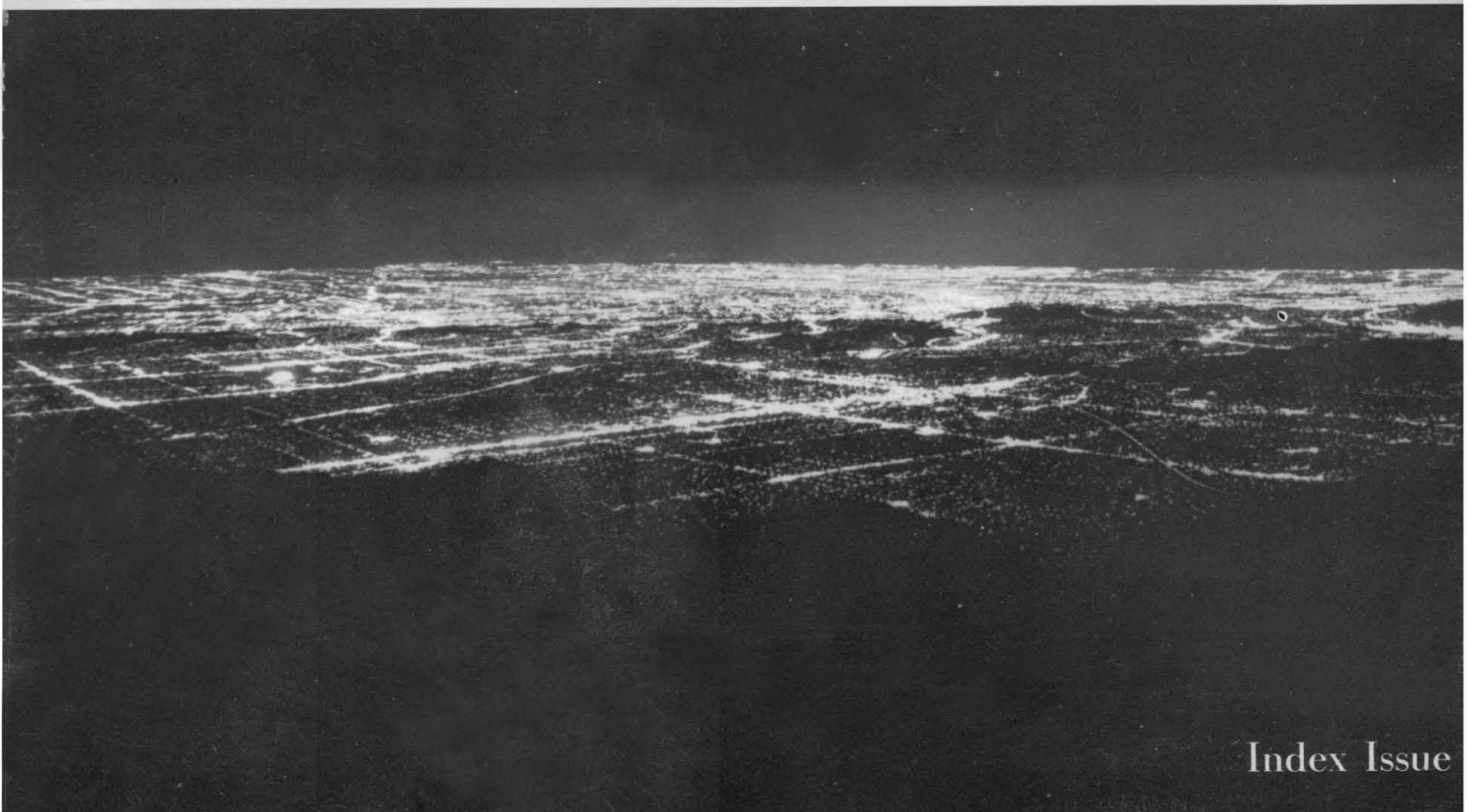


SCIENCE

30 March 1973

Vol. 179, No. 4080

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Index Issue

I did 500 radioimmunoassays while I slept

The big, 500-sample capacity of the LKB-Wallac Automatic Gamma Sample Counter means that you, too, could set up for long uninterrupted runs overnight or on weekends. Come back in the morning and find a complete printout of results in digital form, with every sample positively identified. And with sample transfer taking as little as 10 seconds, you get fast results.

The LKB-Wallac Gamma Counter is simple to operate. You will be able to handle a high volume of samples for radioimmunoassays with a minimum of effort and at low cost. Samples can be added or removed from the counter at any time, without interrupting the run. They will always be positively identified. And you can add a binary-coded cap when you need to identify the samples of multi-users, or to give a

command to your computer to select a certain program for processing the data from a group of samples.

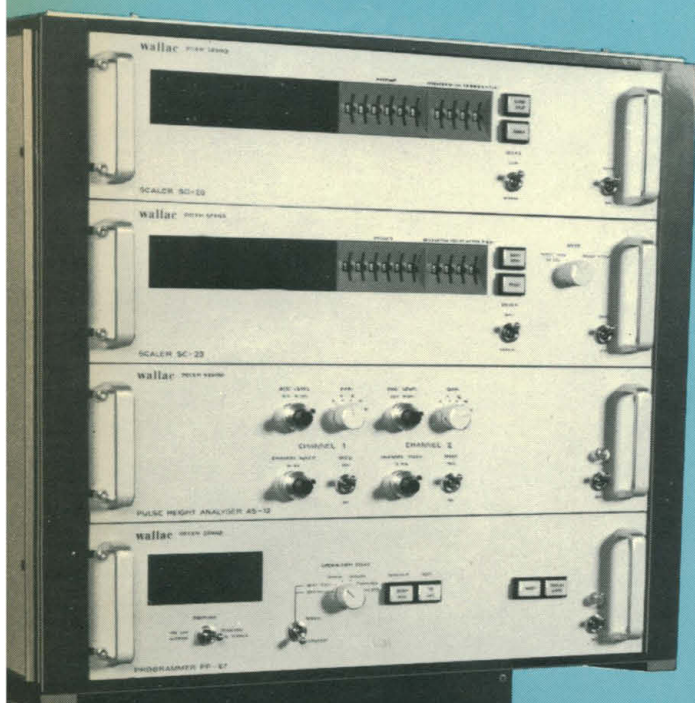
Write now for information about LKB-Wallac Gamma Counters for either 300 or 500 samples, with one or two channels, for single or dual labelled samples.

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

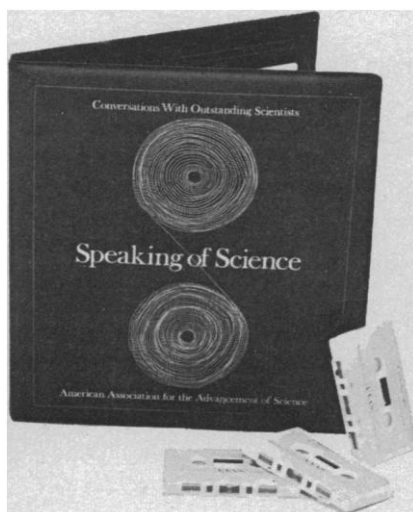
see the new LKB at FASEB



“The eternal mystery of the world is its comprehensibility.”

– Einstein

Speaking of Science



To help you understand the world through science, the AAAS—the largest general scientific organization in the United States—has created a series of audiotapes.

Designed for listening in the home and the classroom, the 12 half-hour conversations feature 30 of America's leading scientists discussing today's problems.

These conversations, narrated by Edward Edelson, science writer for the *New York Daily News*, and Mitchell Krauss of WNET-TV in New York, will be of interest to the scientist wanting to keep up-to-date in other fields. To the student. To libraries. To the general listener.

The audiotape cassettes, for playback on standard cassette machines, are packaged in an attractive vinyl binder.

