

26 September 1980 • Vol. 209 • No. 4464

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SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



If you want a reliable and quiet high-speed centrifuge the J2-21 is the one!



The Beckman J2-21 is the most reliable high-speed centrifuge in the world. It uses proven components designed for continuous, trouble-free performance at speeds up to 21,000 rpm. A powerful DC drive accelerates rotors quickly. An automatic partial vacuum makes parts last longer, and you use less energy. The J2-21 is sound engineered for quiet—very quiet—operation. And it is the only centrifuge of its type that is UL listed.

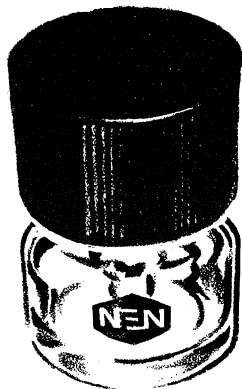
With the J2-21, you have a choice of eleven different rotors. There are six fixed angle, including the popular JA-17 which holds 14 50-mL tubes; two swinging bucket; a vertical tube; and the JCF-Z with interchangeable cores for continuous flow and zonal centrifugation. Of special interest is the Elutriator Rotor for gently harvesting whole cells and other fragile materials.

The quiet, reliable J2-21 is backed by Beckman, with the

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No detectable DNA endonuclease activity

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NEE-100: Available in 600 or 3000 units

T₄ Polynucleotide Kinase

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Tested to demonstrate high dATP, [α - ^{32}P]-incorporation into DNA

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New for Herpes Simplex Virus Studies

Iodo-2'-deoxycytidine, 5-[^{125}I]-

>700Ci/mmol

Ethanol:water, 1:1

NEX-150 10 μCi 2 x 10 μCi 50 μCi 2 x 50 μCi

Prepared fresh for stock first Monday each month

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DNA, IdCTP, IUdR

Deoxyribonucleic acid,

Iododeoxycytidine-5-[^{125}I]-

(Calf thymus. No single-stranded DNA detected immunologically.)

>0.1 $\mu\text{Ci}/\mu\text{g}$

0.01M Tris-HCl, 1.0M NaCl, 0.0001M EDTA,

pH 7.5, shipped in dry ice

NEX-082 1 μCi 5 μCi

Prepared fresh for stock fourth Monday each month

Iododeoxycytidine 5'-triphosphate, tetra(triethylammonium) salt, 5-[^{125}I]-

>900Ci/mmol

Ethanol:water solution, 1:1, shipped

in dry ice

NEX-074 100 μCi 500 μCi 1mCi

Prepared fresh for stock third Monday each month

Iododeoxyuridine 5-[^{125}I]-

>2000Ci/mmol

0.01M Acetic acid:ethanol solution, 1:1

NEX-072 0-500 μCi 1mCi 2mCi

Prepared fresh for stock Wednesday
after fourth Monday each month

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Not for use in humans or clinical diagnosis.



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COVER

Leech embryo showing part of the future nervous system as a band of small, red-fluorescing cells bordering the ventral midline. An N teloblast was injected with rhodamine-labeled dodecapeptide at stage 6a. After subsequent development to mid-stage 8 the embryo was fixed and stained with Hoechst 33258. Nuclei appear as blue-fluorescing dots; only the injected cell (center) and its clonal descendants fluoresce red (about $\times 610$). See page 1538. [Saul J. Zackson, Molecular Biology, University of California, Berkeley]

Powerful HP Series 9800 desktop acquisition and control: the time

Imagine a computer with the interfacing power to automate your test and measurement system in days, instead of weeks or months. A computer that puts the entire system under your personal control—even if you're not a programmer.

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Pick a card. Any card.

