SCIENCE

30 March 1973

Vol. 179, No. 4080

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Index Issue

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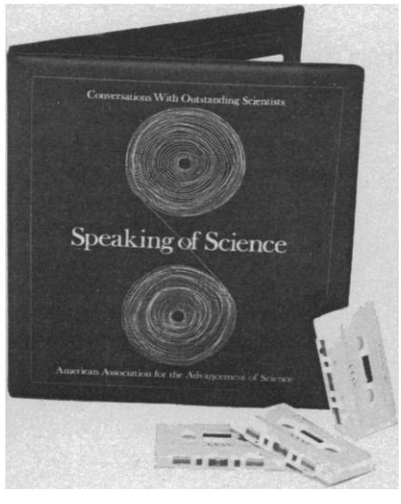
– Einstein

Speaking of Science



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Vol. 179, No. 4080

SCIENCE

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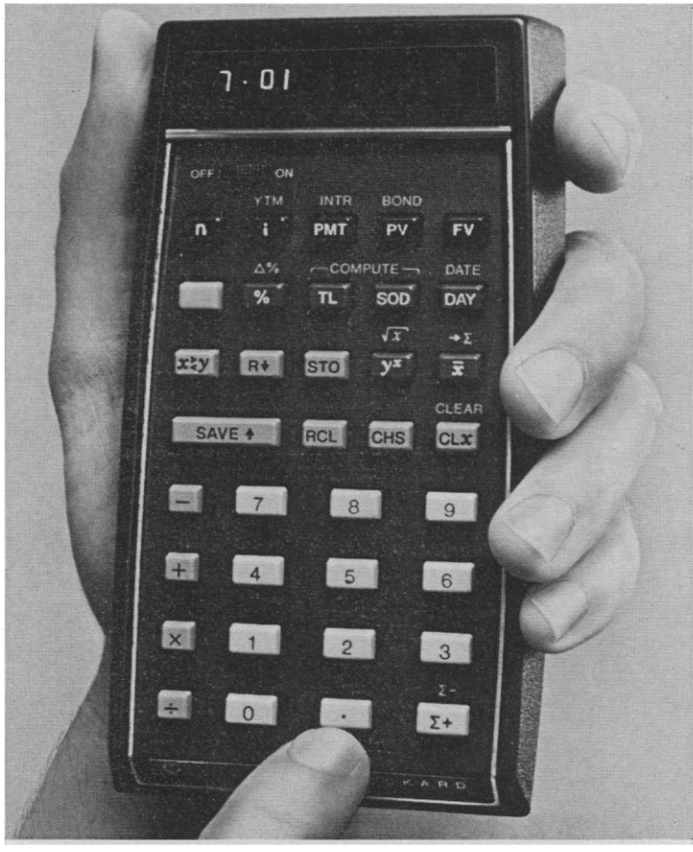
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

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

Some things are changing for the better.



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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.

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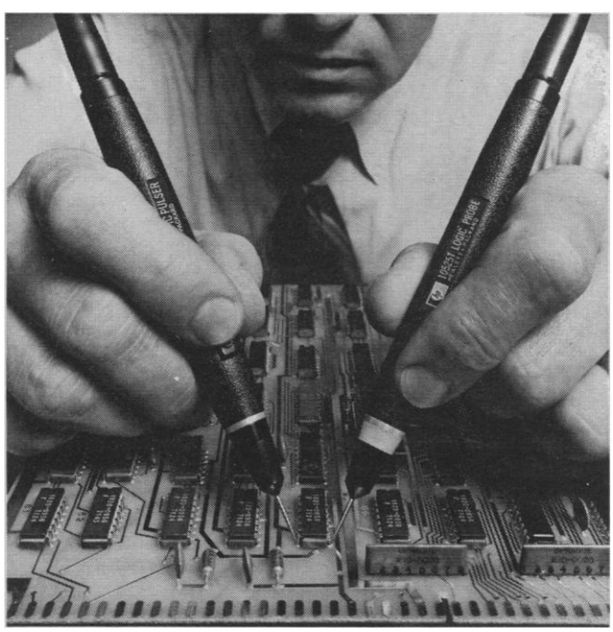
cardiac, surgical and fetal monitoring systems, HP has recently introduced a compact new instrument designed expressly for neonatal monitoring. A plug-in module monitors respiration from a set of skin electrodes that detect changes in transthoracic impedance due to respiration; the same set of electrodes 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 trouble-shooting 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.

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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

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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: *$g^{w}eH_{u}$- (Greek *boûs*, English *cow*), **suH*- (Latin *sūs*, English *sow*), *$H_{u}eu$- (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*).

The authors find horses represented rather late. The Indo-European reconstruction **ekʷo-* (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 prehistory 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

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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-

dressed 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 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

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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
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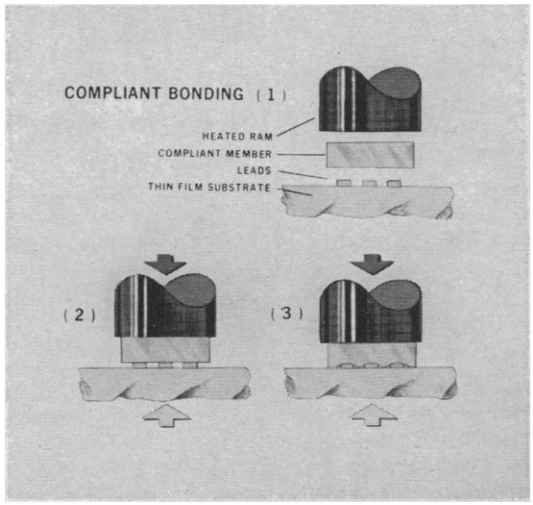
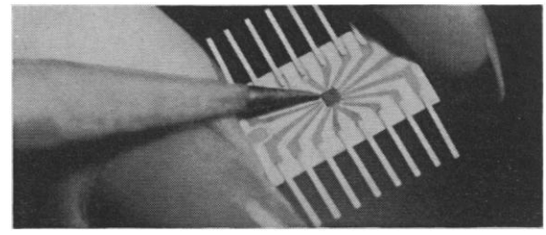
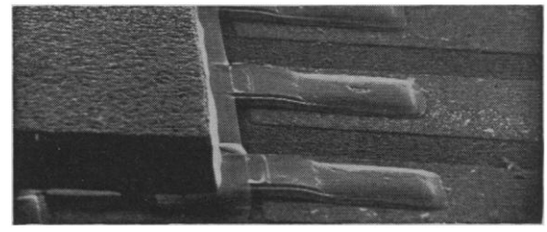
WESTERN ELECTRIC REPORTS



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-leaded 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.

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30 March 1973, Volume 179, Number 4080

SCIENCE

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 routiné, 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).

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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

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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.

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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).

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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.

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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.

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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.

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Journal: H. Smith, *Amer. J. Physiol.* **98**, 279 (1931).

Book: F. Dachille and R. Roy, *Modern Very High Pressure Techniques* (Butterworth, London, 1961), pp. 163–180.

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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.

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