SCIENCE

7 December 1973

Vol. 182, No. 4116

The NEW Uvicord

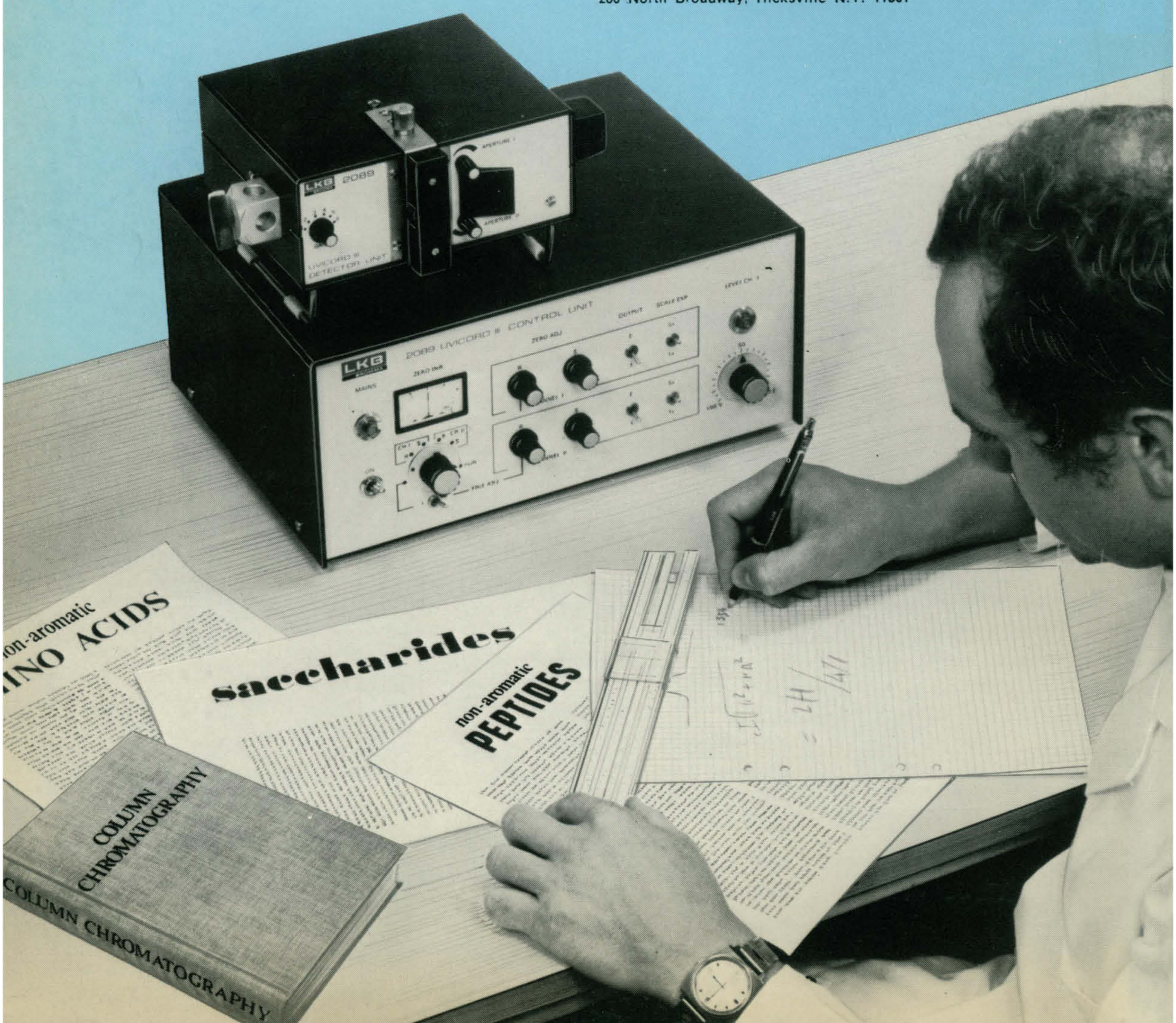
UV-monitor

With the new LKB Uvicord III UV-monitor you can increase sensitivity for proteins several hundred times. The LKB Uvicord III operates at 206 nm, which is a wavelength where you can simply and quickly detect non-aromatic amino acids, non-aromatic peptides and a number of saccharides. The high sensitivity of the LKB Uvicord III allows you to apply the convenient UV-monitoring method to practically all your chromatographic runs.

The Uvicord III also operates at 254, 280, 340 and 365 nm. It can measure simultaneously, at two different wavelengths, both the sample cell and a reference cell. Added to that, it has automatic scale expansion, provides results in Extinction or % Transmission, and incorporates a built-in level sensor for switching valves or controlling a gradient mixer. Write now for details of this revolutionary UV-monitor.

LKB

LKB Instruments Inc.
12221 Parklawn Drive, Rockville MD. 20852
11744 Wilshire Blvd. Los Angeles Calif. 90025
6600 West Irving Park Road, Chicago Ill. 60634
260 North Broadway, Hicksville N.Y. 11801



RNA DNA Transcription Hybridization Sequencing

NEN TIDES TABLE

^{32}P	^{14}C	^{3}H
d-ATP [α-^{32}P]	d-ATP [^{14}C]	d-ATP [^{3}H]
d-CTP [α-^{32}P]	d-CTP [^{14}C]	d-CTP [^{3}H]
d-GTP [α-^{32}P]	d-GTP [^{14}C]	d-GTP [8-^{3}H]
TTP [α-^{32}P]	TTP [^{14}C]	TTP [^{3}H]
ATP [α-^{32}P]	ATP [8-^{14}C]	ATP [2, 8-^{3}H]
ATP [γ-^{32}P]	ATP [^{14}C (U)]	CTP [5-^{3}H]
CTP [α-^{32}P]	CTP [2-^{14}C]	GTP [8-^{3}H]
GTP [α-^{32}P]	GTP [8-^{14}C]	UTP [5-^{3}H]
GTP [γ-^{32}P]	GTP [^{14}C (U)]	UTP [5, 6-^{3}H]
UTP [α-^{32}P]	UTP [2-^{14}C]	

Call or write for our complete catalog of Nucleotides.

NEN New England Nuclear

575 Albany Street, Boston, Mass. 02118
Customer Service 617-482-9595

Canada: NEN Canada Ltd., Dorval, Quebec, Tel: (514) 636-4971
Europe: NEN Chemicals GmbH, D6072 Dreieichenhain, Siemensstrasse 1, Germany. Tel: Langen (06103) 8353

7 December 1973

Volume 182, No. 4116

SCIENCE

BOARD OF DIRECTORS
GLENN T. SEABORG, Retiring President, Chairman
LEONARD M. RIESER, President
ROGER REVELLE, President-Elect
RICHARD H. BOLT
LEWIS M. BRANSCOMB
BARRY COMMONER
EMILIO Q. DADDARIO

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS
MATHEMATICS (A): Lipman Bers, F. A. Ficken
PHYSICS (B): Edwin M. McMillan, Rolf M. Sinclair
CHEMISTRY (C): Thomas E. Taylor, Leo Schubert
ASTRONOMY (D): Frank D. Drake, Arlo U. Landolt
PSYCHOLOGY (J): Carl P. Duncan, William D. Garvey
SOCIAL AND ECONOMIC SCIENCES (K): Robert K. Merton, Harvey Sapolsky
HISTORY AND PHILOSOPHY OF SCIENCE (L): Ernest Nagel, Dudley Shapere
INDUSTRIAL SCIENCE (P): Jacob E. Goldman, Jordan D. Lewis
EDUCATION (Q): Gordon Swanson, Phillip R. Fordyce
DENTISTRY (R): Martin Cattoni, Sholom Pearlman
PHARMACEUTICAL SCIENCES (S): William Heller, John Autian