1. DISCOVERING MARS
Dr. Carl Sagan
2. EVOLUTION AND THE DESCENT OF MAN
Dr. Theodosius Dobzhansky, Dr. Ernst Mayr, Dr. Elwyn Simons
3. ADVANCES IN THE BEHAVIORAL SCIENCES
Dr. Eric Lenneberg, Dr. Ward H. Goodenough, Dr. Lionel Tiger
4. WHAT IS NEEDED FOR PEACE?
Dr. Chadwick F. Alger, Dr. Richard A. Falk, Dr. George W. Rathjens
5. HEALTH CARE AND DELIVERY
Dr. Walter J. Lear, Dr. Paul Friedman, Dr. H. Jack Geiger

6. ADVANCES IN THE PHYSICAL AND LIFE SCIENCES
Dr. Mark Kac, Dr. Charles Price, Dr. Charles P. Leblond
7. ADVANCES IN THE OCEAN SCIENCES
Mr. E. W. Seabrook Hull, Dr. John L. McHugh
8. PUBLIC UNDERSTANDING OF SCIENCE
Dr. Margaret Mead, Mr. Peter Hackes, Dr. Paul B. Sears
9. TECHNOLOGY TODAY
Dr. J. E. Goldman, Dr. J. Herbert Holloman
10. THE FINITE EARTH
Dr. Athelstan Spilhaus, Dr. Arthur Kantrowitz, Mr. Daniel J. Fennell, Mr. Herman Kahn
11. ADVANCES IN ASTRONOMY
Dr. Herbert Gursky
12. NOISE AND MUSIC
Mr. F. Richard Moore, Mr. Paul B. Ostergaard

List price: \$39.95
(\$34.95 for AAAS members).

Please send money order or check payable to AAAS—No cash. Send to Dept. I

Name _____

Street _____

City _____ State _____ Zip _____

American Association for the Advancement of Science

1515 Massachusetts Avenue, N.W. Washington, D. C. 20005

30 March 1973

Vol. 179, No. 4080

SCIENCE

LETTERS	AAAS Herbicide Assessment Commission: <i>A. H. Westing</i> ; Language and Prehistory: <i>E. P. Hamp</i> ; Remedial College Courses: <i>M. Beach</i> ; <i>A. B. Grobman</i> ; Emergency Core Cooling: <i>C. T. Chave</i> ; Clarifying Differences: <i>W. J. Yurkiewicz</i> ; <i>C. G. Clear</i>	1278
EDITORIAL	Natural Science: <i>L. Thomas</i>	1283
ARTICLES	Light Pollution: <i>K. W. Riegel</i>	1285
	The Genetics of Hereditary Disorders of Blood Coagulation: <i>O. D. Ratnoff</i> and <i>B. Bennett</i>	1291
	Efficiency of Energy Use in the United States: <i>E. Hirst</i> and <i>J. C. Moyers</i>	1299
NEWS AND COMMENT	National Cancer Plan: The Wheel and the Issues Go Round	1305
	Two Academies at Parting of Ways?	1307
	Lunar Science: Letting Bygones Be Bygones	1309
	Environmental Law (II): A Strategic Weapon Against Degradation?	1310
	White House Science: Hail and Farewell	1311
RESEARCH NEWS	Lunar Science: Analyzing the Apollo Legacy	1313
BOOK REVIEWS	The Biology of Amoeba, reviewed by <i>A. C. Giese</i> ; Nerve Growth Factor and Its Antiserum, <i>S. M. Crain</i> ; The Biology of Imaginal Disks, <i>J. H. Postlethwait</i> ; Biological Applications of Electron Spin Resonance, <i>T. C. Hollocher</i>	1316
REPORTS	Microorganisms from the Late Precambrian of the Grand Canyon, Arizona: <i>J. W. Schopf</i> , <i>T. D. Ford</i> , <i>W. J. Breed</i>	1319
	Fossil Lepidopterous Leaf Mines Demonstrate the Age of Some Insect-Plant Relationships: <i>P. A. Opler</i>	1321

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

CHAIRMAN 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

John D. Isaacs
President
Robert T. Orr
Secretary-Treasurer

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

J. Linton Gardner
President
Marlowe G. Anderson
Executive Secretary

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. Annual subscription \$20; foreign postage: Americas \$3; overseas \$5; air freight to Europe, North Africa, Near East \$16; single copies \$1 (back issues, \$2) except Guide to Scientific Instruments which is \$4. School year subscription: 9 months, \$15; 10 months, \$16.75. Member rates on request. New rates effective 1 May 1973: Annual subscription \$30; foreign postage: Americas \$4, overseas \$6, air lift to Europe \$18. Provide 4 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

Bacterial Origin of Sulfuric Acid in Geothermal Habitats: <i>J. L. Mosser, A. G. Mosser, T. D. Brock</i>	1323
Toxin from <i>Fusarium moniliforme</i> : Effects on Plants and Animals: <i>R. J. Cole et al.</i>	1324
Electrogenic Sodium Pump in Squid Giant Axon: <i>P. De Weer and D. Geduldig</i>	1326
Polyadenylic Acid in Visna Virus RNA: <i>D. Gillespie et al.</i>	1328
Isolated Adrenal Cortex Cells: Hypersensitivity to Adrenocorticotrophic Hormone after Hypophysectomy: <i>G. Sayers and R. J. Beall</i>	1330
Observations of Apparent C-Type Particles in Baboon (<i>Papio cynocephalus</i>) Placentas: <i>S. S. Kalter et al.</i>	1332
Cloning of Rat Kangaroo (PTK ₂) Cells following Laser Microirradiation of Selected Mitotic Chromosomes: <i>G. Basehoar and M. W. Berns</i>	1333
<i>Rana pipiens</i> Complex: Hemoglobin Phenotypes of Sympatric and Allopatric Populations in Arizona: <i>J. E. Platz and A. L. Platz</i>	1334
Electrogenic Sodium Pump and High Specific Resistance in Nerve Cell Bodies of the Squid: <i>D. O. Carpenter</i>	1336
Electrocardiogram Monitoring: Computerized Detection of Ventricular Changes Induced by Drugs: <i>A. J. Berni, M. W. Luttges, D. E. Dick</i>	1338
Serotonin: Radioimmunoassay: <i>B. Peskar and S. Spector</i>	1340
Insect Juvenile Hormones: Highly Potent Synthetic Mimics: <i>R. Sarmiento et al.</i>	1342
Retrograde Amnesia Gradients: Effects of Direct Cortical Stimulation: <i>P. E. Gold, J. Macri, J. L. McGaugh</i>	1343
Directionality of Rewarding Impulses within the Medial Forebrain Bundle Self-Stimulation System of the Rat: <i>D. C. German and F. A. Holloway</i>	1345
ASSOCIATION AFFAIRS Science, Development, and Human Values: <i>H. Brown</i> ; Health Services: <i>C. D. Flagle</i> ; Neurohumoral Coding of Brain Function: <i>R. D. Myers</i> ; Behavior and Violence	1348

