's needs. For example, you look down on the collector through a glass lid so you can quickly pick out the tubes you want. The unit is mobile. For chromatography, up to four columns can be mounted on the outside of it and can be cooled—or heated—via a built-in temperature control system, while the fractions in the collector are held at a steady 4°C.

For more information, just send us the coupon. There's a lot more to be said for the Beckman Fraction Collector!

Please send information on the Model 132 Fraction Collector and its Refrigeration Unit.



Name_____
please print

Department_____

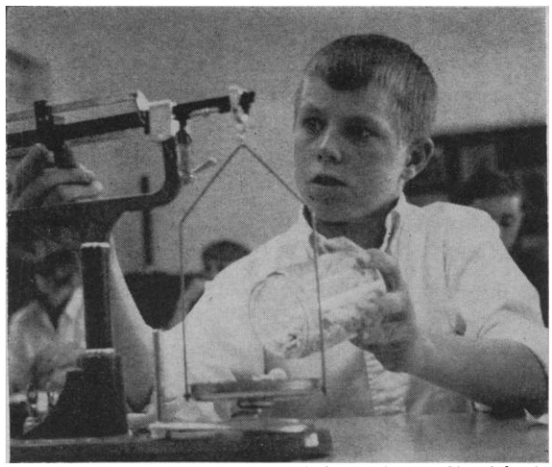
Institution_____

Address_____

City_____ State_____ Zip No._____

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

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



Courtesy Earth Science Curriculum Project, Boulder, Colorado.

Teaching Science Creatively

By Nathan S. Washton, Ed.D.,
Queens College, City U. of N.Y.

This new text gives the present or prospective secondary school teacher research-based principles and classroom-tested methods for teaching science creatively by stimulating inquiry. Dr. Washton discusses the new curricula in biology, physical science, and general science, and the research that is evaluating them. He shows how to organize curricula, prepare unit and lesson plans, select equipment, and construct tests. Every point is illustrated with practical examples—even a complete classroom-tested syllabus for a unit on matter and energy. Valuable lists of sources and materials are included.

About 432 pages, illustrated. About $8.50. Ready February.

New Saunders Books

Behavior Problems of Children

By Elinor Verville, Ph.D.,
Consulting Psychologist.

An experienced clinical psychologist has brought together in this book a wide range of facts, insights, and conclusions garnered by many professional workers in the field of child behavior problems. Dr. Verville first sets forth what is known of the determinants of behavior, and shows how multiple factors in the child, his environment, and his rearing produce deviant behavior. She shows how proper treatment can help the child become self-respecting through the adequate use of his own capacities and acceptable to society through the attainment of self-control. She describes rehabilitation techniques that take advantage of developmental changes to achieve these ends. Then she traces the normal development and specific problems characteristic of the preschool, elementary school, and adolescent periods, plus the particular problems of the handicapped child. Fifty case histories illuminate the points discussed.

About 550 pages. About $8.50. Ready February.

Theories of Psychopathology

By Theodore Millon, Ph.D., Lehigh University.

For this new anthology, Dr. Millon has selected papers in which such theoreticians as Bleuler, Sheldon, Freud, Sullivan, Rogers, Maslow, Skinner, and Dollard apply their theories to abnormal psychology. Dr. Millon groups these theories according to the kinds of data they emphasize—biophysical, intrapsychic, phenomenological, or behavioral. For each of these categories he presents papers that discuss the bases of the theory and the views of its proponents regarding the etiology and development, pathological patterns, and therapy of abnormal behavior—and others that critically examine its philosophical presuppositions and empirical support. In an introductory essay Dr. Millon shows how, although they appear contradictory, the theories actually complement one another. As a text for courses in abnormal psychology, for supplementary reading, or for reference, this book is a valuable contribution.

Hard cover about $7.50. Soft cover about $4.50.
444 pages. Ready February.

W. B. Saunders Company West Washington Square, Philadelphia, Pa. 19105

Please send on approval and bill me: (discount to full-time teachers listing affiliation)

Author..... Title.....

Name.....

Address..... Zip.....