DIVISIONS
ALASKA DIVISION: Gunter E. Weller, President; Irma Duncan, Executive Secretary
PACIFIC DIVISION: Robert C. Miller, President; Robert T. Orr, Secretary-Treasurer
SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION: Gordon L. Bender, President; Max P. Dunford, Executive Secretary-Treasurer

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. **Now combined with The Scientific Monthly®.** Second-class postage paid at Washington, D.C. Copyright © 1973 by the American Association for the Advancement of Science. Member rates on request. Annual subscription $30; foreign postage: Americas $4, overseas $6, air lift to Europe $18. Single copies $1 (back issues, $2) except **Guide to Scientific Instruments** which is $4. School year subscriptions: 9 months $22.50; 10 months $25. Provide 6 weeks notice for change of address, giving new and old address and zip codes. Send a recent address label. **Science is indexed in the Reader's Guide to Periodical Literature.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

EDWARD E. DAVID, JR. CARYL P. HASKINS WILLIAM T. GOLDEN WILLIAM BEVAN
WARD H. GOODENOUGH PHYLLIS V. PARKINS Treasurer Executive Officer

GEOLOGY AND GEOGRAPHY (E)
Helmut Landsberg
Ramon E. Bisque

BIOLOGICAL SCIENCES (G)
Dorothy Bliss
Richard J. Goss

ANTHROPOLOGY (H)
Richard N. Adams
Anthony Leeds

ENGINEERING (M)
Raynor L. Duncombe
C. Towner French

MEDICAL SCIENCES (N)
Robert A. Good
F. Douglas Lawrason

AGRICULTURE (O)
Roy L. Lovvorn
Michael A. Farrell

INFORMATION AND COMMUNICATION (T)
Jordan Baruch
Scott Adams

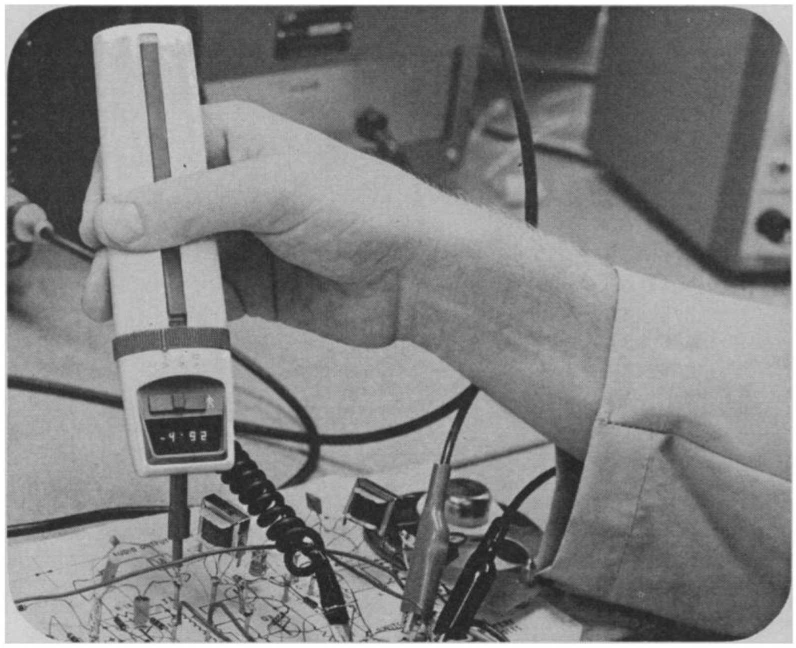
STATISTICS (U)
Frederick Mosteller
Ezra Glaser

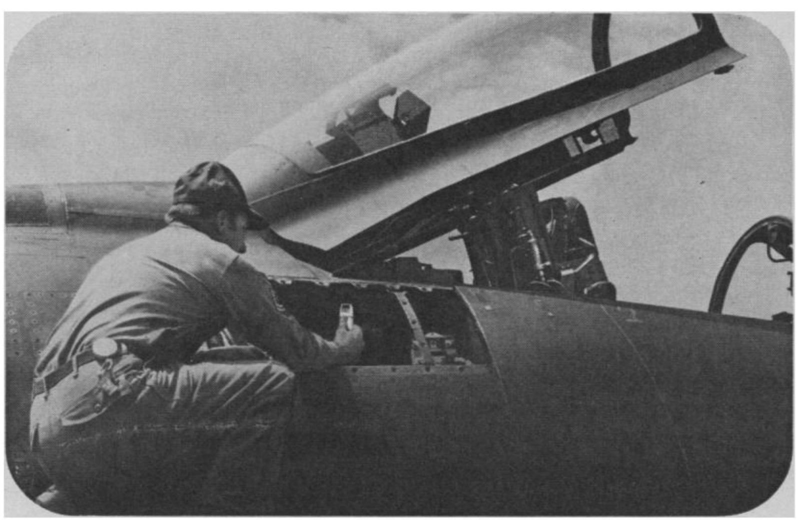
ATMOSPHERIC AND HYDROSPHERIC SCIENCES (W)
Max A. Kohler
Louis J. Battan

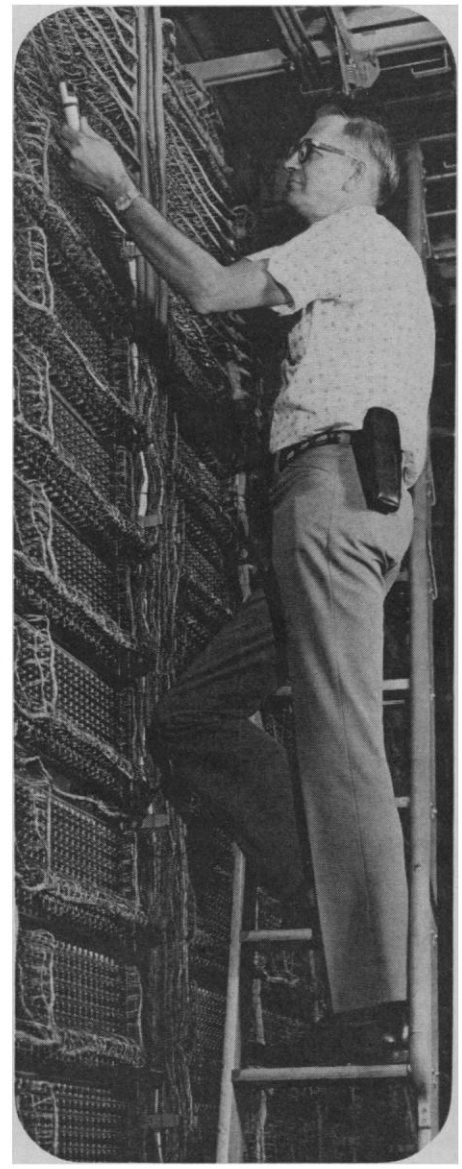
The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

COVER

Lobster with sea urchins in a forest of seaweed. Sea urchins clear seaweeds from large areas; lobsters help control sea urchin populations by preying upon them. See page 975. [Mary Primrose, Dalhousie University, Halifax, Nova Scotia, Canada]







A small tool with a big impact on field service

To designers and technology buffs, the fascinating aspect of the new HP 970A Digital Multimeter is how we managed to squeeze a complete $3^1/_2$-digit autoranging DMM into a package that fits the palm of your hand. (The secret, briefly, is a unique thin-film IC that incorporates the equivalent of 3,000 transistors, and combines digital and analog circuitry, on the same hybrid substrate.)

To service technicians and engineers, those harried souls who keep electronic wizardry in good repair, the important news is how the 970A radically improves the measurement of volts and ohms. The battery-powered DMM goes wherever the work is to perform fast and accurate troubleshooting in hard-to-get-at places, and it does this so simply and easily that it's tough to make a measurement error.