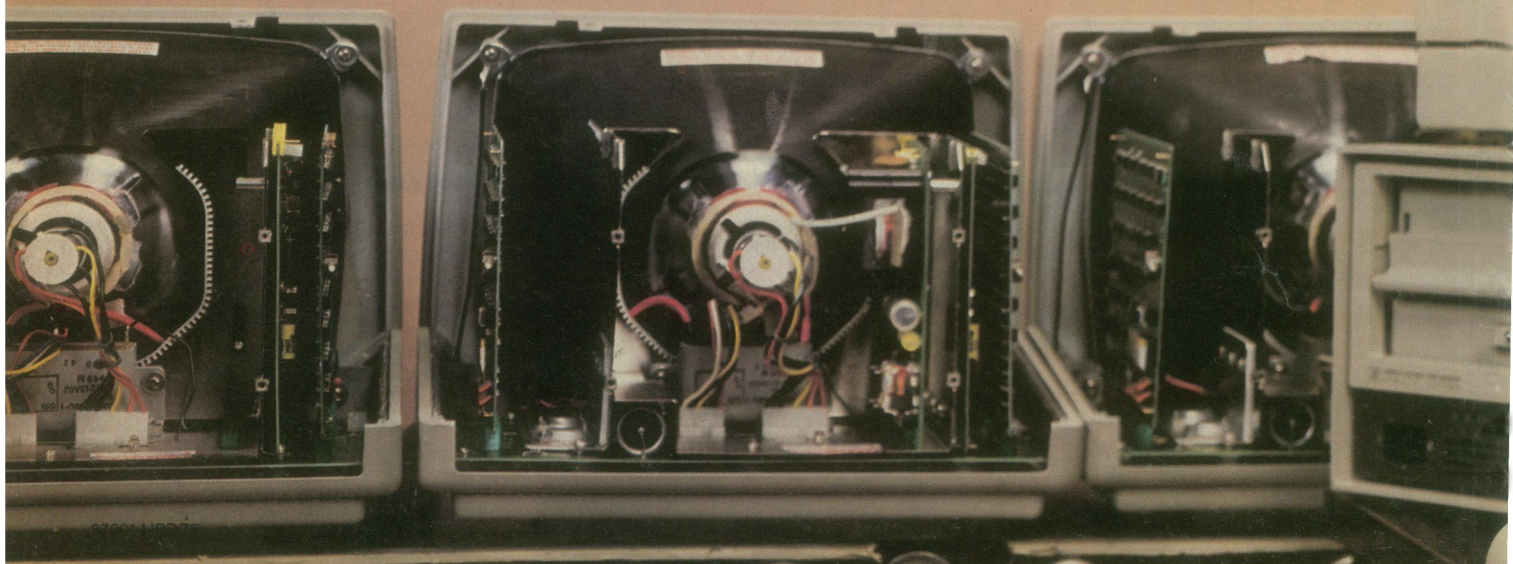
Interfacing to your instruments and any combination of HP printers, plotters, and storage devices has never been so easy. Just choose the plug-in interface card that's right for your needs: HP-IB, Bit-Parallel, BCD or RS-232-C. The I/O drivers are already built-in, so you can concentrate on your applications, and not on system configurations. The result? Less development time (which means a lower total cost), and a more productive system all around.

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What's more, if your applications warrant it, you can get an added dimension of versatility by linking your desktop computer to our powerful HP 1000 minicomputer system. Communication is easily managed, and by combining the



computers for data they save is your own.

relative strengths of desktops and minis, you'll get a remarkable degree of flexibility and efficiency for test, measurement, and control jobs.

If you'd like to find out more about how HP Series 9800 desktop computer systems can help you improve your engineering productivity, just contact your local HP sales office listed in the White Pages. Or write for more information to Hewlett-Packard, Attn: Fred Bode, Dept. 3582, 3404 East Harmony Road, Fort Collins CO 80525.

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ref	chn	function	ref	chn	function	ref	chn	function
no.	no.		no.	no.		no.	no.	
1	1		11	11		21	21	
2	2		12	12		22	22	
3	3		13	13		23	23	
4	4		14	14		24	24	
5	5		15	15		25	25	
6	6		16	16		26	26	
7	7		17	17		27	27	
8	8		18	18		28	28	
9	9		19	19		29	29	
10	10		20	20		30	30	