Sc 2/10/67

10 February 1967
Vol. 155, No. 3763

SCIENCE

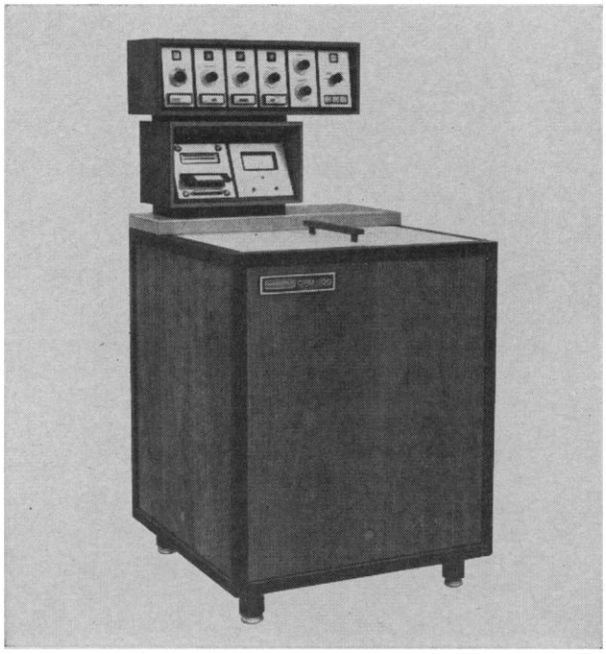
SCIENCE is published weekly on Friday and on the fourth Tuesday in November by the American Association for the Advancement of Science, 1515 Massachusetts Ave., N Washington, D.C. 20005. Now combined with **The Scientific Monthly**®. Second-class postage paid at Washington, D.C. Annual subscriptions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

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Map drawn by a Nepalese schoolboy depicts his house and its surroundings. The line leading to the door of the smaller house represents the process of going, not an actual path. The two houses actually face each other. Such maps are used to help determine the readiness of children or adults of another culture to understand and use scientific models and abstractions. See page 649. [Francis E. Dart and Panna Lal Pradhan, University of Oregon, Eugene]

Let's do a little counting in liquid scintillation.



Model X -	$15,000
Beckman - (at left)	$ 7,995
Minor Difference -	$ 7,005

MAJOR DIFFERENCES

Beckman systems are easier to use. By far. Just one knob does all the work of 76 knobs on Model X. Almost unbelievable. But true.

And speaking of counting, Beckman systems do it faster. And with greater efficiency and reliability. The analytical performance is far superior to any other. Unbelievable? Let us prove it.

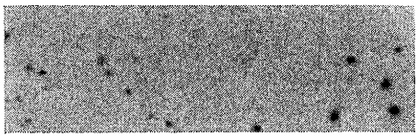
Beckman INSTRUMENTS, INC.
SCIENTIFIC AND PROCESS INSTRUMENTS DIVISION
FULLERTON, CALIFORNIA • 92634

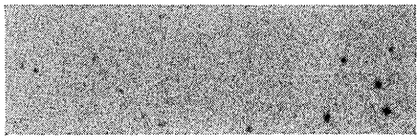
INTERNATIONAL SUBSIDIARIES: GENEVA; MUNICH; GLENROTHES, SCOTLAND; TOKYO; PARIS; CAPETOWN; LONDON; MEXICO CITY

The hope of doing each other some good prompts these advertisements

You want a fast emulsion?

We have recently made a photographic emulsion based on a new line of reasoning (*J. of the Optical Society of America*, 55:907) and sent it out on some plates to the Palomar Observatory. Here is a comparison at 10× of what the new plate saw (*top*) with what was seen before in a

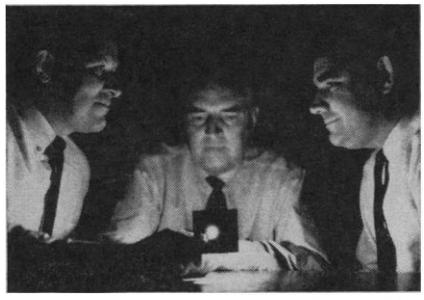




certain tiny piece of sky near Messier 101.

The new emulsion extends the limit of optically observable celestial objects by another magnitude or two. You might think that to record such a faint trickle of photons—perhaps the oldest physical entities sensible to man—might require a new high in emulsion speed. Not so. The trick was turned by going to a slower emulsion, but of a very special nature. It doesn't lose the tiny difference made by the age-old photons among all the other photons around, even with the hour-long exposure required for a statistically significant sampling of the photons.*

Though a plateful of spaghetti impresses far more inhabitants of this planet than does a plateful of new galaxies, we ourselves are sufficiently impressed to make the plate a regular product, hereafter designated KODAK *"Spectroscopic" Plate, Type IIIa-J. Information about it and other plates and films designed for long-time exposures can be obtained from Dept. 918, Eastman Kodak Company, Rochester, N. Y. 14650.*



Here are three men from Dept. 918 photographed by the light of a single match. They are exploring the extent of customer interest in the film on which they were photographed. Unlike the emulsion for plumbing the universe, this one is just plain more sensitive to light than any we have ever before offered.