To managers responsible for field service, and the customers they serve, the key benefit is the time that can be saved. Since half the cost of field service is labor, and the 970A speeds and simplifies a laborious task, its true value is often realized on invoices for service calls.

Whether a technician is toiling over a dishwasher, a television set, telephone switchgear or the most advanced computer, the 970A works the same way: he selects the desired function, attaches a clip lead to circuit common and touches the test point with the probe tip. A touch of the thumb on the DMM's bar switch, and the measurement appears on the digital display. That's all. The rest is automatic. There's no need to select the proper knob, look for the right scale, figure out where the decimal point goes, or decide what the polarity is: the 970A does it all automatically.

Reading time is faster because the display is always in the line-of-sight, right next to the test point. Even if the 970A must be held upside down to reach a test point, the display can be electronically inverted so there's no chance of reading 6's for 9's.

Price is $275* including three interchangeable probe tips, built-in battery pack good for 2,000 measurements on a single overnight charge, charger, belt case, travel case and sun hood.

New portable spectrum analyzer "fingerprints" low-frequency signals

As its esoteric name implies, a spectrum analyzer is an instrument which separates and measures the individual frequencies that make up a complex electrical signal.

This ability to take apart and examine a waveform by spectrum analysis — to display, at one time, the frequencies and amplitudes of its individual spectral components — has been traditionally limited to the higher frequencies.

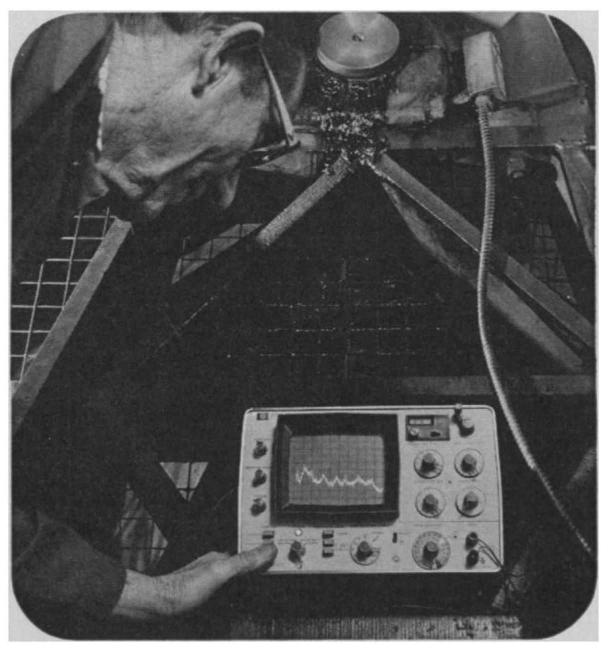
Now there's a low-cost way to do the same thing in the low-frequency range — the spectral deep where lurk such phenomena as mechanical vibrations, underwater sounds, communications signals and power line-related electrical interference. The new HP 3580A Spectrum Analyzer can look at a low-frequency event such as the signals produced by a jet engine or power plant generator and provide a signature analysis, or "fingerprint", containing important clues to how well it's working. The potential of using the 3580A for preventive maintenance — to help predict a failure before it occurs — exists in the instrument's use of digital storage.

Because necessarily slow sweeps of the frequency of interest are repetitively refreshed from the 3580A's digital memory, the CRT display is sharp and flickerless. This also allows a user to store a spectrum indefinitely, recall it whenever convenient, and even superimpose it on a new spectrum for comparison to see if there have been any tell-tale changes in the fingerprint.

Total analysis time is reduced by a factor of 10 or so through a technique called adaptive sweep. Akin to a "volume control" this sets a variable baseline high enough to exclude all noise and low-level signals that do not interest him and still obtain a full-resolution scan.

Fundamentally a precision instrument, the 3580A has a minimum bandwidth of 1 Hz (rather than the usual 10 Hz) over its entire range of 5 Hz to 50 kHz. It is thus capable of detecting spurious responses which can't be seen in the time domain or with older instruments.

The 3580A can be operated on line power or on internal rechargeable batteries. It weighs only 35 pounds and costs $3800*, plus $255* for the optional battery pack.



For more information on all of the above write to us. Hewlett-Packard, 1507 Page Mill Road Palo Alto, Calif. 94304

*US Domestic Prices Only. 00402

Mail to: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, CA 94304

Please send me information on:
☐ 970A Digital Multimeter ☐ 3580A Spectrum Analyzer

Name_____ Title_____
Company_____
Address_____
City_____ State_____ Zip_____

HEWLETT hp PACKARD

Sales and service from 172 offices in 65 countries.
Palo Alto, California 94304

AAAS Audiotapes

Inventory Sale

The following audiotapes are offered at a reduced rate of $10 for the first session and $5 for each additional session.

1-69 Hunger and Malnutrition (I–VII)
6-69 The City as a Social System: Perspectives on Urban Social Organization (I–II)
7-69 The Organization of Urban Places (I)
8-69 Statistics, Governments, and the Analysis of Social Problems (I–II)
9-69 Systems Models of Urban Systems (I–II)
11-69 The Identity and Dignity of Man: A Scientific and Theological Dialogue on Issues Emerging from Behavioral, Surgical, and Genetic Interventions (I–VIII)
14-69 Recent Developments in the Field of Pulsars (I)
18-69 Deep Sea Drilling Project (JOIDES) Science and Resources (I–II)
26-69 Approaches to Policy Sciences (I–II)
27-69 Science and Public Policy Workshop: Technology Assessment (I)
28-69 The Political Attitudes of Scientists (I)
29-69 Science and Society: A New Intergovernmental Approach to Domestic Problems (I–II)
30-69 Arms Control and Disarmament (I–II)
31-69 Academic Research and the Military (I–III)
37-69 Comparative History and Sociology of Science (I)
38-69 The Sorry State of Science: A Student Critique (I–II)
39-69 Photosynthetic Organisms: Origin and Evolution on Early Earth (I)
47-69 Expanding Horizons in Medical Education (I–II)
48-69 Ecology and the Undergraduate Curriculum (I)
63-70 The U.S. Contribution to the International Biological Program (I–II)
69-70 Industrial Approaches to Urban Problems (I–II)
71-70 Science Education in the Seventies (I)
72-70 Urbanization in the Arid Lands (I–III)
76-70 Mood, Behavior, and Drugs (I–IV)
78-70 Crime, Violence, and Social Control (I–II)
80-70 The Teaching of Science (I–II)
81-70 Scientific Organizations, War-Peace Issues, and the Public Policy Process (I–II)

Money order or check payable to AAAS—No cash. Allow 3 to 4 weeks for delivery.

Please Check: ___Reel ___Cassette

Name ____________________

Street ____________________

City ____________ State ____________ Zip ____________

Tape No. ______ Session No. ______ Tape No. ______ Session No. ______ Tape No. ______ Session No. ______
Tape No. ______ Session No. ______ Tape No. ______ Session No. ______ Tape No. ______ Session No. ______
Tape No. ______ Session No. ______ Tape No. ______ Session No. ______ Tape No. ______ Session No. ______

|A|A|A|S|

AMERICAN ASSOCIATION for the ADVANCEMENT OF SCIENCE
Department GF
1515 Massachusetts Avenue, NW, Washington, D.C. 20005

The IEEE invites you to spend 90 minutes in the presence of giants.

A device called a transistor, which has several applications in radio where a vacuum tube ordinarily is employed, was demonstrated for the first time yesterday at Bell Telephone Laboratories . . . where it was invented.
—The New York Times, *July 1, 1948*

This introductory line from an eight-sentence announcement in "The News of Radio" section of the *Times* 25 years ago heralded an era of technological advancement unprecedented in history.