WARD H. GOODENOUGH
CARYL P. HASKINS

DANIEL P. MOYNIHAN
PHYLLIS V. PARKINS

WILLIAM T. GOLDEN
Treasurer

WILLIAM BEVAN
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

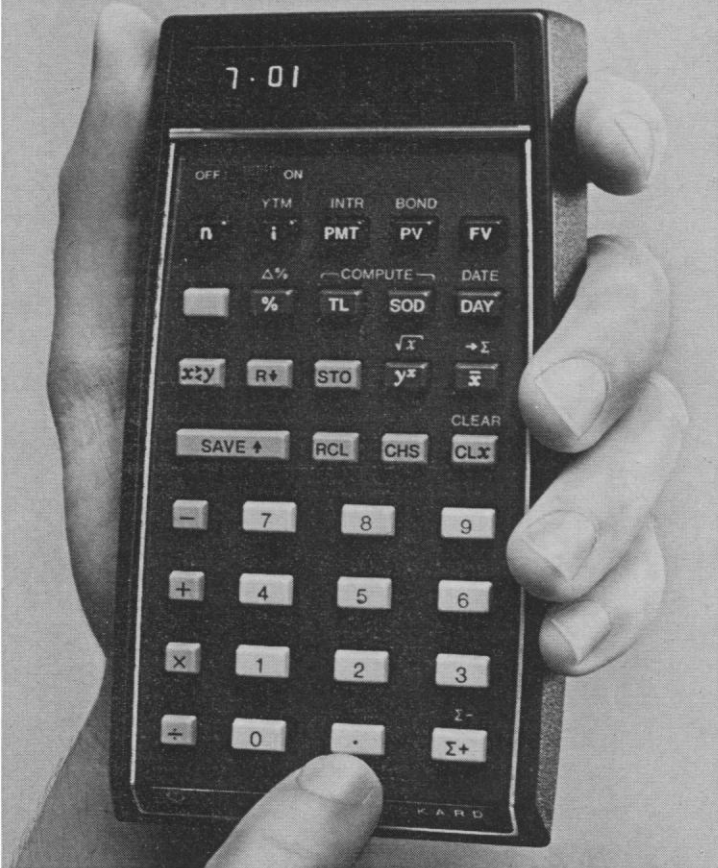
ATMOSPHERIC AND HYDROSPHERIC
SCIENCES (W)
Max A. Kohler
Louis J. Battan

COVER

View of Pasadena and Los Angeles taken from Mount Wilson in 1911 (top) and 1965 (bottom). See page 1285.

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.

Some things are changing for the better.



With the new HP-80, here's how easy it is to calculate the annual yield to maturity of a bond:

Purchase date: **March 15, 1973** 3 • 1 5 1 9 7 3 **SAVE** \rightarrow

Maturity date: **March 15, 2003** 3 • 1 5 2 0 0 3 **DATE DAY**

Coupon: **5%** 5 **INTR PMT**

Present value: **75** 7 5 **BOND PV**

Yield (YTM): \square **YTM i**

With four data entries and six keystrokes, you get the answer: **7.01(%)**

The fundamental formula in common use by the financial community for the same problem follows. Solving for p (price of bond expressed as a percent) is tough enough; care to figure m (annual yield to maturity) without a computer?

$$p = -100 \left(\frac{a}{2} \right) \left(\frac{180-b}{180} \right) + \left[\sum_{k=1}^c \frac{100 \left(\frac{a}{2} \right)}{\left(1 + \frac{m}{2} \right)^{k-1 + (b/180)}} \right] + \frac{100}{\left(1 + \frac{m}{2} \right)^{c-1 + (b/180)}}$$

Now, a handful of fast solutions to time-and-money problems.

Most problems in business and finance are those involving time and money calculations: computing bond prices, rate of return on investments, depreciation, and the like.

Problems like these can take up to 20 minutes to solve, with constant referral to cumbersome tables. This means that there are numerous possibilities for error.

Now, time and money calculations can be done quickly, easily and accurately with the HP-80, the financial counterpart of the shirt-pocket-sized HP-35 calculator used by thousands of scientists and engineers.

The 9-ounce HP-80 has 40 specific capabilities built into its internal circuitry, which combine to perform more than 100 different financial calculations involving a relationship between time and money. There's no need to remember complicated formulas or use tables. All necessary programs, including a 200-year calendar, are built into the HP-80's solid-state memory.

You just enter the data, push a few keys, and read the answer — accurate to within the last penny on a million-dollar transaction.

Since it can perform most financial calculations in about 10 seconds, a user can save up to 20 minutes

on a single problem. The price is \$395 (U.S. only, plus tax).

If you're in business, you can't afford to be without it. Write for full information.

A better chance for the newborn.

Each year in the U.S. alone, almost a half-million babies begin life with a physical or mental impairment. Yet most medical authorities agree that a significant number of these tragedies can be prevented or mitigated, *right now*, by borrowing from hospital experience with patient monitoring techniques that were developed for intensive care units in cardiac, surgical and fetal care.

For the neonate the greatest need is to monitor respiration continuously. All too frequently, the newborn baby stops breathing spontaneously and unexpectedly — apnea, in medical terminology. A nurse usually can revive him just by picking him up or tickling his feet. But she must do so within 30 seconds or the infant runs a high risk of brain damage, even death.

Temperature and, in the high risk cases, blood pressure and ECG should also be monitored. Continuous monitoring not only helps prevent disaster in the nursery crib, but also aids the pediatrician in his diagnosis and therapy.

Building on our decade of experience with

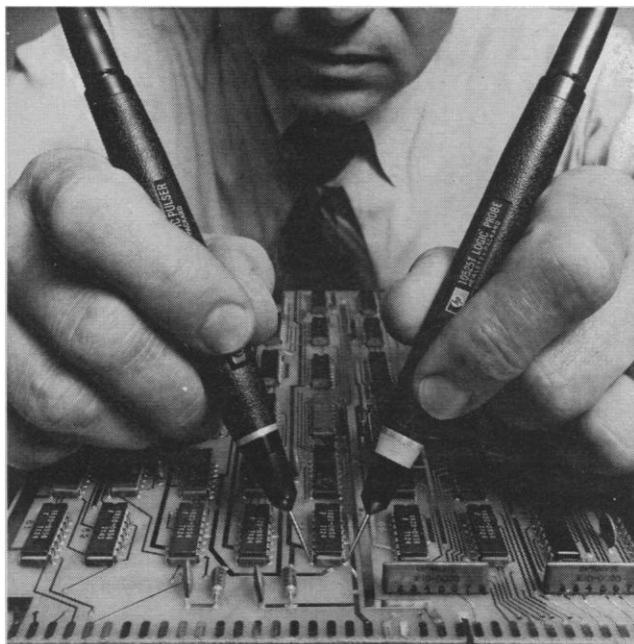
*Many people know us as an instrument manufacturer:
we make more than 2,000 products for measurement, test and analysis.
Others know us as a computer company: more than
10,000 own our calculators and computers. We prefer to think
that our business is to serve your measurement and computation needs.*

cardiac, surgical and fetal monitoring systems, HP has recently introduced a compact new instrument designed expressly for neonatal monitoring. A plug-in module monitors respiration from a set of skin electrodes that detect changes in transthoracic impedance due to respiration; the same set of electrodes can be used to monitor ECG and heart rate. A second module monitors temperature to 0.1°. Both display the measurement in large red numbers that are easily read even in nurseries without a central station; they have adjustable alarms, visual and audible, to alert the nurse in case of trouble. The neonate monitor with respiration and temperature plug-ins is priced under \$2000 and is completely compatible with HP's extensive ICU line. A complete description is available on request.

How to live happily in an increasingly digital world.

Most electronic products have changed drastically in the last few years. Everywhere you look, digital logic is displacing the familiar analog circuitry. And you'll be deceived if you believe that troubleshooting these new products is the same as it was before the advent of the ubiquitous integrated circuit (IC). There are at least two important differences.

In the first place, you can easily check if any of the discrete components in an analog circuit is functioning properly by testing its input and output leads, usually two or, at worst, three. In a digital circuit, on the other hand, each IC has 14 or 16 leads and you may need to know what's going on at all the leads simultaneously.



Furthermore digital circuits are intentionally designed with low output impedances to make them insensitive to noise . . . perhaps their greatest single virtue. Unfortunately for circuit troubleshooters, this means that each IC input is clamped in either a high or a low logic state; hence the only way to perform a stimulus/response test on an IC has been to unsolder its input lead before injecting a test pulse and observing the output.

We're happy to report that things have changed for the better in the world of digital logic testing, with HP's IC Troubleshooters.

First there's the Logic Clip which instantaneously indicates the logic state of all 14 or 16 nodes on an IC without cables or power connections. Or the Logic Comparator which compares an in-circuit test IC with a duplicate IC known to be good and identifies any dissimilarities.