Plain? That depends. It depends on processing. An experimental product still designated "S.O. 166," this film can be processed to a negative in the routine way—by hand or in a KODAK VERSAMAT Film Processor—and appear to be no faster than our older superfast films. With those films, if you try to compensate for too skimpy exposure by tripling the development time, all you do is convert more silver halide into black silver without much reference to the light values in the subject you were trying to photograph. With S.O. 166, extended development can multiply the effective light sensitivity as much as fourfold before the fog closes in. There is some sacrifice in sharpness and granularity, but the resolving power is enhanced by the higher contrast that is obtained. For streamer chambers (research hardware for the other end of the scale from galaxies), re-entry studies, fast rises on P-11 phosphor screens, surveillance of dimly lit antisocial activities, and applications that require fleeting signals to be recorded on a go or no-go basis, S.O. 166 is probably great and should outsell galactic plates by a factor of many thousands.

The three on a match would be interested to learn of your requirements. Don't expect any S.O. 166 yet for the family camera.

*Controlled baking of the plate yields greater sensitivity by improving its reciprocity characteristic and its quantum efficiency. This means that you get to use a lot of photons that would otherwise be lost and therefore get your sampling done in a shorter time. Contrary to our naive conjecture, you do not lose the advantage of improved S/N which was acquired by going to a fine-grain emulsion and long exposure. Moral: you can have your cake and eat it too—if it's baked twice, once at the factory and once in your own oven!

Vitamin E in Pittsburgh and Rochester

We have reported a curious finding in *The American Journal of Clinical Nutrition* (17:351). Blood level of α-tocopherol (the substance principally responsible for the physiological vitamin E effect) averaged 358 ± 21 μg per cent in a group of 37 Pittsburghers whose serum lipids we were permitted to analyze. None of them had given their physicians any clinical evidence of vitamin E deficiency, but many were in an economic status that had brought them with other medical problems to a public hospital. This compared with 507 ± 32 μg per cent for a group of 37 persons in Rochester, N. Y., randomly picked from a healthy, working population, some of whom had been taking multivitamin tablets but no special vitamin E supplementation.

Besides vitamin E in bulk for the pharmaceutical and animal agriculture industries, Distillation Products Industries (Division of Eastman Kodak Company), Rochester, N. Y. 14603, also markets EASTMAN CHROMAGRAM *Sheet, the convenient new medium for thin-layer chromatography—convenient for anyone in a position to see for himself how significant might be the differences in tocopherol level in the population's plasma. Paper cited gives suggestions on the procedure.*

Two Indians

At a station in Montana two members of the Blackfeet tribe boarded a train we were riding. The soft-voiced young men were leaving home and parents for a distant city where one could learn to be an x-ray technician, they told us as the coniferous forests clicked past.

Coniferous forests today are grown and processed by firms like Weyerhaeuser Company. The game that the forests support make excellent sport, but for sustaining human life a regular paycheck proves far more convenient. People trained in handling x-ray film serve Weyerhaeuser, for example, in:

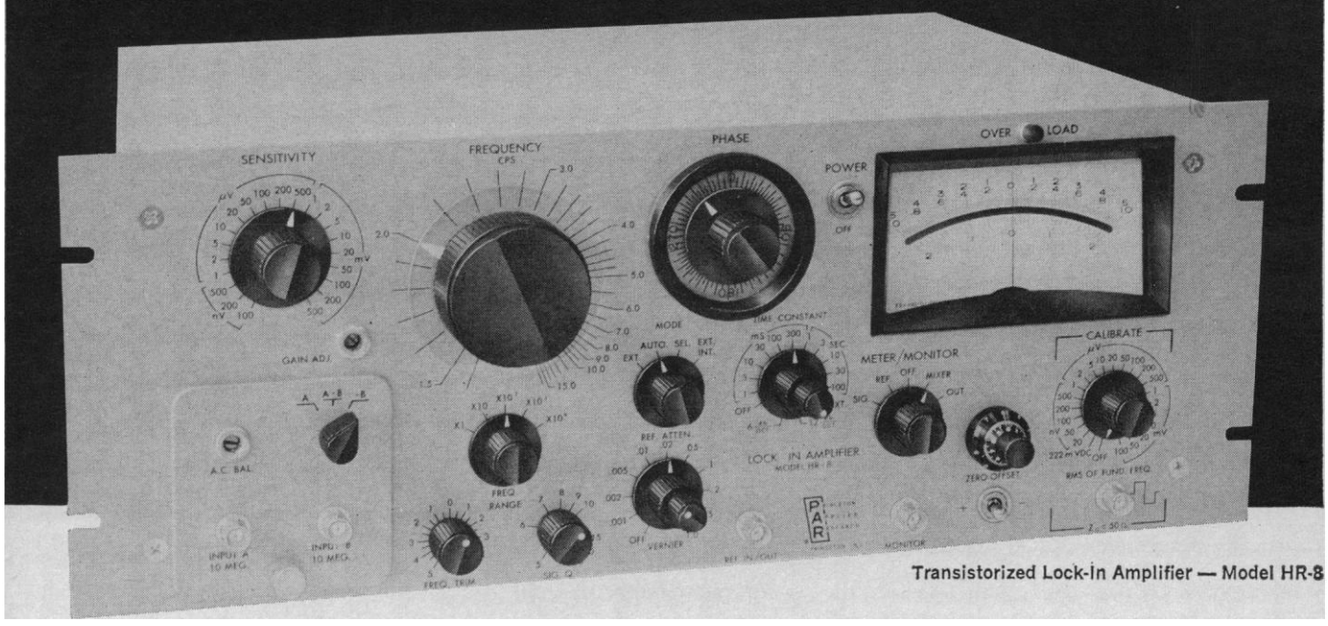
- Showing why the cones of noble fir must not be picked and immediately processed in an attempt to cut loss of viable seed.
- Selecting seed reasonably unriddled by larvae.
- Saving vast amounts of tedious dissection of bark samples in studies of Douglas-fir beetle populations and behavior.
- Finding an effective systemic insecticide that is translocated into the growth and needles of Sitka spruce and grand fir seedlings.