Operations: 10-5-1
Functions: 10-6-1-1

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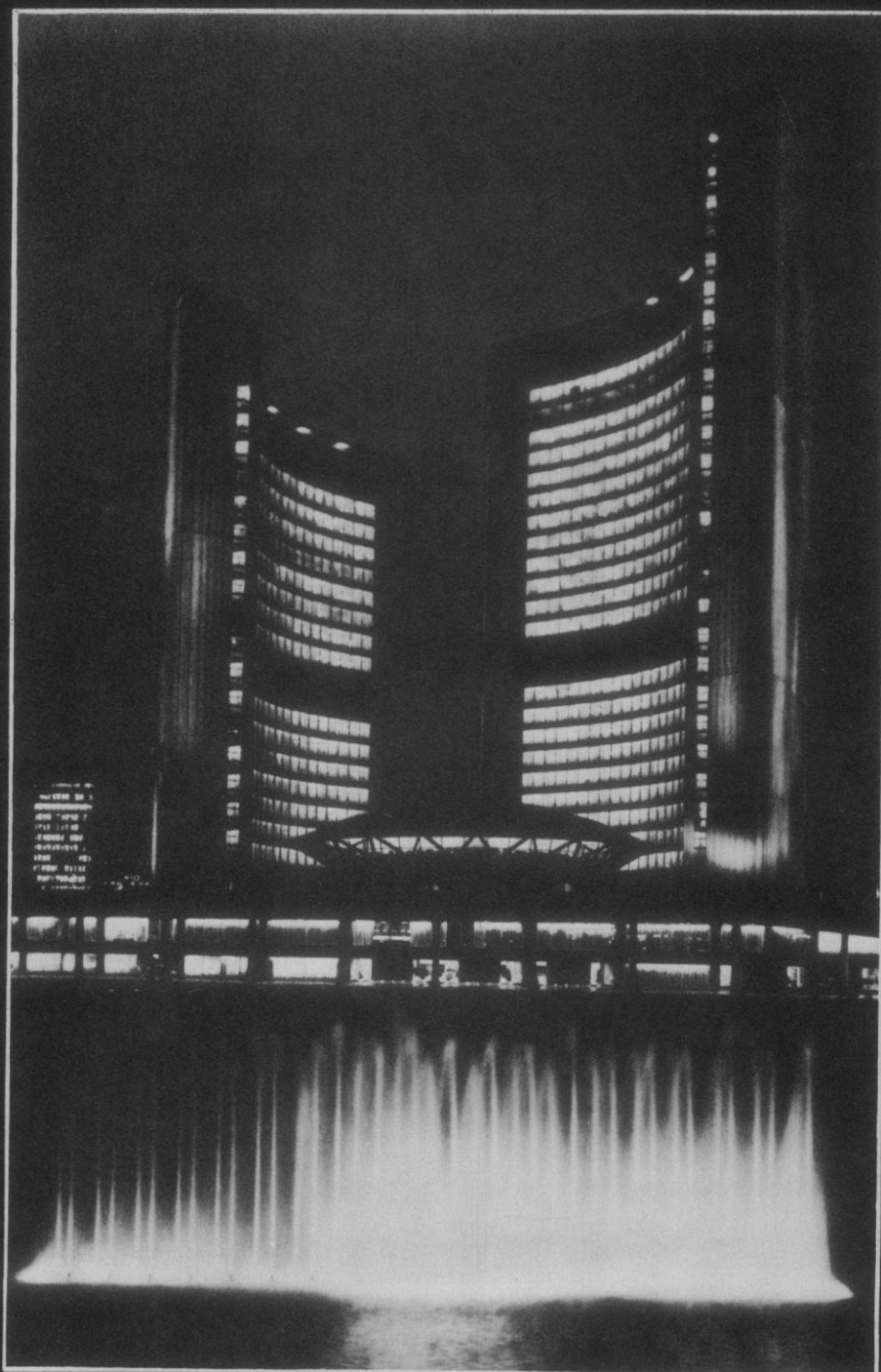
For details about the Meeting program, as well as housing and registration forms, see the Preliminary Program issue of Science 12 September 1980

or write

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1776 Massachusetts Avenue, N.W.
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AAAS Annual Meeting and Exhibit
Toronto, Ontario, Canada
3-8 January 1981