The invention of the first point-contact transistor (TRANsfer reSISTOR) makes a fascinating tale—a story of genius at hard work, of singleminded pursuit, interdisciplinary cooperation, of failure, frustration, and, finally, success.

Now you can hear this story in the words of the three Nobel Laureate inventors themselves on an IEEE audio-tape cassette titled *The Invention of the Transistor.*

Shockley, Bardeen, and Brattain (l. to r.) at 25th-anniversary award ceremonies in New York City, March 1973.

We invite you to listen in as John Bardeen, William Shockley, and Walter Brattain tell about the people, experiments, and decisions that led to the first successful demonstration —a transistor amplifier—on December 23, 1947. With keen memories and an equally shared sense of humor, Bardeen, Shockley and Brattain recount the earlier discoveries that guided them, plus their own individual contributions.

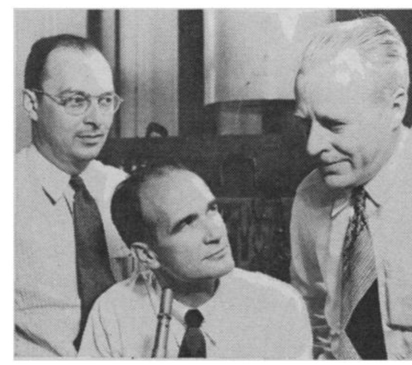
The discovery group

You'll hear about the unusual "discovery group" assembled at Bell Telephone Laboratories in 1945—an interdisciplinary team of physicists, electrical engineers, metallurgists and chemists—and how they worked together toward their common goal.

The Nobel prize winners are generous in their praise of other well-known scientists whose contributions led the way—men like Schroedinger, Wilson, Franck, Lark-Horowitz, Mott and Gurney. And in their praise of Bell Labs' research heads —James Fisk, Harvey Fletcher and Marvin Kelly—for it was only the free and open research philosophy at the Labs which permitted the discovery team to function so well.

An historical document

Edited by Prof. Richard A. Rikoski of the University of Pennsylvania, *The Invention of the Transistor* is much more than the reminiscences of three famous scientists. It's an historical and scientific document that puts into perspective the importance of pure research, interdisciplinary awareness, free and open publication, fellowships and sabbaticals, and a research department attitude that attracts talented people and allows them to function productively.



courtesy of Bell Laboratories

John Bardeen, William Shockley, and Walter Brattain (l. to r.) at Bell Telephone Laboratories in 1948.

The IEEE recommends *The Invention of the Transistor* to everyone interested in the formulation of concepts, whether or not trained in the sciences. We suggest you send for a copy today.

Extra Bonus

Along with the cassette, each purchaser will receive a 16-page retrospective summary titled "How the Transistor Emerged". Authored by Charles Weiner of the AIP Center for History of Physics, this illustrated report provides a concise and well-documented history of the people, places and events involved in the transistor's discovery.

To order *The Invention of the Transistor* cassette and "How the Transistor Emerged," use the convenient Order Form below.

The Institute of Electrical and Electronics Engineers, Inc., has published over 40 cassettes relating to virtually all phases of electro-technology, including seminar proceedings plus specially developed tutorial cassettes to foster current awareness and career development. All IEEE C-60 and C-90 cassettes are recorded on two-track monaural magnetic tape that can be played on any cassette player or recorder. To receive a complete listing of IEEE cassettes, or to inquire about IEEE membership and services, please use Order Form at the right.

IEEE Education Registrar CT
345 East 47th Street, New York, N. Y. 10017
Please send me postpaid ________ copy(ies) of the Invention of the Transistor cassette (EH00752) plus a copy of "How the Transistor Emerged." My check in the amount of ________ is enclosed.
[Price: IEEE members $7.00; Nonmembers $9.95]

NAME________________ MEMBER #________

ADDRESS________________________

CITY__________ STATE__________ ZIP________

PLEASE MAKE CHECK PAYABLE TO IEEE.

☐ SEND CASSETTE CATALOG.

☐ SEND INFORMATION ON IEEE MEMBERSHIP AND SERVICES.

The world's leader in labeled steroids is only a telephone call away: (617) 482-9595.

Progestins, androgens, corticoids, estrogens. Over 100 carbon-14 and tritium-labeled steroids. High specific activity, radiochemical purity guaranteed.

D-Aldosterone [1,2,6,7-^{3}H(N)] NET-419
80-105Ci/mmole $95/250μCi $330/1mCi
In sealed ampoule under vacuum

5α-Androstan-$3\alpha,17\beta$-diol [1,2-^{3}H(N)] NET-407
40-60Ci/mmole $80/250μCi $245/1mCi

Corticosterone [1,2,6,7-^{3}H(N)] NET-399
80-105Ci/mmole $43/250μCi $85/1mCi $235/5mCi

Dexamethasone [1,2,4-^{3}H(N)] NET-415
30-50Ci/mmole $45/250μCi $85/1mCi $320/5mCi

Dihydroprogesterone [1,2-^{3}H(N)] NET-438
40-60Ci/mmole $88/250μCi $230/1mCi
Benzene solution

Dihydrotestosterone [1,2-^{3}H(N)] NET-302
40-60Ci/mmole $88/250μCi $230/1mCi

Ecdysterone [^{3}H(G)] NET-360
1-5Ci/mmole $98/10μCi $180/25μCi

Estetrol [2,4-^{3}H(N)] NET-439
40-60Ci/mmole $43/250μCi $85/1mCi $270/5mCi

Estradiol [2,4,6,7-^{3}H(N)] NET-317
85-105Ci/mmole $43/250μCi $85/1mCi $235/5mCi

Estrone [2,4,6,7-^{3}H(N)] NET-319
85-105Ci/mmole $43/250μCi $85/1mCi $235/5mCi

Hydrocortisone [1,2,6,7-^{3}H(N)] NET-396
80-100Ci/mmole $43/250μCi $85/1mCi $235/5mCi

Ouabain [^{3}H(G)] NET-211
10-20Ci/mmole $47/250μCi $115/1mCi $335/5mCi
Ethanol: benzene solution, 9:1

Progesterone [1,2,6,7-^{3}H(N)] NET-381
80/100Ci/mmole $43/250μCi $90/1mCi $270/5mCi
Benzene solution

Testosterone [1,2,6,7-^{3}H(N)] NET-370
85-105Ci/mmole $43/250μCi $90/1mCi $270/5mCi

Compounds shipped in benzene:ethanol solution, 9:1; in combi-vial unless otherwise noted.

Most of our labeled steroids are routinely available for immediate shipment. Get the full specifications in our complete listing.

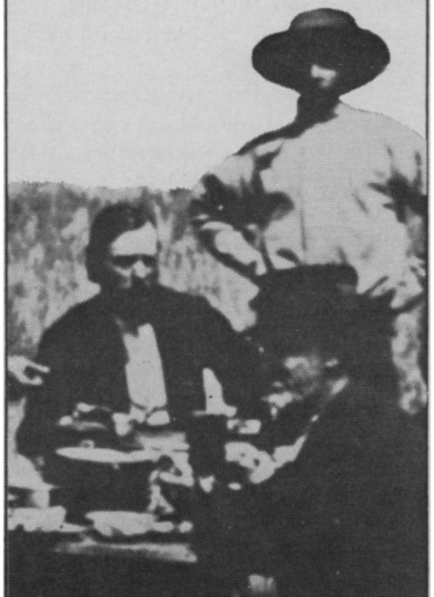
NEN **New England Nuclear**
575 Albany Street, Boston, Mass. 02118
Customer Service: (617) 482-9595

Canada: NEN Canada Ltd., Dorval, Quebec, Tel: (514) 636-4971, Telex: 05-821808
Europe: NEN Chemicals GmbH, D6072 Dreieichenhain, Siemensstrasse 1, Germany. Tel: Langen (06103) 8353

...where the Titanothere and the Allosaur play.