The big market for our radiographic products is not in the forest products industry but in the healing arts, in certain routine procedures in structural safety assurance, and in industrial quality control. Otherwise x-ray technique is easy to shove off into a seldom frequented corner of the technical mind. Too bad.

Weyerhaeuser Company's address is Tacoma, Wash. 98401. Ours is Eastman Kodak Company, Dept. 740, Rochester, N. Y. 14650, in case you care to propose a suitable audience for a new informational film of ours—an audience of Indians or other people willing to open their minds to x-ray. It's called "More Than Meets the Eye."

Kodak

New PAR Lock-In Amplifier Measures Signals in the Presence of Noise by Crosscorrelation



Transistorized Lock-In Amplifier — Model HR-8

The PAR Model HR-8 Lock-In Amplifier represents a significant advance in signal processing equipment for experimentalists who must measure low-level signal intensities in the presence of noise. It employs the theoretically optimum technique for signal recovery, and can be incorporated into a large class of experiments in which the signal of interest is, or can be made periodic, and in which a reference voltage related in frequency and phase to the signal can be obtained. The Model HR-8 first amplifies and bandlimits the input signal and then crosscorrelates it with the reference signal, suitably phase shifted and shaped. The crosscorrelation of input and reference signals yields a DC output voltage proportional to the signal of interest, while the crosscorrelation of the reference and noise results in no net DC voltage. The system can also be described as a continuously integrating, highly sensitive, phase conscious voltmeter, the response of which is "locked" to that particular frequency and phase at which the signal information has been made to appear.

Technical Features:

Frequency Range: 1.5 cps to 150 KC continuously tunable in 5 ranges.

Time Constants: 11 values in 1-3 sequence extending from 0.001 to 100 seconds. Single or double section RC filtering.

Pre-Amplifiers: Interchangeable low-noise pre-amplifiers, operable either within the HR-8 or remotely, are used.
Type A: Differential 10 megohm input.
Type B: Low impedance transformer input for low source impedances.

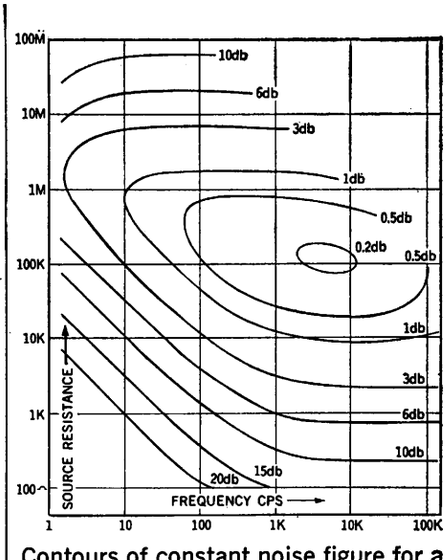
Sensitivity: 21 calibrated full scale ranges in 1-2-5 sequence.
With Type A Pre-Amplifier: 100 nanovolts to 500 millivolts rms.
With Type B Pre-Amplifier: 1 nanovolt to 5 millivolts rms.

Output: ± 10 volts full scale, single-ended with respect to ground. Will drive galvanometric and servo recorders.

Frequency Selective Amplifiers: Notch network in negative feedback loop used in both signal and reference channel tuned amplifiers. Reference channel Q of 10. Signal channel Q adjustable from 5 to 25 with calibrated dial (no gain change with Q adjustment).