The longest line

α-Adrenergic

Clonidine hydrochloride, [4-³H]-
Desmethylinipramine hydrochloride,
[2,4,6,8-³H]-
Dihydro-α-ergocryptine, 9,10-[9,10-³H(N)]-
WB-4101 (2,6-Dimethoxyphenoxyethyl)
aminomethyl-1,4-benzodioxane,
2-[*phenoxy*-3-³H(N)]-
Epinephrine, *levo*-[*methyl*-³H]-
Norepinephrine, *levo*-[7,8-³H(N)]-

β-Adrenergic

Carazolol, DL-[3,6-³H(N)]-
Dihydroalprenolol hydrochloride, *levo*-
[*propyl*-2,3-³H]-
Epinephrine, *levo*-[*N-methyl*-³H]-
Hydroxybenzylisoproterenol, *p*-[7-³H]-
Isodihydroxybenzylpindolol, [1²⁵]-
Isoproterenol, DL-[7-³H(N)]-
Norepinephrine, *levo*-[7,8-³H(N)]-
Propranolol, L-[4-³H]-

Aspartate

Aspartic acid, D-[2,3-³H]-
Aspartic acid, L-[2,3-³H]-
Methyl-D-aspartic acid, *N*-[*methyl*-³H]-

Benzodiazepine

Diazepam, [methyl-³H]-
Flunitrazepam, [methyl-³H]-

Cholinergic

Muscarinic

Acetylcholine chloride, [*N-methyl*-³H]-
Choline chloride, [methyl-³H]-
Pilocarpine, [³H(G)]-
Scopolamine methyl chloride,
[*N-methyl*-³H]-

Nicotinic

Acetylcholine chloride, [*N-methyl*-³H]-
α-Bungarotoxin, [1²⁵]-
Choline chloride, [methyl-³H]-
Tubocurarine chloride, *dextro*-[13'-³H(N)]-

Dopaminergic

ADTN Amino-6,7-dihydroxy-
1,2,3,4-tetrahydronaphthalene,
2-[5,8-³H]-
Amphetamine sulfate, D-[³H(G)]-
Apomorphine, [8,9-³H]-
Chlorpromazine, [³H]-
Dihydroxyphenylethylamine,
3,4-[ethyl-1-³H(N)]- or [ethyl-2-³H(N)]-
Haloperidol, [³H(G)]-
Propylorapomorphine, *N*-[*propyl*-³H(N)]-
Spiroperidol, [1-*phényl*-4-³H]-

GABA

Alanine, β-[3-³H(N)]-
Aminobutyric acid, γ-[2,3-³H(N)]-
Dihydrocrotinin, α-[8,10-³H]-
Isoguvacine hydrochloride, [³H]-
Muscimol, [methylene-³H(N)]- or [4-³H]-
Nipeotic acid, [ring-³H]-

Glutamate

Glutamic acid, L-[3,4-³H]-

Glycine

Glycine, [2-³H]-

of labeled ligands

Histamine

H₁

Histamine, [³H(G)]-
Pyrilamine, [*pyridinyl*-5-³H]- (Mepyramine)

H₂

Histamine, [³H(G)]-

Opiate

Dihydromorphine, [7,8-³H(N)]-
Enkephalin (5-L-leucine), [*tyrosyl*-3,5-³H(N)]-
Enkephalin (5-L-methionine),
[*tyrosyl*-3,5-³H(N)]-
Enkephalinamide
(2-D-alanine-5-L-methionine),
[*tyrosyl-ring*-2,6-³H]-
Ethylketocyclazocine, [9-³H]-
Morphine, [6-³H(N)]-

Serotonin

Hydroxytryptamine binoxalate, 5-[1,2-³H(N)]-
Hydroxytryptamine creatinine sulfate,
5-[1,2-³H(N)]-

Steroid

Androgen

Dihydrotestosterone,
[1,2,4,5,6,7,16,17-³H(N)]-
Methyltrienolone, [17α-*methyl*-³H]- (R1881)*
Testosterone, [1,2,6,7,16,17-³H(N)]-

Estrogen

Estradiol, [2,4,6,7,16,17-³H(N)]-
Iodo-3,17β-estradiol, 16α-[1²⁵]-
Moxestrol, [11β-*methoxy*-³H]- (R2858)*

Glucocorticoid

Dexamethasone, [6,7-³H(N)]-
Prednisolone, [6,7-³H(N)]-
Triamcinolone acetonide, [6,7-³H(N)]-