For testing individual IC nodes, there is a series of Logic Probes covering the various IC families which immediately indicate logic states and pulse activity. New partner to the Logic Probes is the Logic Pulser which automatically injects a single pulse that drives a logic-low node high and a logic-high node low for 300 nsec. These are an effective stimulus/response test team — without unsoldering leads and despite low IC output impedances.

We've told the full story in an easy-to-read booklet that's yours for the asking.

For more information on the products described in these pages, fill out the coupon or write to: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, Calif. 94304.



Sales, service and support in 172 centers in 65 countries.

00303

.....
Please send me information on the following:

- ☐ HP-80 Business Calculator
- ☐ HP Neonate Monitor
- ☐ IC Troubleshooters

Name _____

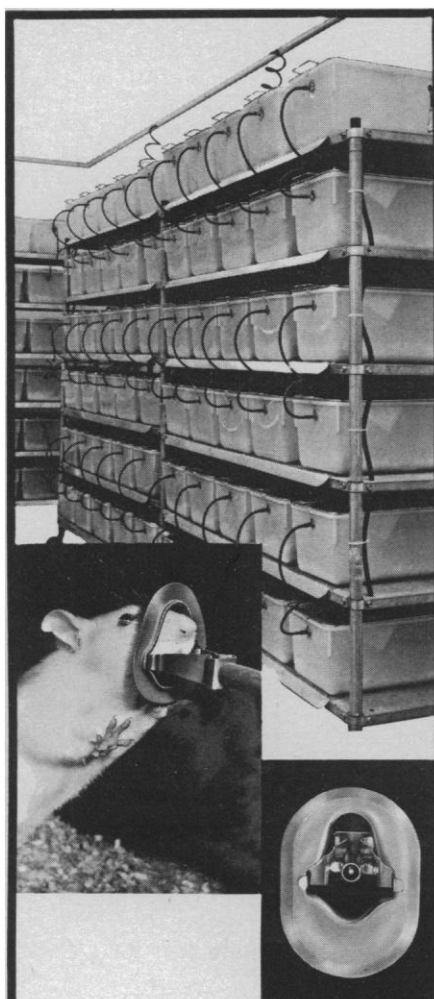
Title _____

Company _____

Address _____

City _____ State _____ Zip _____

.....



LIFEGUARD® "Outside-of-Cage" Automatic Watering Systems...

For dependable, low-cost watering of mice, rats, hamsters, rabbits, guinea pigs and other small animals

LIFEGUARD "outside" watering with quick-change cage attachment gives immediate improvement in small animal care . . . Total dryness, positive safety, superior sanitation and reduced work load. Indeed, better animal care at lower cost. Guaranteed satisfactory performance. Write or call.

SE systems engineering

A Div. of Atco Mfg. Co., Inc.

461 Walnut St., Napa CA 94558

Telephone: (707) 252-1622

LETTERS

AAAS Herbicide Assessment Commission

At the AAAS annual meeting in Washington, I received various requests for information on the AAAS Herbicide Assessment Commission (HAC). AAAS/HAC—apparently the financially most ambitious single project ever undertaken by the AAAS, and one with rather interesting public policy ramifications—was established by the AAAS Board of Directors at the AAAS annual meeting in Boston in 1969 (1). The board appointed M. S. Meselson of Harvard University as its chairman and sole member (2); he in turn appointed me director of AAAS/HAC (3), in which capacity I served throughout 1970.

During 1970, AAAS/HAC gathered information, prepared a background paper, convened an international conference, and visited South Vietnam. The AAAS/HAC investigation in South Vietnam was carried out by Meselson and me, as well as by J. D. Constable of Massachusetts General Hospital and R. E. Cook of Yale University; S. L. Popkin of Harvard University also assisted for a time (4).

The preliminary findings of AAAS/HAC were presented at the AAAS Chicago meeting in 1970 (5). News accounts of these findings appeared in *Science* and elsewhere (6). Both the AAAS/HAC background paper and preliminary report have been published (7), and several technical and popular reports based on the AAAS/HAC trip have been published independently (8). A final AAAS/HAC report is being prepared by Meselson and will be published in 1973 or 1974.

The preliminary findings of AAAS/HAC and the accompanying publicity contributed to the termination of the military use of herbicides in South Vietnam (9); herbicides, however, have not been removed from the U.S. arsenal (10).

Finally, the AAAS/HAC endeavors should not be confused with the similar ones of the NAS Committee on the Effects of Herbicides in Vietnam (11).

ARTHUR H. WESTING

*Department of Biology, Windham
College, Putney, Vermont 05346*

References

1. D. Wolfe, *Science* **167**, 1151 (1970); *AAAS Bull.* **15** (No. 3), 7 (1970).
2. *Science* **167**, 37 (1970).
3. *Ibid.*, p. 1104.
4. *Ibid.* **170**, 42 (1970).

PUT THESE TEXTS TO WORK FOR YOU

PIERRE TEILHARD DE CHARDIN'S PHILOSOPHY OF EVOLUTION by H. James Bix, *Canisius College, Buffalo*. '72, 192 pp., \$9.75

ARTIFICIAL CELLS by Thomas Ming Swi Chang, *McGill Univ., Montreal, Canada*. '72, 224 pp., 77 il., 5 tables, \$16.00

FUNDAMENTALS OF CELL PHARMACOLOGY edited by S. Dikstein, *Hebrew Univ., Jerusalem, Israel*. (26 Contributors) '73, about 580 pp. (7 x 10), 150 il., 40 tables

RUBELLA: First Annual Symposium of the Eastern Pennsylvania Branch, American Society for Microbiology edited by Herman Friedman, *Albert Einstein Medical Center*, and James E. Prier, *Temple Univ. School of Medicine, Both of Philadelphia*. (16 Contributors) '73, 164 pp., 9 il., 33 tables, \$9.25

PROBLEM SOLVING, SYSTEMS ANALYSIS, AND MEDICINE by Ralph Raymond Grams, *Univ. of Minnesota Medical School, Minneapolis*. '72, 244 pp. (6 3/4 x 9 3/4), 106 il., 18 tables, \$19.75 With *Companion Volume . . . SYSTEMS-ANALYSIS WORKBOOK: Coordinated with the Textbook Problem Solving, Systems Analysis, and Medicine*. '72, 72 pp. (6 3/4 x 9 3/4), 8 il., 6 tables, \$4.75 paper

MALNUTRITION AND RETARDED HUMAN DEVELOPMENT by Sohan L. Manocha, *Emory Univ., Atlanta*. Foreword by G. H. Bourne. '72, 400 pp., 20 il., 8 tables, \$19.75

BIOLOGY OF MAMMALIAN FERTILIZATION AND IMPLANTATION edited by Kamran S. Moghissi and E. S. E. Hafez. (21 Contributors) '72, 520 pp., 174 il. (11 in full color), 90 tables, \$31.00

ORGAN REGENERATION IN ANIMALS: Recovery of Organ Regeneration Ability in Animals by L. V. Polezhaev, *Academy of Sciences of the USSR, Moscow*. '72, 200 pp., 209 il., \$14.00

**CHARLES C THOMAS
PUBLISHER**

301-327 East Lawrence Avenue
Springfield • Illinois
62717

5. W. Bevan, *ibid.* 171, 710 (1971).
6. P. M. Boffey, *ibid.* p. 43; T. Aaronson, *Environment* 13 (No. 2), 34 (1971).
7. M. S. Meselson, A. H. Westing, J. D. Constable, R. E. Cook, *Congr. Rec.* 118, S3226 (3 March 1972).
8. J. Constable and M. Meselson, *Sierra Club Bull.* 56 (No. 4), 4 (1971); R. E. Cook, *Yale Alumni Mag.* 34 (No. 8), 26 (1970-71); A. H. Westing, *BioScience* 21, 893 (1971); *J. Forest.* 69, 777 (1971).
9. A. H. Westing, *Biol. Conserv.* 4, 322 (1972).
10. D. S. Greenberg, *Sci. Gov. Rep.* 2 (No. 11), 1 (1972).
11. *Congr. Rec.* 117, S15995 (6 October 1971); *ibid.* 118, S3246 (3 March 1972).