Phase Adjustment: Calibrated 360° phase shifter, providing continuous rotation as well as a four position quadrant switch which shifts phase in 90° increments.

Price: $2,250 with either Type A or Type B Pre-Amplifier.



Contours of constant noise figure for a typical PAR Type A preamplifier plotted to show dependence on frequency and source resistance at 300° K. Amplifier operated single-ended.

Write for bulletin No. 120 on the HR-8 or ask for information on PAR's complete line of Lock-In Amplifiers and accessories.

PRINCETON APPLIED RESEARCH CORP.
Dept. G
Box 565, Princeton, N. J., Tel. (609) 924-6835

. . . Studies of psychiatric effectiveness, whether their conclusions are favorable or not, characteristically overlook the meaning of the patient's "choice" of adaptive responses to a painful world. One may say that the patient and the person reporting spontaneous remission of symptoms are equally programmed by their experiences, but that the program elicits a different adaptation in each case. Isn't it fortunate, then, that clinical psychiatry can serve those whose programs dictate a mode of secular medical assistance? The very fact of therapy may influence the individual's "choice" of responses, but that proves nothing more than its perceived usefulness. Realistically, psychiatric insights are so influential that whether they are absolutely true or not is historically irrelevant. They came into existence to meet a need, and modern society could not be imagined without them. They are probably necessary first steps toward a true science of the mind.

DON BRONKEMA
110 Bleecker Street, New York 10012

. . . If the hypothesis is correct, and I as an interested nonprofessional find the evidence impressive, that psychoanalysis does not in fact contribute to the cure of mental disease or to measurable improvement in mental health, what should the scientific community do about it? The Hoxsey clinic with its cures for cancer was eventually effectively quarantined on the basis of scientific opinion. Recently we have had the "battery additive" and Krebiozen cases. These are simpler issues and much less dangerous for the scientific community. The responsibility of the scientist in shielding the public from more pervasive *possible* frauds is even greater. If typical psychoanalysis is basically a fraud insofar as it does not deliver what it purports to deliver, *and in return for a fee*, then surely something should be done about it.

As the evidence accumulates and the minority of psychologists and psychiatrists become more vocal, it may be wise for a responsible body, such as the National Academy of Sciences, to set up a committee to study the matter before it is sensationalized by the press some years hence. One of the special difficulties that can be anticipated is that deeply religious believers in the mythical thought structure of Freudian analysis are to be found at the highest educational levels. Will such an enquiry into basic beliefs be permitted by those who feel that psychiatry has helped them personally? Has society a right to ask for such validation? I believe it has *only* as long as fees are charged. Perhaps herein lies the eventual solution to the psychiatrists' proposal reported in Linn's book review. Surely if believers in the psychoanalytic world-view were to take their rightful place as another religion or way of life, they could then carry their gospel of "psychiatry out of the hospitals and clinics into the community" as a charitable service.

RUSTUM ROY
Materials Research Laboratory, Pennsylvania State University, University Park 16802

Rimland's letter reveals anger over the failure of psychiatrists to make impartial judgments about the effectiveness of their daily work and about the soundness of their theories. . . . Psychiatry and psychology are infant sciences in the 20th century, swathed in superstition and under authoritarian control. The visible inadequacies of psychiatry should be not a source of anger but rather a spur to the inquiring mind; they should also be a stimulus to scientific humility.

The psychiatrists of the 21st century will look back with amusement and tolerance (let us hope) at the psychiatry of today. Let us pray that they are that much ahead of us!

JOHN T. FLYNN
Beekman-Downtown Hospital, 170 William Street, New York 10038

Specialization and Medical Education

The lucid letters of Mellinkoff and King (11 Nov.) go to the heart of several of the many complex problems afflicting medical education, whereas much of the current writing on the subject is characterized by stereotypical and wishful thinking. For example, proposals to produce greater numbers of general practitioners more often reflect the myth of the old-fashioned family doctor than familiarity with the history of medicine and current medical needs and social problems. Ignored, among other facts, are the increasing mobility of the average individual and average family, and the increasing demand by the public for direct access to specialists.

Among the many economic problems, insufficient attention is given to the high cost of medical education. If we are to recruit enough highly qualified students to study medicine, medical education will have to be subsidized by direct federal grants to the student, without a means test. While I am familiar with noteworthy exceptions, most medical students are being contaminated by a value gradient along which "basic research" is placed in a hallowed shrine, with clinical or applied research and teaching in descending order of value. That such valuation is specious is recognized by those department chairmen, as King indicates, who encourage the highest standards in every area of professional work, and who thereby tend to elicit the most productive and creative work from students and co-workers.