When the first fossils were discovered in the Great West during the 1860's, they set off a bone hunter's race as dramatic as any land rush or cattle stampede. Men like Othniel Charles Marsh and Edward Drinker Cope braved Indian raids, bandits, rattlesnakes, desert heat and blizzards to stake their claims to some of the most important discoveries of modern times. And then they shot it out—figuratively speaking—in some of the most vicious verbal battles in the history of science. Url Lanham, Curator in the Museum of the University of Colorado, tells their story with a connoisseur's appreciation of its color, excitement, and scientific importance.

THE BONE HUNTERS
Url Lanham
32 pages of photographs
$12.95



COLUMBIA UNIVERSITY PRESS
136 South Broadway, Irvington, N.Y. 10533

resurgence of interest in solar energy, as it has a real place in the national energy picture. At the same time, it is vital that we be realistic about the problems so as to best channel our resources toward a solution.

FREEMAN A. FORD
Fafco Incorporated, 2860 Spring Street, Redwood City, California 94063

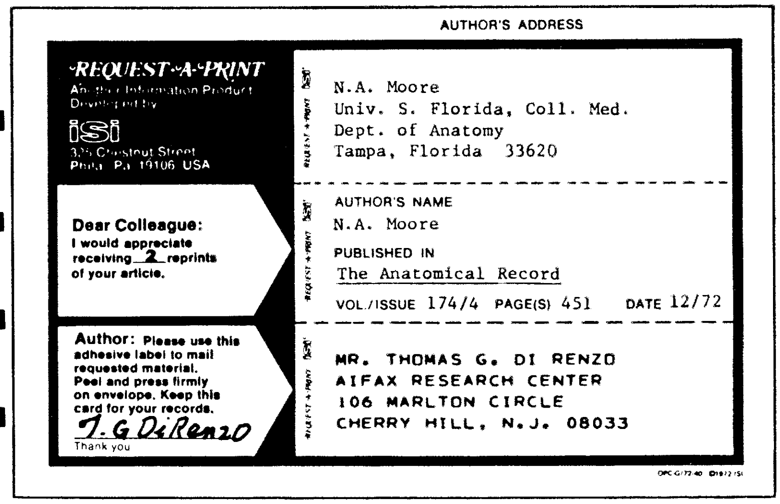
Berg treats, among other factors, the optimum use of heat in industry. In many industrial processes, such as the drying of paint, the curing of adhesives, or the vulcanization of rubber, energy is supplied grossly in the form of heat, whereas the basic goal is change at the molecular level. A more subtle and efficient approach is to bring about interaction directly at the molecular level using electrons, ions, or photons. For example, electron processors can be used to dry suitably formulated paints instantaneously with no significant increase in temperature and using much less power than with the more traditional ovens. There is generally no effluent problem, as the material being processed is almost 100 percent solid, whereas many thermal drying processes involve evaporation of the solvent. A major limitation to the application of the process is betrayed by the phrase "suitably formulated," although the radiation chemist has already produced many useful products, and a number of companies are already using electron beam processing. Another area where electrons can radically reduce power requirements is in product sterilization, which is often accomplished by the application of heat. The science of electron, or radiation, sterilization is fairly well understood, at least pragmatically, and lethal doses can be delivered to bacteria with a relatively small expenditure of energy.

Intense electron beam bombardment can also be used for the efficient application of heat, for example, when metal strip has to be heated to annealing temperatures. Here, electron beam bombardment generates the heat directly in the product, and the problem of efficient heat transfer in a large oven is removed. One disadvantage in such an application of electron beam technology is that the product must be treated in a vacuum, which requires transfer of the product through a vacuum seal or lock. This complication does not apply when the electron beam is used for radiation chemistry, as in the applications mentioned initially. For such applications, much lower beam power levels than for heating are sufficient. These lower levels permit the transmission of electrons through a thin metal membrane without overheating the metal, and thus the beam can pass through a "window" in the vacuum vessel in which it is generated to treat a product in the atmosphere.

A. STUART DENHOLM
Energy Sciences, Inc.,
111 Terrace Hall Avenue,
Burlington, Massachusetts 01803

Berg's analysis of some of the "externalities" involved in the purchase of returnable glass milk bottles and analogous items deserves approbation. It is gratifying to see someone recognizing in a widely distributed scientific journal that there are reasons other than ignorance, laziness, or sheer perversity which keep households from being run on ideal ecological principles. Writers who coin phrases like "everything is connected to everything else" and "there is no such thing as a free lunch" choose to completely ignore the effect of the new environmental asceticism on child-rearing practices and the status of women. It is obvious that technology frees many women both to have interests outside the home and to treat their children as human beings rather than as obstacles to getting the housework done; it is at least conceivable that disposable diapers permit a more relaxed attitude toward toilet training, and that detergents, clothes dryers, and no-iron synthetic fabrics give children more chances to play without worrying about getting dirty. Perhaps it is even better for Father to be at home in the evening drinking Coke out of a throwaway bottle than for him to be in the tavern drinking beer out of a glass (*1*). Except in the context of their contribution to overpopulation, women and children are scarcely mentioned in either textbooks or popular writings on ecology. Apparently ecologists tend to share the assumption that once a woman has brought forth her allotted one or two children, she will naturally be home alone with them for 8 to 12 hours a day, and therefore she will have plenty of time to hang clothes on the line or fold diapers or remove plastic wrappings from cookies in the supermarket or shell peas or put eggshells and orange peels on the family compost heap. She will not have an infant who cries 14 hours a day or a toddler who gets bored with staying

THE REPRINT REQUEST THAT CAN'T BE IGNORED



Cards conform to International Postal Card size regulations.

Everybody's busier than they used to be. Scientific authors and their secretaries are no exception. Maybe that's why so many of your reprint requests go unanswered these days. People are just too busy to notice that little post card you've sent. Or they've got more important things to do than address envelopes.

Request-A-Print not only gets attention, it also makes it easier for authors to send reprints. That's because **Request-A-Print** features an adhesive label that's imprinted with your name and address. When an author gets your request, he peels off the label, sticks it on an envelope, then files the card. Saves time. Prevents errors.

Request-A-Print® It can't be ignored.

I would like to take advantage of this new method of requesting reprints. Please send me ________ thousand personalized **Request-A-Print** cards at $65 per thousand plus shipping charges for delivery outside the U.S.A. (**Surface Mail:** $5. **Air Mail:** Japan—$12; Australia, S. America, & Africa—$22)

☐ Payment enclosed ☐ Purchase order to follow ☐ Bill organization

The following information should appear on my **Request-A-Print®** mailing labels:

Name & Title

Organization/Department

Street Address

City, State, Zip, Country

(Note: Limit of 30 characters per line—spaces and punctuation count as characters. Use abbreviations as required.)

29-3096 ©1973 ISI

isi® **Institute for Scientific Information**

325 Chestnut St., Philadelphia, Pennsylvania 19106, Tel.: (215) 923-3300, Cable: SCINFO, TELEX: 84-5305

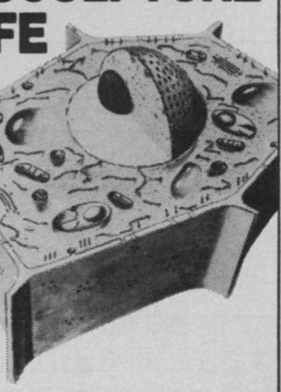
Since the genetic code is linear, why aren't we all shaped like spaghetti?