Mineralocorticoid

Aldosterone, D-[1,2,6,7-³H(N)]-

Progesterone

Dihydroprogesterone, [1,2-³H(N)]-
Nor-17α-ethynyltestosterone, 19-[6,7-³H(N)]-
Progesterone, [1,2,6,7-³H(N)]-
Promegestone, [17α-*methyl*-³H]- (R5020)*

*Manufactured by NEN under licensed agreement of
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Miscellaneous

Dihydroxyvitamin D₃, 1α, 25-[26,27-³H]-
Hydroxyvitamin D₃, 25-[26,27-³H]-
Imipramine hydrochloride, [2,4,6,8-³H]-
Phencyclidine, [*piperidyl*-3,4-³H(N)]-
Reserpine, [*benzoyl*-³H(G)]-

Circle No. 371 on Readers' Service Card

is longer yet:

New labeled ligands

Aminoclonidine, *p*-[3,5-³H]-
Dioxolane, L(+)-*cis*-[2-*methyl*-³H]-
Domperidone, [*benzene-ring*-³H]-
Doxepin, [methyl-³H]-
Lysergic acid diethylamide,
[*N-methyl*-³H]-
Melanotropin Release Inhibiting
Hormone, [*L-proline*-2,3,4,5-³H]- (MRIH)
Naloxone, [*N-allyl*-2,3-³H]-
Oxotremorine-M, [methyl-³H]-
Oxymorphone hydrochloride,
[*N-methyl*-³H]-
Pargyline, [³H(G)]-
Prazosin, [*furoyl*-5-³H]-
Quinuclidinyl benzilate,
L-[*benzyl*-4,4'-³H(N)]-
SKF 10,047, [*N-allyl*-2,3-³H]-
Yohimbine, [methyl-³H]-