H. ROBERT BLANK

Department of Psychiatry,
Albert Einstein College of Medicine,
New York 10061

One is relieved to read that the more medicine tends to become a science "the more it becomes simple and easy to understand" (Mitchell, Letters, 11 Nov.). In one field, radiology, the time when it will be simple and easy seems to be receding. So much knowledge has been acquired since 1945 that one person cannot know it all; not that it is too difficult; there is too much.

Radiation therapy is a separate discipline; curable types of cancer (larynx, cervix, tongue, and others) are now being treated by people with special experience and proven ability. The scope of diagnostic radiology in a large hospital practice is too great for any one man to handle with authority. Therefore, it is divided into subspecialties, not only according to organ systems, but according to the age of the patient. Pediatric radiology has some 100 practitioners in the United States, even though it became an established subspecialty only in the past 20 years. Knowledge in this field alone has increased to the extent that one man can no longer be expected to be thoroughly familiar with all aspects of radiographic manifestations of diseases in children.

Generally 5 to 6 years of training after the internship are necessary for a radiologist to acquire expert knowledge in an area of pediatric x-ray diagnosis. Some specialize in children's diseases of the heart, especially congenital heart disease, others in diseases of the genitourinary tract, still others in dis-

eases of the skeleton; of the latter, one man is particularly interested in the pelvic bones. There is one person in the country who can rightfully be called a pediatric neuroradiologist.

One must agree with Mitchell that "a foundation of trained clinical observation is necessary" in medicine. It is hard to see how this makes specialization unnecessary. Even if man's capacity for knowledge were limitless, his time to acquire it is not. A boy with a removable brain tumor or a surgically curable congenital cardiac malformation would benefit more from being seen by a physician with relevant special experience than by one without it.

Specialization is not evil; what is to be deplored is *specialism*, a parochial attitude. The general physician is not immune to it, as we can see when he deplores specialization.

STEVEN E. ROSS
University of California School of Medicine, San Francisco 94122

Automatic Language Processing: Source of Funds

In discussing the report of the Automatic Language Processing Advisory Committee, National Academy of Sciences—National Research Council entitled *Language and Machines: Computers in Translation and Linguistics*, Bryce Nelson reported an interview with R. Ross Macdonald, director of the Georgetown University Machine Translation Research Project (6 Jan., p. 59). According to the article Macdonald denied that the National Science Foundation had ever supported the Georgetown MT group—as stated in the Automatic Language Processing Advisory Committee report. "Macdonald argued that this was one of the errors in the report, since it was known that all NSF money given to the Georgetown project came from the CIA." It happens that the National Science Foundation did make grants (G-2723, G-3867, and G-5513) of $106,000 to the Georgetown MT Project. My authority for these figures is page v of the Georgetown University Machine Translation Research Project "General Report" (June 1963) prepared by R. Ross Macdonald.

A. HOOD ROBERTS
Automatic Language Processing Advisory Committee, National Academy of Sciences, Washington, D.C. 20418

ANALOG MONOLOGUE

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

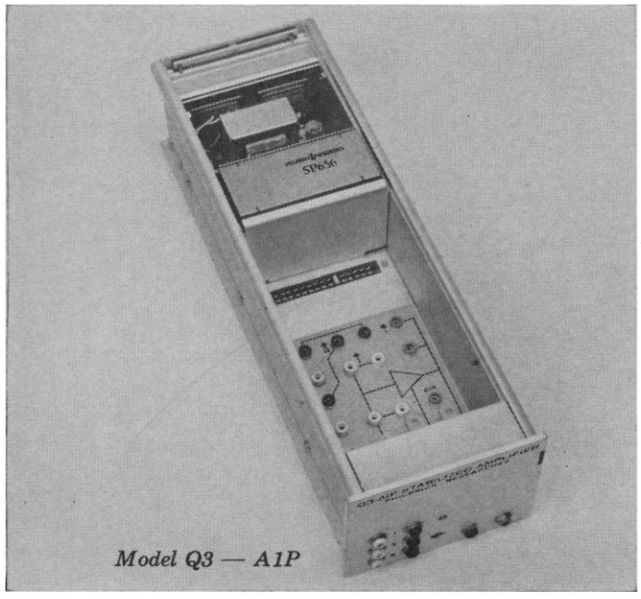
Volume 1, No. 4

A SHORTER PATH TO PRACTICAL ELECTRONIC MEASUREMENTS

One requirement is common to all scientific research . . . threads through all development engineering . . . marks every empirical exercise — *the need to measure.* Our interest in this arises from the fact that electronic circuits (often with transducers) are generally the most practical means for measuring and recording parameters. Moreover, an increasing number of practical and economical electronic measuring circuits employ Operational Amplifiers — our specialty in analog computing devices since before 1946, and as a circuit component since their introduction as such in 1952.