Language and Prehistory

Reiner Protsch and Rainer Berger (19 Jan., p. 235) summarize radiocarbon dates for domesticated animals showing that southeastern Europe was no less an early center of domestication than the Near East was. Even though the early dates in question reach back considerably before the time of our earliest linguistic reconstructions of the Indo-European language (perhaps 3500 B.C.), the authors' results are striking to a student of comparative Indo-European linguistics.

It has been well known for a century or more that reliable reconstructions can be arrived at for the nouns naming most of the animals discussed by the authors. Recent scholarship on the structure and formation rules of reconstructed Indo-European, however, enables us to be more precise today regarding the chronology of certain aspects of the lexicon of that language. The authors find particularly early domestication dates for four animals; we reconstruct their Indo-European names as follows: *g^heH₂- (Greek *boûs*, English *cow*), *suH- (Latin *sūs*, English *sow*), *H₂eyi- (Latin *ovis*, English *ewe*), *kuon- (Greek *kýōn*, English *hound*). Each of these nouns has a shape and declensional class that place them among the earlier morphological layers of the reconstructed language; in other words, these nouns should already have been in the Indo-European language for a considerable time.

No direct dates yet exist for goats in Europe; goat bones are found in the lowest levels of one Greek site, but does this mean they do not occur thereafter? It may be of interest that we can recover no single Indo-European word for the goat. This does not mean that the speakers did not know goats, but that at an early date their term for the goat diverged dialectally, which conceivably reflects some important cultural change (1).

surprising

what you can do with our NEW two-quart Blendor®!



This new Blendor handles as easily as smaller models, yet holds twice as much. It blends large or small quantities . . . also liquefies, purees, cuts, chops, grates, crumbs, or shreds with perfect results, thanks to its patented cloverleaf shape.

The stainless steel container, cover, and blades; the two-speed, heavy duty motor in its smooth-finish base; the neoprene rubber drive all spell trouble-free performance. This Waring two-quart Blendor is warranted for one year of laboratory use.

Our new six-page catalog tells all about our complete line of Blendors — including explosion-proof models — and accessories. Write for your copy.



Waring Blendors® are unique . . . no wonder we registered the name!

waring

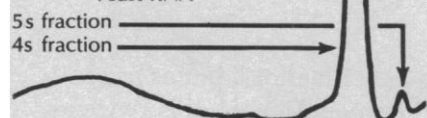
Waring Products Division, Dynamics Corporation of America
New Hartford, Connecticut 06057

recover purified gel zones

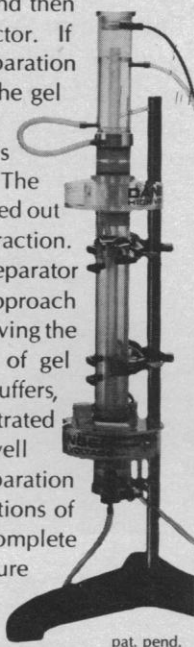
With conventional gel electrophoresis apparatus, recovery of undiluted sample components or quantitation of them without denaturation is difficult or impossible. By combining the separating power of sieving gels with the zone storage and retrieval convenience of density gradients, the ISCO ELECTROSTACTM separator greatly improves zone recovery.

TYPICAL SCAN OF GEL ZONES COLLECTED IN DENSITY GRADIENT

sample: 7.5 micrograms
Yeast-RNA



The ELECTROSTAC separator positions a polyacrylamide gel above a sucrose density gradient column. Separated zones migrate from the lower surface of the gel downward into the density gradient, maintaining their isolation and relative positions. The zone is then recovered by removing the ELECTROSTAC separator and pumping the gradient upward through a UV absorbance monitor, and then to a fraction collector. If scanning shows separation to be incomplete, the gel can be replaced for further electrophoresis before fractionation. The sucrose can be dialyzed out to leave a purified fraction. The ELECTROSTAC separator permits a multiple approach to separation by allowing the use of wide ranges of gel characteristics and buffers, and has been demonstrated to be particularly well adapted to the preparation of gel-separable fractions of nucleic acids. For complete details send for literature and our current catalog.



pat. pend.



**INSTRUMENTATION
SPECIALTIES COMPANY**

BOX 5347 LINCOLN, NEBRASKA 68505
PHONE (402) 434-0231 TELEX 48-6453

The authors find horses represented rather late. The Indo-European reconstruction **ekyo-* (Latin *equus*) is clear and certain, but morphologically the word seems to be not a simplex, but a derivative of something else. Moreover, the noun is a so-called thematic stem (Latin second declension); this is recognized as representing a rather recent layer of noun formation in the pre-history of the Indo-European language.

The structural linguistic chronology strikingly parallels that indicated by the radiocarbon measurements.

ERIC P. HAMP

Department of Linguistics, University of Chicago, Chicago, Illinois 60637

References

1. The taboo on eating goat observed by the Roman priest of Jupiter [see R. E. A. Palmer, *Homenaje a Antonio Tovar* (Editorial Gredos, Madrid, 1972), pp. 341-347] may reflect an older, more general abstinence.

Remedial College Courses

In his editorial of 28 July 1972 (p. 297), Arnold B. Grobman contends that disadvantaged students will be educationally short-changed if they are given college credit for "remedial courses." Yet he nowhere defines such courses other than by allowing the reader to infer that they are courses which, if credited, lead to graduation "on a basis different from that used for other college students."

Two points need to be made. First, nearly every college student already is graduated on a basis different from that of every other student. Students enter with a wide range of skills and interests. That range increases as a result of the variety of individual abilities and the thousands of individual choices made every year by every student. Grobman posits a homogeneous student body and set of academic standards suddenly fragmented by the introduction of disadvantaged students. A more accurate model is one of a heterogeneous student body where disadvantaged students slightly increase the variety.

The second and more important point concerns the nature of courses which are frequently considered remedial. Almost every student, regardless of ability or background, takes at least one such course.

Most colleges require freshmen to take a basic course in expository writing. Yet many faculty who teach freshman English courses believe that students should have mastered writing skills in

high school, and that such skills are requisite to success in most other college courses. The typical freshman English course is remedial in the common use of the term. Should students therefore be denied credit?

The curricula in sciences and mathematics in most colleges is tightly articulated. Yet students typically enter those curricula at different points and for different reasons. For example, a student might enter a sequence of calculus courses at the intermediate level because of prior background, luck on an advanced placement test, poor advice, or sheer nerve. Does that make introductory calculus remedial?

Most colleges require students to develop some skill in a foreign language. Yet many freshmen have already studied or learned a language. Students enrolled in a typical introductory college language course may be taking their first language instruction, want to learn a second or third language, have some previous background but are unable to handle more advanced work, need the skill for further study, or are simply trying to meet a requirement. Is introductory foreign language study remedial? If so, for what category of student?

The concept of remediation is so complex there seems only one way to apply it in a nondiscriminatory way to all students—define a remedial course as one which prepares a student to pass an examination required of all applicants prior to their admission as regular students. Only a definition such as this allows college officials to grant or deny credit without capriciously categorizing either certain students or certain courses as disadvantaged. In the absence of such a procedure, every high school graduate should receive full college credit for every course taught at the college.

MARK BEACH

University of Rochester,
Rochester, New York 14627

In an earlier editorial (29 Oct. 1971, p. 457), I suggested that on several campuses the result of the enrollment of a significant number of disadvantaged students could be described as a tendency toward a bipolarity of the student body. I think this a more useful portrayal than that of a slight increase in the variety of a heterogeneous student body. Remedial courses, therefore, may play a somewhat different role on such campuses than they did in the past.