We are just beginning to understand how nature creates three-dimensional molecules on a linear framework. Biologists have found that in at least one case, evolution has devised a protein hinge to swing the parts into place. This is just one of many exciting discoveries explained in Ernest Borek's new book, THE SCULPTURE OF LIFE.

Borek, acclaimed for his achievements in both molecular biology and science writing, tells about: the truth behind the old wives' tale that children grow in their sleep; the hardy microbe that lives happily in nuclear reactors; the virus that beat Buckminster Fuller to an idea by several million years; the prospects for genetic engineering and human cloning. . . .

THE SCULPTURE OF LIFE is essential reading for anyone interested in man's understanding and control of nature.

ERNEST BOREK THE SCULPTURE OF LIFE



Hardcover $10.00, Paperback $2.95
At bookstores or from

COLUMBIA UNIVERSITY PRESS
136 South Broadway, Irvington, N.Y. 10533

inside, and certainly she will not be spending part of her children's preschool years trying to keep up with a profession.

Shortsightedness in this regard is not, to be sure, limited to ecologists. On the other side of the coin, child psychologists and feminist writers, despite their manifold philosophical differences, converge in a fairly uncritical admiration of technology. It seems to be taken for granted that modern society will always be able to provide enough gadgets to give women plenty of time to devote to breastfeeding or writing or teaching a 3 year old to read or political organizing or whatever. To me, it seems rather evident that equality for women and decent treatment for children cannot be made contingent on a maintenance or expansion of the contemporary American middle-class standard of living.

It would, I think, be profitable for anyone who, like me, is attempting a synthesis of Spock and Commoner and Friedan to read some contemporary accounts of what life with children and without technology was really like. According to Quentin Bell, the nephew of Virginia Woolf, an early 20th-century household in which the wife pursued serious intellectual interests required at least one servant per family member (*2*). In Victorian days, even the wife of a poor curate with six children could be expected to employ a 12-year-old servant girl to help with the heaviest drudgery (*3*). Our pioneer ancestresses may have gotten along without help, but even the gentlest and most considerate of them practiced a strict, often severe, arbitrary and puritanical discipline (*4*); and they had to be inured to a high level of infant mortality and crippling illness or injury which they could do very little to prevent.

It seems that the principles of ecology bear very much the same relationship to liberal ideals that Darwinism did to religious faith. I feel, at present, like echoing the cry of the 19th-century Darwinian John Fiske: "If the world's long-cherished beliefs are to fall, in God's name let them fall, but save us from the intellectual hypocrisy that goes about pretending we are none the poorer!" (*5*).

SARA S. BRETSKY

Department of Earth and Space Sciences, State University of New York, Stony Brook 11790

References

1. B. Commoner, *The Closing Circle* (Knopf, New York, 1971).
2. Q. Bell, *Virginia Woolf* (Harcourt Brace Jovanovich, New York, 1972).
3. G. Eliot, *Scenes of Clerical Life* (Houghton Mifflin, Boston, 1907).
4. L. I. Wilder, *Little House in the Big Woods* (Harper, New York, 1932).
5. P. A. Carter, *The Spiritual Crisis of the Gilded Age* (Northern Illinois Univ. Press, De Kalb, 1971).

Blair raises an important question which I did not explicitly address. The data necessary to evaluate all trade-offs between the energy required to produce energy-saving devices (storm windows, insulation, heat exchangers, and so forth) and the energy savings realizable through their use are not all available. Nevertheless, the limited data now available indicate that use of energy-saving devices is readily justifiable. For example, architects and engineers who have studied energy use in construction find that for each unit of energy required to erect a large office building (including indirect energy use for extraction of natural materials, manufacturing, transportation, and ultimate erection of the building) approximately one unit of energy will be consumed annually to provide services in the building throughout its useful life. Thus, the energy required for building services during the life of a building looms large in importance compared with the indirect "hidden" energy consumption attributable to construction. This is, of course, reflected by the fact that direct consumption of fuel for building services is nearly as great as the consumption of fuel by *all* industrial processes, of which the production of building materials is but one component.

Moreover, the marginal benefits of installing additional energy conservation equipment appear highly favorable. For example, a unit of building insulation (fiberglass, mineral wool, and so forth) that requires one unit of energy to produce can, when properly installed in a building, yield energy savings as high as 25 units of energy per year.

A general rule which is useful in this matter is that the energy required to produce any material or device is but one component of the total cost of bringing the device to market, and is accordingly reflected in the price which the consumer pays for the device. Where economic justification for installing the device is based solely upon the savings to the consumer of costs of the energy which the device conserves, there is a very high probability that use of the device will yield significant net savings of energy in the economy as a whole. While one can conceive of circumstances in which this rule might not hold, the limited data presently available have not revealed such an example. It would be both interesting and useful to gather more data on the trade-offs between energy of manufacture and energy conserved by conservation equipment, and to develop a better systematic understanding of these trade-offs. However, it is not necessary to wait upon the development of this information in order to justify implementing presently available conservation devices. The indirect (or "hidden") energy expenditures associated with production of these devices appear to be rather small compared with the energy they can save.

It is unclear to me why Ford interprets the costs of solar hot water heat that I cited as representing simply the manufacturer's cost of fabrication. Nevertheless, the data upon which the cost estimates I offered are as follows. Tybout and Löf (*1*) gave a brief survey of solar energy equipment available on the international market (*1*, p. 285). They noted that very simple plastic solar hot water heaters could be obtained commercially in Japan for the U.S. equivalent of $1 per square foot (or $10.75 per square meter) of collector surface area. Further, a professional colleague who recently traveled to Japan examined these devices at my request.

The devices work by batch processing. They are simple, in some respects even crude, and yet they are apparently quite effective. If one were pressed to implement solar-assisted hot water heating immediately, one could import these devices (or copy them), equip them with elementary controls to ingest and discharge batches of water, and install them on existing residences, using the existing hot water tanks for storage. Bearing in mind that conventional domestic hot water heating now operates essentially by batch processing, one can assume that inconvenience to the householder who would adopt solar equipment could be minimized by thoughtful design. Because of the low retail price of these units, it would not seem unreasonable to assume that suitably modified units could be offered to householders at a price in the neighborhood of $18 per square meter.

In addition, Tybout and Löf considered the manufacture of more advanced solar collectors of the type suitable for both space heating and water heating. They noted that the full economies of scale have not been approached in the production of these devices, and estimated that a long-run marginal cost of $2 per square foot (or $21.50 per square meter) of collector surface (installed) for space heating might be expected. If one can assume that equipment suppliers will follow marginal cost pricing, this implies a price to the consumer of $21.50 per square meter for installed collectors. This cost to the consumer is somewhat greater than the figure used in my article, but the collectors to which it applies provide superior performance and probably would not have to be quite as large as those which I considered. It should be reemphasized that existing residences already have hot water storage tanks, and newly constructed units will be equipped with hot water tanks; thus the *extra* cost (to the consumer) of using solar heat for hot water is the installed price of the collector and its controls.

I have received several letters from firms which offer solar energy equipment. In view of the growing interest in solar energy, it might be appropriate to establish a directory of sources of such equipment.

Denholm's comments are most interesting. The general field of tailoring the type of energy supplied to a process to meet the thermodynamic requirements of the process is one in which substantial gains in efficiency can be made. It is reassuring to learn of efforts along these lines.

I am grateful to Bretsky for her comments. I offered the example to which she refers only to point out that certain conservation measures entail broad social implications which extend well beyond the technical aspects of efficient fuel use. Bretsky's examples illustrate this point most effectively, and I look forward to a more complete exposition of her investigations.