During the past twenty years, we have been privileged to work closely with specialists in many disciplines, helping them to design and build literally thousands of different kinds of circuits — instruments, signal "conditioners", and data "processors" and others ad infinitum. We have learned that our "opposite numbers" in Chemistry, Metallurgy, Aerodynamics, Hydraulics, Mathematics, Stress Analysis, Physics, Thermodynamics, etc., are generally enthusiastic about what Analog Operational circuits *can do,* but almost totally disinterested in *how* they can be made to do it . . . and that is pretty much as it should be. To each his own.

We have observed that a major deterrent to more widespread use of the powerful Analog Way (of sensitive, accurate measurement and data processing) has been the time, effort, and considerable skill required to convert the circuit diagram into a complete, functioning instrument. Now we have found a way to speed and simplify that process. We call it the *Universal Operational Module* (U.O.M.): One such module, the Q3-A1P, is shown here.



Model Q3 — A1P

The Q3-A1P consists of a unique mechanical structure, in which are mounted a high-performance, chopper-stabilized Operational Amplifier, a compatible power supply, and an "Operating Deck", on which is located a cluster of conveniently-disposed, clearly-labeled jacks, for interconnecting input and feedback components with the amplifier and its supply. The structure also provides connectors and space for auxiliary networks, for input and output cables, and a front panel with duplicate input/output terminations. With a Q3-A1P and a few simple pluggable components (i.e., resistors, capacitors, etc.) any one of literally thousands of useful circuits — complete and ready to use — may be realized . . . *minutes after it is conceived,* without punching a hole, or soldering a wire.

Best of all, the physical organization of the Q3-A1P has been carefully planned to anticipate and prevent or circumvent most of the tiresome and unproductive "debugging" and "tweaking" that plagues almost any original design. Shielding, guarding, wire-routing; "strays", "sneaks", "parasitics" — you may forget them all, in almost every instance.

The Q3-modular packaging system which includes a variety of universal operational modules, some of which are listed in Table 1, permits concentration on the *important* things — What and Why, instead of How.

TABLE 1

Q3-A1P	Compact, self-powered, chopper-stabilized amplifier complete with patch panel and accessory socket.
Q3-A2P	As above, but using a low noise, low current-offset, differential amplifier.
Q3-J1P	A switch-programmable, self-powered integrator-differentiator.
Q3-M1P	A switch-programmable, self-powered unit capable of performing non-linear functions such as multiplying, dividing, squaring and rooting.
Q3-M2P	As above, less switches, programmable via a patch panel.

These universal operational modules (U.O.M.'s) consist of a standard Q3 series package, equipped with a carefully optimized interface facility to permit the combination of amplifiers, networks, components, and power supplies into highly-flexible, universal analog devices.

If you have been thinking of adding staff, perhaps to accelerate important programs, consider this alternate possibility: reducing the instrumentation burden on your present staff, with Philbrick Q3 U.O.M.'s and Philbrick Applications Engineering assistance — both distinguished by their versatility, integrity and reliability.

Write today for MBA Package #4 which contains a short form catalog. Philbrick Researches, Inc., 25-F Allied Drive at Route 128, Dedham, Massachusetts 02026. Phone (617) 329-1600.

Φ

PHILBRICK

10 February 1967, Volume 155, Number 3763

SCIENCE

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

Goals, Priorities, and Dollars

In 1975 the U.S. will spend over $30 billion for research and development if the projections of *Goals, Priorities, and Dollars** are confirmed. This book, by Leonard Lecht, is the first report of the National Planning Association's Center for Priority Analysis. It projects the amount of money likely to be available for 16 classes of expenditure and the cost of meeting national goals in each class, as those goals have been formulated by legislative enactment, expert studies, or knowledgeable public bodies. The classes are: consumer expenditures and savings, private plant and equipment, urban development, social welfare, health, education, transportation, national defense, housing, research and development, natural resources, international aid, space, agriculture, manpower retraining, and area redevelopment. The listing is in decreasing order of the amounts expected to be spent in 1975.