My editorial of 28 July was not ad-

ressed to the definition of remedial courses, important as that matter is, but, rather, to the question of awarding college credit for such courses, however defined. Dean Beach's recommended definition is a good one, and it could be made operational by utilizing proficiency tests and counseling interviews as a replacement for, and an extension of, entrance examinations.

ARNOLD B. GROBMAN
University of Illinois at Chicago
Circle, Chicago 60680

Emergency Core Cooling

The interesting reports by Robert Gillette on nuclear safety (News and Comment, 1 Sept. through 22 Sept. 1972) move me to comment. I agree with critics that the LOFT project has been set back by misguided direction, both from Idaho Falls and from Washington, D.C.

The question of emergency core cooling, now claimed by some to be the principal safeguard against cataclysmic reactor plant accidents, has gotten completely out of hand. In the early days (before 1960, more or less), the basic safeguard was containment. Emergency core cooling was introduced to prevent fuel rupture or melting in the event of a rupture of the pressure parts of the reactor system. The idea was to reduce dependence on the outer containment structure. There were even those who contended that such a system might permit the elimination of this containment. In a sense, emergency core cooling is like a parachute for an airplane in case the wings fail, or like a fourth leg for a three-legged stool. Uncertainty about the functioning of emergency core cooling should not cause panic about the safety of water reactors.

Rather than spending huge sums and instituting crash research programs, it might be better to evaluate the chances of primary system failure more carefully and institute means to increase the reliability of the system's pressure parts. If we think pipes might fail, we could use multilayer or composite construction, such as wire wrapping. If we think vessels might fail, we could consider layer-built or prestressed concrete as an alternative. In designing airplanes, we ensure against wing failure rather than depend on parachutes. It would be better to abandon elaborate emergency core cooling systems and use them only

to deal with small leaks. The systems in current vogue are very much "Rube Goldberg" designs. We should depend more on pressure parts.

If information on emergency core cooling could be developed in the meantime, without crash programs, without irrelevant questions about quality assurance, and certainly without hysterical reports that say "This test failed. All is lost," it would be of value. We could then decide whether it was worth it to put a fourth leg on the stool.

It is inappropriate to suggest conflict of interest on the part of professionals in industry, who, to a man Jack, have public safety foremost in their minds. Perhaps the scientists who are suspicious of industry should read the Canons of Ethics for Engineers (1). Could the conflict of interest charge apply more to researchers who see their work and status threatened by the abandonment of gigantic research projects?

CHARLES T. CHAVE
4 Waterbury Avenue,
Madison, Connecticut 06443

References

1. Engineers' Council for Professional Development, 40th Annual Report, 1971-72 (Engineers' Council for Professional Development, New York, 1973).

Clarifying Differences

The comment by Deardorf (Letters, 22 Dec. 1972, p. 1240) that organically grown foods taste better suggests that there might be a chemical difference between organically and nonorganically grown foods. A panel of tasters combined with a team of biochemists should be able to clarify the question rather easily. I offer my services as one of the tasters.

WILLIAM J. YURKIEWICZ
Millersville State College,
Millersville, Pennsylvania 17551

Hedges and Deardorf are the soul of reasonableness in their defense of "organic gardening," and we all could applaud if the movement's main concern were the misuse of technology. But for the more fervent members, the spiritual leaders, its thrust is far more than that; it is antiscience. It is an integral part of the counterculture package along with astrology and other mysticisms.

C. GERALD CLEAR
31 George Lane,
Sausalito, California 94965

SAVANT'S ANALYTICAL GROUP

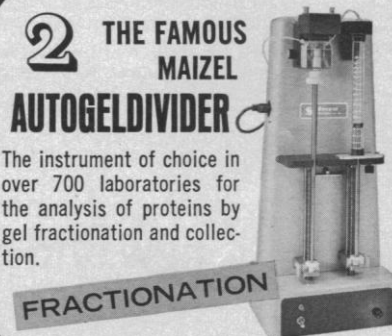
Every research laboratory
can use one or more
of these systems.



1 ACRYLAMIDE GEL ELECTROPHORESIS

Savant offers the most complete range of ROUND GEL or SLAB GEL equipment...including Destainers, Polymerizing Racks and Power Supplies.

SEPARATION



2 THE FAMOUS MAIZEL AUTOGELDIVIDER

The instrument of choice in over 700 laboratories for the analysis of proteins by gel fractionation and collection.

FRACTIONATION



3 NEW-IMPROVED UNIFRAC FRACTION COLLECTOR

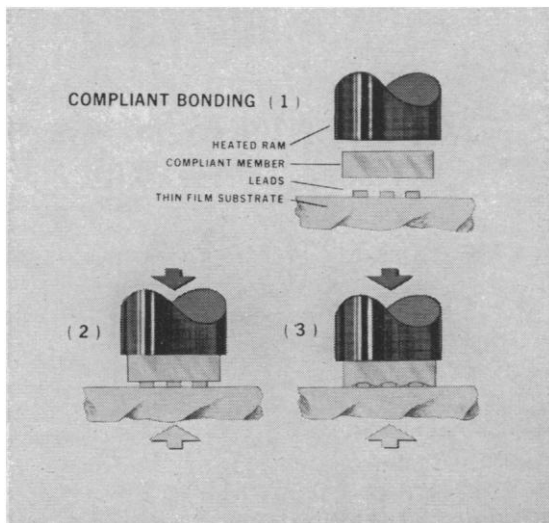
The system that allows the researcher to collect fractions in Scintillation Vials, Test Tubes and Gradient Tubes. Collect 1 drop or 999 drops with an instrument that contains ONLY ONE MOVING PART.

You owe it to your lab to investigate these systems by requesting Catalog No. 123.

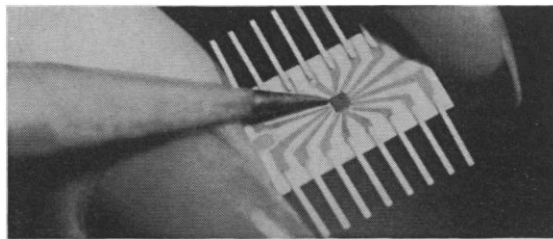
Savant
Instruments, Inc.

221 Park Ave. / Hicksville, N.Y. 11801 / 516-935-8774

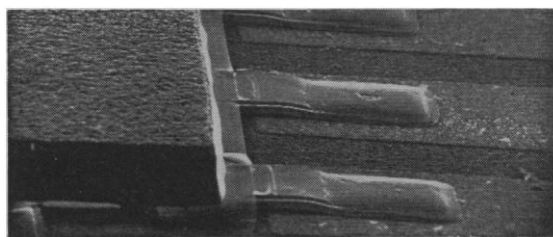
WESTERN ELECTRIC REPORTS



When heat and pressure are applied to the compliant medium, it begins to deform around the gold-plated leads. Deformation of leads is controlled by the flow stress properties of the medium. When the medium bottoms out, it stops the ram and the delicate metal parts are instantaneously and permanently bonded without damage.



Slightly magnified, the pencil points to a beam-led circuit chip which has been bonded to 16 gold conductors that converge on it. Within the silicon chip are dozens of microscopic transistors, diodes, resistors.



Greatly magnified, we can see gold beam leads projecting from a chip bonded to thin gold conductors on a thin ceramic substrate.

A new and better way to bond integrated circuits.

Engineers at Western Electric's Engineering Research Center (ERC) and Allentown Works have come up with a revolutionary but simple solution to some very complex circuit bonding problems. It's called compliant bonding.

As in other solid state bonding methods, heat and pressure are used to bond tiny integrated circuits to other components. (Some circuits have fifty or more delicate leads.)

However, our process differs in a very important way. ERC researchers added a compliant or yielding medium between the energy source and leads being joined. On contact, the medium compresses and transmits an equal amount of controlled, predictable bonding pressure to each lead.

There are many advantages to this new technique.