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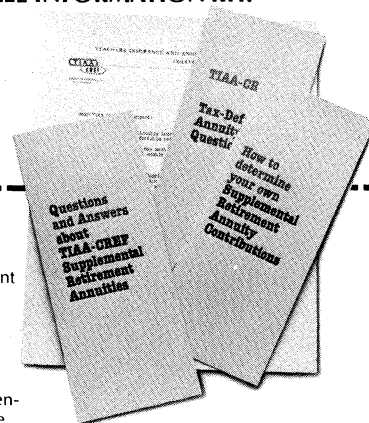
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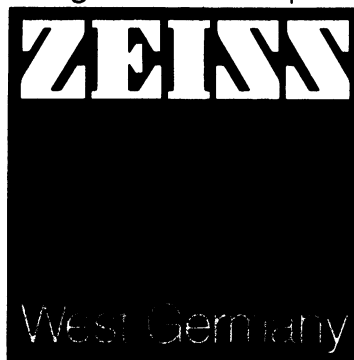
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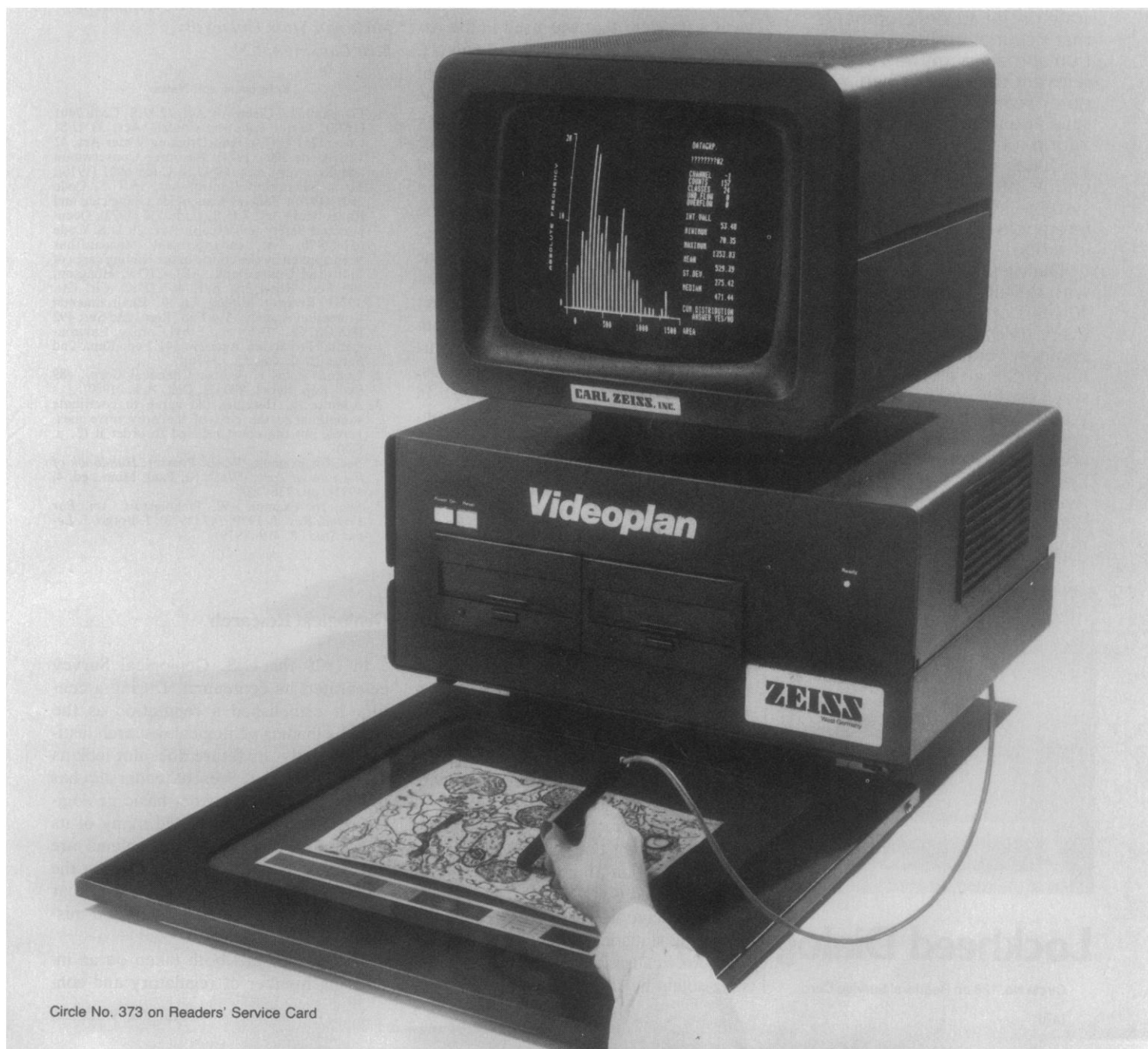
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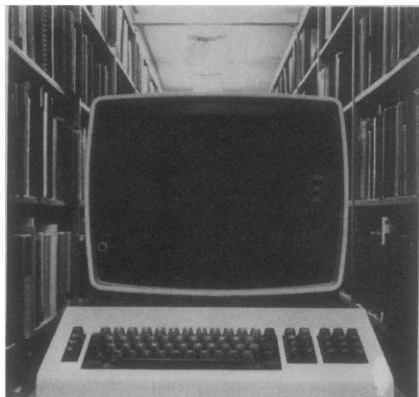
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LETTERS

Love Canal and Legal Precedent

As Barbara Culliton indicates in the article "Continuing confusion over Love Canal" (News and Comment, 29 Aug., p. 1002), the interactions between law and science are frequently complex and difficult. Nowhere is this more true than when courts must deal with problems of toxicology or epidemiology, where, as Culliton notes, different standards are used in law and science. I believe, however, that Culliton and *Science* readers may have been misled by some of the quoted comments made by Anthony Roisman of the Department of Justice.

The statutes that deal with the problems of chemical threats to human health frequently do have an "endangerment" standard which requires less than certainty that harm will result (1). It was just such a standard that was used in the Arkansas case referred to by Roisman (2). It is difficult to see, however, how that case can provide a precedent for the Love Canal problem. The Arkansas case involved the current and future storage and disposal of materials contaminated by 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (dioxin) on land currently owned by the Vertac Chemical Corporation and previously owned by Hercules, Inc. The court applied an "endangerment" standard and required Vertac, the current owner, to take various steps to prevent the escape of dioxin; however, the court expressly refused to require Hercules, the former owner, to do anything (3). In the Love Canal situation Hooker Chemical Corporation, the former owner, may well argue that the Arkansas decision regarding Hercules is a precedent in its favor, not against it, as apparently contended by Roisman.