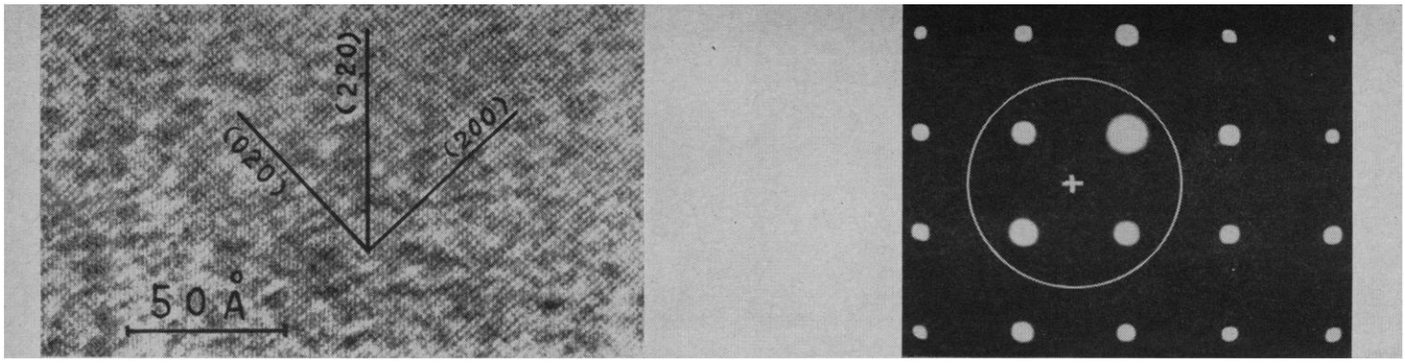
The U.S. population is expected to increase to 226 million in 1975. For a population of this size, a gross national product (GNP) of $770 billion will be required to equal 1962 per-capita expenditures for civilian goods, education, health care, and the rest of the 16 areas. The actual GNP for 1975 is likely to be higher—$981 billion, if Lecht is right in assuming a steady 4-percent-a-year increase from 1962 to 1975. This rate is higher than that in recent years, but he considers it reasonable and attainable. A GNP of $981 billion will be $211 billion above the amount necessary to maintain 1962 standards, but it will not be enough to meet in full the goals in all 14 areas. That would require a GNP of $1127 billion.

The projections give hope of $211 billion for discretionary use in raising standards above present levels for some or all of the goal areas, and they also give warning that we will fall short by $146 billion of having enough to satisfy all the aspirations. For research and development, continuation of the 1962 expenditure rate of 3 percent of GNP would provide $30 billion in 1975, an amount that seems reasonable in light of actual increases from 1962 through 1967. The aspiration level for 1975 is $39 billion.

Obviously choice will be necessary. Every budget-maker knows this necessity, yet Lecht's calculations help to define the area in which we can maneuver. Moreover, projection of the R & D range and of the size and range of other claims on the GNP strengthen the argument that we need better information on which to base our choices.

Traditionally, individual companies, universities, foundations, government agencies, and congressional committees have each looked at some portion of the total research and development realm. Their individual decisions, made for their individual reasons, collectively determine the national total and distribution of R & D expenditures. We will not depart from this decentralized system, yet we could provide many decision-makers with two kinds of help to make better-informed choices. One is additional, updated, and more refined projections and analyses of the kind Lecht has given us. The other is the clearer formulation of criteria for choice among various scientific and technological alternatives. Choices are inevitable; scientists can lead in establishing the criteria on which they are made, or they can leave this responsibility to others.—DAEL WOLFLE

* Leonard A. Lecht, *Goals, Priorities, and Dollars*, Free Press, New York, 1966, $2.95.



Electron micrograph and diffraction pattern taken on the HU-11C showing the crossed lattice images of the (200) planes of gold. The (020) and (200) planes = 2.04 Angstroms. The (220) plane = 1.44 Angstroms. All important factors such as contamination, stage drift, astigmatism and aberrations must be negligible to achieve this ultra-high resolution. The HU-11C was operated at an accelerating voltage of 100 KV and an electron optical magnification of 270,000 X. The illumination was tilted until the three reflections showed nearly equal intensity in the diffraction pattern; then the micrograph was taken.

FROM HITACHI PERKIN-ELMER

THE HU-11C: LEADER IN A NEW GENERATION OF ELECTRON MICROSCOPES

Here is the highest-resolution electron microscope in the world. The unique electromagnetic alignment and focusing system, centered on the objective lens, assures that ultra-high resolution conditions will be maintained on a day-to-day basis with unexcelled ease of operation. Resolution of better than five Angstroms is guaranteed. Resolution of better than 1.5 Angstroms has been demonstrated (see micrograph). Accelerating voltages of 50 KV, 75 KV and 100 KV provided. Magnification range: 400 X to 250,000 X. A 125 KV version of the HU-11C is available. A wide range of accessories extends the research capabilities of the HU-11C Electron Microscope. Electron Microprobe Attachment, Image Intensifier and Electromagnetic High Resolution Darkfield Attachment are but a few of the many outstanding accessories available. For full details, write to: The Perkin-Elmer Corporation, Electron Microscope Dept. 723 Main Avenue, Norwalk, Conn. 06852.

PERKIN-ELMER