First, it is more reliable. Under heat and pressure, the compliant medium spreads the bonding pressure to all the leads uniformly. It automatically compensates for surface and lead irregularities. Strong, reliable electrical connections are assured for every lead.

It is also more versatile. We can now bond more than one circuit at a time, even with leads of different thicknesses or area widths. The compliant medium perfectly controls

lead deformation in even the most complicated multiple bonding. It's no longer necessary to design and test complex bonding tools for each bonding job.

Engineers at Allentown are working to apply the process to large-scale manufacturing. They have developed the first production machines using the process. These machines are now in growing use at Allentown and many other Western Electric plants.

Conclusion: Compliant bonding is technically and economically superior to other solid state bonding techniques. Combined with automated production, compliant bonding promises reliable, high-speed production of circuit packages.



Western Electric

We make things that bring people closer.

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
AUTHUR D. HASLER	RAYMOND H. THOMPSON
RUDOLF KOMPFFNER	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. RINGOLE

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

Book Reviews: SYLVIA EBERHART, KATHERINE LIVINGSTON, ANN SELTZ-PETRASH

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, MARSHALL KATHAN, MARGARET LLOYD, DANIEL RABOVSKY, JEAN ROCKWOOD, PATRICIA ROWE, LEAH RYAN, JOHN SCHAUER, LOIS SCHMITT, MICHAEL SCHWARTZ, YA LI SWIGART

Guide to Scientific Instruments: RICHARD SOMMER

Membership Recruitment: LEONARD WRAY; Subscriptions: BETTE SEEMUND; Addressing: THOMAS BAZAN

Advertising Staff

Director

EARL J. SCHERAGO

Production Manager

PATTY WELLS

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*, 29 September 1972. ADVERTISING CORRESPONDENCE: Room 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Natural Science

The essential wildness of science as a manifestation of human behavior is not generally perceived. As we extract new things of value from science, we also keep discovering parts of the activity that seem in need of better control, more efficiency, less unpredictability. We'd like to pay less for it and get our money's worth on some more orderly, businesslike schedule. The Washington planners are trying to be helpful in this, and there are new programs for the centralized organization of science everywhere, especially in the biomedical field.

It needs thinking about. There is an almost ungovernable, biologic mechanism at work in scientific behavior at its best, and this should not be overlooked.

The whole scientific enterprise must be arranged in such a way that the imaginations of different human beings can be pooled, and this is more a kind of game than a systematic business. It is in the abrupt, unaccountable aggregation of random notions and intuitions, known in science as good ideas, that the high points are attained.

The most mysterious aspect of difficult science is the way it is done. Not the routine, not just the fitting together of things that no one had guessed at fitting, not the making of connections—these are merely the workaday details, the methods of operating. They are interesting, but not as fascinating as the central mystery, which is that we do it at all and that we do it under such compulsion.

I don't know of any other human occupation, even what I have seen of art, in which the people engaged in it are so caught up, so totally preoccupied, so driven beyond their strength and resources.

Scientists at work have the look of creatures following genetic instructions; they seem to be under the influence of instinct. They are, despite their efforts at dignity, rather like young animals engaged in savage play. When they are near an answer, their hair stands on end, they sweat, they are awash in their own adrenalin. To grab the answer, and grab it first, is for them a more powerful drive than feeding or breeding or protecting themselves against the elements.

It sometimes looks like a solitary activity, but it is as much the opposite of solitary as human behavior can be. There is nothing so social, so communal, so interdependent. An active field of science is like an immense intellectual anthill: the individual almost vanishes into the mass of minds tumbling over each other, carrying information from place to place, passing it around at great speed.

In the midst of what seems to be a collective derangement of minds, with bits of information being scattered about, torn to shreds, disintegrated, reconstituted, engulfed in an activity that seems as random and agitated as that of bees in a disturbed part of the hive, there suddenly emerges, with the purity of a slow phrase of music, a single new piece of truth about nature.

In short, it works. It is the most powerful and productive thing human beings have learned to do together in many centuries—more effective than farming, or hunting and fishing, or building cathedrals, or making money.

It is instinctive behavior, in my view, and I do not understand how it works. It cannot be prearranged in any precise way; the minds cannot be lined up in tidy rows and given directions from printed sheets. It cannot be done by instructing each mind to make this or that piece for central committees to fit with the pieces made by other instructed minds. It does not work this way.—LEWIS THOMAS, *Dean of Medicine, Yale University, New Haven, Connecticut 06510*

Reprinted from *The New England Journal of Medicine* 288, 307 (1973).



The complete aqueous cocktail

For liquid scintillation counting

The PCS™ (Phase Combining System) cocktail delivers a one-two punch in dissolving aqueous samples: complete organic-inorganic versatility and higher counting efficiency. For PCS is uniquely designed for hundreds of different solutions: acids, bases, buffers, salts, sucrose, and urine, to mention a few. (In most cases, just add the radioactive sample to the counting vial, shake vigorously, and count.)

PCS not only mixes well, but counts with higher efficiency and holds more water than almost any cocktail you can make or purchase. (Compare values in the table.) This also means you can run samples in a shorter time and improve counting reproducibility.

Product	Sample Vol. (Ml)	Cocktail Vol. (Ml)*	% of Sample	H3 Counting Efficiency (%)**
PCS	0.5	14.5	3.3	42.7
	5.0	10.0	33.3	28.4
	6.0	9.0	40.0	26.7
Brand A	0.5	15.0	3.2	33.0
	5.0	15.0	25.0***	28.0

*Manufacturers' recommended volumes. Comparative information is available on request.

**PCS's counting efficiency was determined on a Nuclear-Chicago Mark II LSC; Brand A's on a Packard Tri-Carb.

***Maximum sample is 25%—40% is not recommended.

And as if versatility, high water capacity, and higher efficiency weren't enough to whet your interest, PCS is strong on economy. It costs less, you use less, and you purchase less (good for almost all solutions) than most other cocktails.

Contact our technical service department for detailed information. Our staff will

not only solve problems concerning cocktails and sample preparation, but help with any of your particular counting problems.



Amersham/Searle

AMERSHAM / SEARLE CORPORATION
An Activity of G. D. Searle & Co. and the Radiochemical Centre

2636 S. Clearbrook Drive
Arlington Heights, Illinois 60005
Telephone: 312-593-6300—Telex: 28-2452

Our specific activity is service

In Canada: 400 Iroquois Shore Road • Oakville, Ontario • Telex: 069-82216 • Telephone: (416) 364-2183

Instructions for Contributors

The Editors of *Science*

Manuscripts submitted to *Science* for consideration for publication can be handled expeditiously if they are prepared in the form described in these instructions.

Submit an original and two duplicates of each manuscript. With the manuscript send a letter of transmittal giving (i) the name(s) of the author(s); (ii) the title of the paper and a one- or two-sentence statement of its main point; (iii) the name, address, and field of interest of four to six persons in North America but outside your institution who you think are qualified to act as referees for your paper; (iv) the names of colleagues who have reviewed your paper for you; (v) the field(s) of interest of readers who you anticipate will wish to read your paper.

Editorial Policies

All papers submitted are considered for publication. The author's membership or lack of membership in the AAAS is not a factor in selection. Papers are accepted with the understanding that they have not been published, submitted, or accepted for publication elsewhere. Authors will usually be notified of acceptance, rejection, or need for revision in 4 to 6 weeks (Reports) or 6 to 10 weeks (Articles).

Types of papers. Five types of signed papers are published: Articles, Reports, Letters, Technical Comments, and Book Reviews. Familiarize yourself with the general form of the type of paper you wish to submit by looking over a recent issue of the journal, and then follow the instructions for that type of paper.

Reviews. Almost all Articles, Reports, and Technical Comments, whether solicited or not, are sent to two or more outside referees for evaluation of their significance and soundness. Forms showing some of the criteria reviewers are expected to consider are available on request.