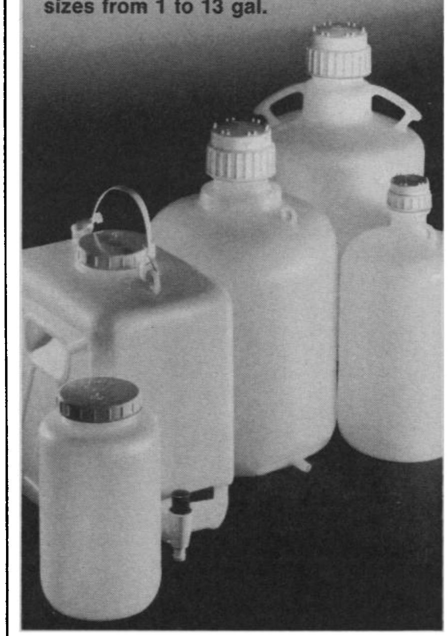
CHARLES A. BERG
Federal Power Commission,
825 North Capitol Street, NE,
Washington, D.C. 20426

References

1. R. A. Tybout and G. O. G. Löf, *Nat. Resour. J.* **10**, 268 (1970).

We put a lot more into NALGENE CARBOYS

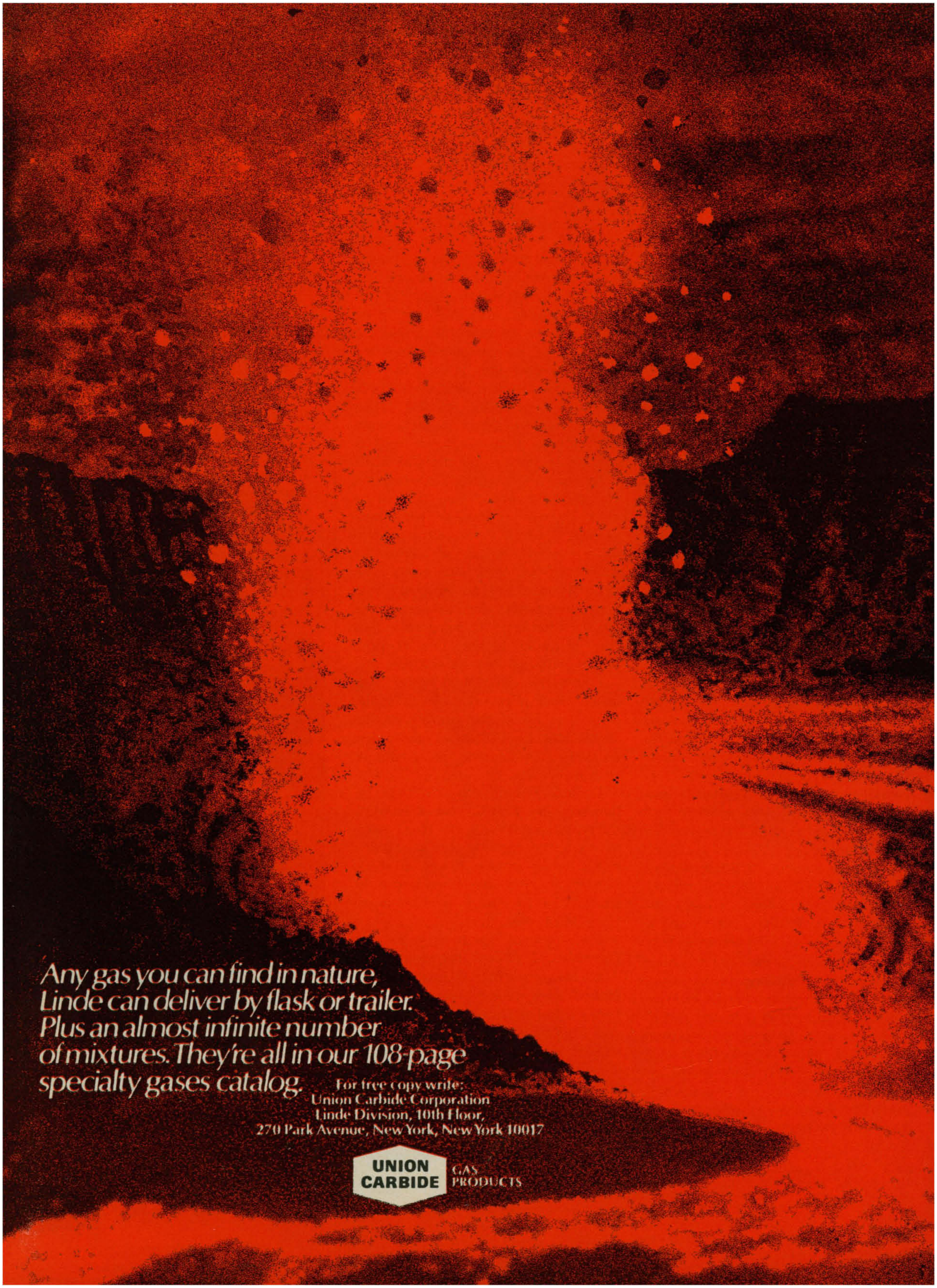
Nalgene® carboys are popular in laboratories everywhere.
Here's why:
- Only virgin, premium-grade plastics resins are used.
- Tubulations, threaded bosses and grips are integrally-molded with the rest of the carboy. Won't leak like the welded type.
- Our quick-action spigot is the most reliable and easiest to use—designed and made by Nalge.
- Tough polypropylene screw closures are leak-proof.
- Made of the right resins to stand up to chemicals and rough use.
- You have the widest choice of rectangular or round shapes in plain, tubulated or spigoted models with wide or narrow mouth in a range of sizes from 1 to 13 gal.



Order Nalgene carboys and large bottles from your laboratory supply dealer's catalog, or write for your 1973 Nalgene Catalog—it describes them all . . . Nalgene Labware Division, Dept. 4212A, P.O. Box 367, Rochester, New York 14602.

NALGE® SYBRON CORPORATION

Nalgene® Labware . . .
the safe unbreakables—preferred by professionals.


Any gas you can find in nature,
Linde can deliver by flask or trailer.
Plus an almost infinite number
of mixtures. They're all in our 108-page
specialty gases catalog.
For free copy write:
Union Carbide Corporation
Linde Division, 10th Floor,
270 Park Avenue, New York, New York 10017
UNION
CARBIDE
GAS
PRODUCTS

7 December 1973, Volume 182, Number 4116

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Editorial Board

1973

H. S. GUTOWSKY, GARDNER LINDZEY, ARTHUR D. HASLER, RAYMOND H. THOMPSON, RUDOLF KOMPFNER, EDWARD O. WILSON, DANIEL E. KOSHLAND, JR.