Editing. Papers are edited to improve the effectiveness of communication between the author and his readers. The most important goal is to eliminate ambiguities. In addition, improvement

of sentence structure often permits readers to absorb salient ideas quickly. When editing is extensive, with consequent danger of altered meanings, papers are returned to the author for correction and approval before type is set. Authors are free to make additional changes at this stage.

Proofs. One set of galley proofs or an equivalent is provided for each paper. Keep alterations to a minimum, and mark them only on the galley, not on the manuscript. Extensive alterations may delay publication by 2 to 4 weeks.

Reprints. An order blank for reprints accompanies proofs.

Writing Papers

Organize your material carefully, putting the news of your finding or a statement of the problem first, supporting details and arguments second. Make sure that the significance of your work will be apparent to readers outside your field, even if you feel you are explaining too much to your colleagues. Present each step in terms of the purpose it serves in supporting your finding or solving the problem. Avoid chronological steps, for the purpose of the steps may not be clear to the reader until he finishes reading the paper.

Provide enough details of method and equipment so that another worker can repeat your work, but omit minute and comprehensive details which are generally known or which can be covered by citation of another paper. Use metric units of measure. If measurements were made in English units, give metric equivalents.

Avoid specialized laboratory jargon and abbreviations, but use technical terms as necessary, defining those likely to be known only in your field. Readers will skip a paper they do not understand. They should not be expected to consult a technical dictionary.

Choose the active voice more often than you choose the passive, for the passive voice usually requires more words and often obscures the agent of action. Use first person, not third; do

not use first person plural when singular is appropriate. Use a good general style manual, not a specialty style manual. The University of Chicago style manual, the style manual of the American Institute of Physics, and the *Style Manual for Biological Journals*, among others, are appropriate.

Manuscripts

Prepare your manuscript in the form used by *Science*. Use bond paper for the first copy. Submit two duplicates. Double-space title, abstracts, text, signature, address, references (including the lines of a single reference), figure legends, and tables (including titles, columns, headings, body, and footnotes). Do not use single spacing anywhere. Put the name of the first author and the page number in the upper right-hand corner of every page.

Paging. Use a separate page for the title; number it page 1. Begin each major section—text, references and notes, and figure legends—on a new sheet. Put each table on a separate sheet. Place figure legends and tables after the references.

Title. Begin the title with a word useful in indexing and information retrieval (not "Effect" or "New").

References and Notes. Number all references to the literature, footnotes, and acknowledgments in a single sequence in the order in which they are cited in the text. Gather all acknowledgments into a single citation, and keep them short ("I thank," not "I wish to thank"). Cite all references and notes but do not cite them in titles or abstracts. Cite several under one number when feasible. Use the "Chemical Abstracts Service Source Index," CASSI, with the few suggested revisions in *International List of Periodical Title Word Abbreviations* for abbreviations of journal names. If the journal is not listed there, provide the full name. Use the following forms:

- Journal:* H. Smith, *Amer. J. Physiol.* **98**, 279 (1931).
Book: F. Dacheille and R. Roy, *Modern Very High Pressure Techniques* (Butterworth, London, 1961), pp. 163–180.
Chapter: F. Dacheille and R. Roy, in *Reactivity of Solids*, J. H. de Boer, Ed. (Elsevier, Amsterdam, 1960), p. 502.

Illustrations. Submit three copies of each diagram, graph, map, or photograph. Cite all illustrations in the text and provide a brief legend, to be set in type, for each. Do not combine line

drawings and photographs in one illustration. Do not incorporate the legend in the figure itself. Use India ink and heavy white paper or blue-lined coordinate paper for line drawings and graphs. Use heavier lines for curves than you use for axes. Place labels parallel to the axes, using capital and lower-case letters; put units of measurement in parentheses after the label—for example, Length (m). Plan your figures for the smallest possible printed size consistent with clarity.

Photographs should have a glossy finish, with sharp contrast between black and white areas. Indicate magnification with a scale line on the photograph.

Tables. Type each table on a separate sheet, number it with an Arabic numeral, give it a title, and cite it in the text. Double space throughout. Give each column a heading. Indicate units of measure in parentheses in the heading for each column. Do not change the unit of measure within a column. Do not use vertical rules. Do not use horizontal rules other than those in the heading and at the bottom. A column containing data readily calculated from data given in other columns can usually be omitted; if such a column provides essential data, the columns containing the other data can usually be omitted.

Plan your table for small size. A one-column table may be up to 42 characters wide. Count characters by counting the widest entry in each table column (whether in the body or the heading) and allow three characters for spaces between table columns. A two-column table may be 90 characters wide.

Equations and formulas. Use quadruple spacing around all equations and formulas that are to be set off from the text. Most should be set off. Start them at the left margin. Use the solidus for simple fractions, adding the necessary parentheses. But if braces and brackets are required, use built-up fractions. Identify handwritten symbols in the margin, and give the meaning of all symbols and variables in the text immediately after the equation.

Articles

Articles, both solicited and unsolicited, may range in length from 2000 to 5000 words (up to 20 manuscript pages). Write them clearly in reason-

ably nontechnical language. Provide a title of one or two lines of up to 26 characters per line and a subtitle consisting of a complete sentence in two lines with a character count between 95 and 105 for the sentence (spaces between words count as one character each). Do not break words at the ends of lines. Write a brief author note, giving your position and address. Do not include acknowledgments. Place title, subtitle, and author note on page 1. Begin the text on page 2.

Insert subheads at appropriate places in the text to mark your main ideas. The set of subheads should show that your ideas are presented in a logical order. Keep subheads short—up to 35 characters and spaces.

Provide a summary at the end.

Do not submit more than one illustration (table or figure) for each four manuscript pages unless you have planned carefully for grouping. With such planning many illustrations can be accommodated in the article. Consult the editorial office for help in planning.

Reports

Short reports of new research results may vary in length from one to seven double-spaced manuscript pages of text, including the bibliography. Short papers receive preferred treatment. Limit illustrative material (both tables and figures) to two items, occupying a total area of no more than half of a published page (30 square inches). A research report should have news value for the scientific community or be of unusual interest to the specialist or of broad interest because of its interdisciplinary nature. It should contain solid research results or reliable theoretical calculations. Speculation should be limited and is permissible only when accompanied by solid work.

Title. Begin the title with an important word (preferably a noun) that identifies your subject. The title may be a conventional one (composed primarily of nouns and adjectives), a sentence (containing a verb), or a structure with a colon (Jupiter: Its Captured Satellites). Limit it to two lines of complete words of no more than 55 characters per line (spaces between words count as one character each). Do not use abbreviations. Type the title in the middle of page 1.

Abstract. Provide an abstract of 45 to 55 words on page 2. The abstract

should amplify the title but should not repeat it or phrases in it. Qualifying words for terms used in the title may be used. Tell the results of the work, but not in terms such as “——— was found,” “is described,” or “is presented.”

Text. Begin the text on page 3. Put the news first. Do not refer to unpublished work or discuss your plans for further work. If your paper is a short report of work covered in a longer paper to be published in a specialty journal, you may refer to this paper if it has been accepted. Name the journal. If the manuscript has not been accepted, refer to it as “in preparation.” Omit references to private communications. Do not use subheads.

Signature. List the authors on the last page of the text and give a simple mailing address.

Received dates. Each report will be dated the day an acceptable version is received in the editorial office.

Letters

The Letters section provides a forum for discussion of matters of general interest to scientists. Letters are judged only on clarity of expression and interest. Keep them short and to the point; the preferred length is 250 words. The editors frequently shorten letters.

Technical Comments

Letters concerning technical papers in *Science* are published as Technical Comments at the end of the Reports section. They may add information or point out deficiencies. Reviews are obtained before acceptance.

Book Reviews

The selection of books to be reviewed is made by the editors with the help of advisers in the various specialties; arrangements are then made with reviewers. A sheet of instructions accompanies each book when it is sent to the reviewer.

Cover Photographs

Particularly good photographs that are suitable for use on the cover are desired.