1974

ALFRED BROWN, FRANK W. PUTNAM, JAMES F. CROW, MAXINE SINGER, SEYMOUR S. KETY, GORDON WOLMAN, FRANK PRESS

Editorial Staff

Editor

PHILIP H. ABELSON

Publisher WILLIAM BEVAN

Business Manager HANS NUSSBAUM

Managing Editor: ROBERT V. ORMES

Assistant Editors: ELLEN E. MURPHY, JOHN E. RINGLE

Assistant to the Editor: NANCY TEIMOURIAN

News and Comment: JOHN WALSH, LUTHER J. CARTER, DEBORAH SHAPLEY, ROBERT GILLETTE, NICHOLAS WADE, CONSTANCE HOLDEN, BARBARA J. CULLITON, SCHERRAINE MACK

Research News: ALLEN L. HAMMOND, WILLIAM D. METZ, THOMAS H. MAUGH II, JEAN L. MARX, ARTHUR L. ROBINSON

Book Reviews: SYLVIA EBERHART, KATHERINE LIVINGSTON, ANN O'BRIEN

Cover Editor: GRAYCE FINGER

Editorial Assistants: MARGARET ALLEN, ISABELLA BOULDIN, BLAIR BURNS, ELEANORE BUTZ, MARY DORFMAN, JUDITH GIVELBER, CORRINE HARRIS, NANCY HARTNAGEL, OLIVER HEATWOLE, CHRISTINE KARLIK, GINA BARI KOLATA, MARGARET LLOYD, JEAN ROCKWOOD, PATRICIA ROWE, LEAH RYAN, JOHN SCHAUER, LOIS SCHMITT, MICHAEL SCHWARTZ, RICHARD SEMIKLOSE, YA LI SWIGART

Guide to Scientific Instruments: RICHARD SOMMER

Membership Recruitment: GWENDOLYN HUDDLE; *Subscription Records and Member Records*: ANN RAGLAND

Advertising Staff

Director EARL J. SCHERAGO

Production Manager MARGARET STERLING

Advertising Sales Manager: RICHARD L. CHARLES

Sales: NEW YORK, N.Y. 10036: Herbert L. Burklund, 11 W. 42 St. (212-PE-6-1858); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: John P. Cahill, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772)

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Phones: (Area code 202) Central Office: 467-4350; Book Reviews: 467-4367; Business Office: 467-4411; Circulation: 467-4417; Guide to Scientific Instruments: 467-4480; News and Comment: 467-4430; Reprints and Permissions: 467-4483; Research News: 467-4321; Reviewing: 467-4440. Cable: Advancesci, Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. See also page xv, *Science*, 28 September 1973. ADVERTISING CORRESPONDENCE: Room 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Prevention of Cancer

Each year in the United States, there are more than 665,000 new cases of cancer and about 380,000 deaths caused by it. The direct medical expenses involved are estimated at $3 billion, and that is only part of the bill. The agony of patients and the heartache of families and friends represent a far more serious cost. We are not alone in our suffering—the whole world shares these experiences.

Since cancer is such a dread disease, many physicians and scientists have devoted their lives to fighting it. They have been only moderately successful. Cancer is not one disease. It is a hundred or more diseases. A few of these respond well to intervention—surgery, radiotherapy, or chemotherapy. But overall, the probability of achieving a 5-year cure is only about 40 percent. In some instances, such as that of brain or lung cancer, the prognosis for a cure is poor.

Cheered on by the success of "miracle drugs" in controlling communicable diseases, the public and, indeed, medical scientists have been concentrating on seeking the "silver bullet." It is just possible that for many of the forms of cancer, there will be no silver bullet and that the most practical approach will be to find means of prevention.

Various experts in epidemiology have estimated that 80 to 90 percent of cancerous tumors may be related to environmental factors. Some of the causative agents are obvious, and they produce major, clear-cut effects. For example, about 30 percent of cancer deaths of men in the United States are attributable to cigarette smoking. In other instances, the causative agents are not definitely known, but there are tantalizing indications of major environmental effects. About 27 percent of all cancer deaths are connected with disease of the digestive organs. A comparison of the incidence of cancer in these organs shows interesting differences around the world. For example, the Japanese suffer nearly seven times as many deaths from stomach cancer as Americans do. However, the Japanese death rate from cancer of the colon and rectum is less than half that of Americans. Various studies suggest that these effects are largely of dietary origin—that is, observations have been made of Japanese who have changed their customs after emigration, and their cancer incidence approaches that of their new neighbors.

Another interesting observation comes from Roland L. Phillips of Loma Linda. He states that devout Seventh Day Adventists in California experience an overall cancer incidence only a third of that of other citizens of the state. He attributes this to their lifestyle.

In the light of comparative apathy about cancer deaths from smoking, the excitement over flimsy evidence of carcinogenicity of cyclamates and some other chemicals seems ridiculous. Yet prudence calls for vigilance. Many new chemicals are being introduced each year, and nasty but delayed surprises could be in store. It was therefore puzzling to read in a government publication, "Cancer is not a reportable disease, and it has been twenty years since a nationwide survey of the extent and impact of cancer in the United States has been undertaken." * Such a survey is now in progress, but surveillance should be continuous, not spasmodic, and it should exploit the power of an electronic computer network. If epidemiologists are to make optimum progress in identifying environmental hazards, they need to be alerted when symptoms first appear and not some years later, after the victims have died.—PHILIP H. ABELSON

* *National Cancer Institute 1973 Fact Book* (publication No. (NIH) 73-512, Department of Health, Education, and Welfare, Washington, D.C., 1973).

For the gifting season, family Talkies.

Professional use permitted.

KODAK EKTASOUND Movie Cameras are now available for less than $190, which is an unprofessional price.* Sights and sounds the camera records stay together on the super 8 film in synch during processing. Spoken comment can be added to the magnetic stripe during projection.

For professional communications without loss of regard for fiscal prudence,** it joins in significance certain other developments that have preceded it in the marketplace. Others will follow soon. Here's a rundown:

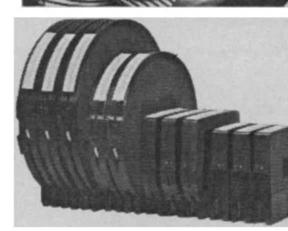
The very idea of super 8. In an image this size, photographic technology today delivers definition and color quality that once asked too much even of 35mm. Scaling everything down in proportion permits great proliferation of super 8 films. Individual communication needs then are met by intercutting original footage with what's suitable and already available.

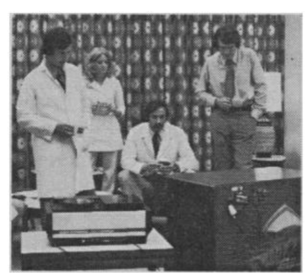
Shooting by available light. First offered in this KODAK XL Movie Camera and now in the new Ektasound cameras. No need for movie lights if showing what the eye would see when coming upon the scene is acceptable.

Viewing in room light. That's a KODAK EKTALITE Projection Screen up front. There is more to it than you'd think when you unwrap it. It rejects stray light originating outside the projection area. Keeping the audience in the dark may or may not be good. Now there is a choice. Note the low profile of the KODAK SUPERMATIC 60 Sound Projector.

Table for one. To convert the Supermatic projector for use like a book, flip a lever. With the Supermatic 70 projector, she could add her own comments on the sound track, like marginal notes one writes in a book. An interlock can forestall marginal notes when used for instruction of the young.

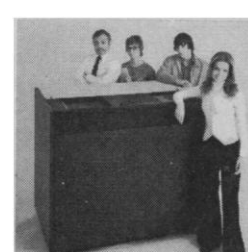
No fumbling with film. Just insert a cassette in the projector. Film comes out, does its stuff, retreats back in. KODAK SUPERMATIC Cassettes come in four sizes, providing anywhere from 15 seconds to 29 minutes of uninterrupted story. Cassettes on any number of subjects are now obtainable. Whatever the number, you can add to it. What author quits because the world already has enough books?





Videoplayer. The cassette doesn't tie you down to movie projectors. Any ordinary TV set will be fine for both picture and sound. Much of the population has been conditioning itself to TV since infancy. Just slip any size Supermatic cassette into a KODAK SUPERMATIC Film Videoplayer connected to the set or a building full of monitors. First shipments of the videoplayer in a few months.

Immediate high-quality processing of super 8 film by anybody around. Mid-'74 will see the advent of the KODAK SUPERMATIC 8 Processor for operation by non-experts. It will contain a little computer and certain other ingenious means to replace personal expertise.



If you want our advice on how to fit any or all of this to your communications plans, write Joerg Agin, Kodak, Rochester, N.Y 14650.

Kodak

*Though subject to change without notice.

**This is a circumlocution. It means that in science and technology Ockham's razor might just possibly shave as well in administration as in reasoning.