Furthermore, there is a very important difference between the type of legal action in the Arkansas case and that in the Love Canal case. The Arkansas case was an action in equity seeking an injunction ordering the defendants to do or not do specific things; Love Canal is a tort/nuisance suit seeking monetary payments to compensate the plaintiffs for injuries resulting from past actions of the defendants. Equity actions traditionally have less rigorous standards of causal proof than do tort suits. Tort suits require a showing that "but for" the defendant's action the injury would not have occurred (4).

Courts have a great deal of difficulty accepting statistical evidence as proving "but for" causation. Even the best possible scientific study (cytological, epide-

miological, or other) could merely conclude that "with a 95 percent (or 99 percent, or any other level) degree of confidence, this chemical pollution resulted in these (cellular, physiological, health) effects." Many legal writers think such a statement might not be sufficient to persuade a court that "but for" causation had been demonstrated (5).

In the Love Canal case, then, contrary to the opinion expressed in Culliton's article, attorneys may require much more proof, not much less proof, than the scientific community would; so much more, in fact, that it might be impossible for scientific studies to meet the needs of the legal system. It may be that a legislative change in the required proof of causation, as is included in some of the "superfund" bills pending in Congress, will be necessary to resolve this issue.

DANIEL A. BRONSTEIN

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References and Notes

1. For example, Clean Air Act, 42 U.S. Code 7401 (1977); Water Pollution Control Act, 33 U.S. Code 1251 (1977); Safe Drinking Water Act, 42 U.S. Code 300f (1974); Resource Conservation and Recovery Act, 42 U.S. Code 6901 (1976); Toxic Substances Control Act, 15 U.S. Code 2601 (1976); Federal Insecticide, Fungicide and Rodenticide Act, 7 U.S. Code 136 (1972); Occupational Safety and Health Act, 29 U.S. Code 651 (1970). The "endangerment" standard has been applied by the courts in the leading cases of *Industrial Union Dept. v. AFL-CIO v. Hodgson*, 499 Fed. Rep., 2nd Ser. 467 (D.C. Cir. Ct., 1974); *Reserve Mining Co. v. Environmental Protection Agency*, 514 Fed. Rep., 2nd Ser. 492 (8th Cir. Ct., 1975); and *Ethyl Corp. v. Environmental Protection Agency*, 541 Fed. Rep., 2nd Ser. 1 (D.C. Cir. Ct., 1976).
2. *United States v. Vertac Chemical Corp.*, 489 Fed. Rep. Suppl. 870 (E. Dist. Ark., 1980).
3. Admittedly, Hercules did agree to contribute something to the cost of the preventive measures, but the court refused to order it (2, p. 888).
4. See, for example, W. L. Prosser, *Handbook of the Law of Torts* (West, St. Paul, Minn., ed. 4, 1971), pp. 236-290.
5. See, for example, W. Pfennigstorf, *Am. Bar Found. Res. J.* 1979, 347 (1979); J. Borgo, *J. Legal Stud.* 8, 419 (1979).

Geological Research

In 1979 the U.S. Geological Survey celebrated its centennial. During a century it established a reputation as the world's leading geological research institution. Sadly, its future does not look as bright as its past. Present leadership has diverted the Survey from basic geological research and has halted many of its important programs. Its problems are not fiscal, as is often claimed to be the plight of federal institutions, but appear to result from poor leadership and misdirection.

The Survey has both taken on an increasing number of regulatory and con-



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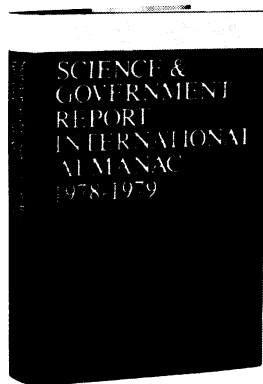
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tract monitoring tasks and decreased its research. Effort to maintain the geological data base has been drastically reduced. Much of the success of the Survey in meeting the demands for earthquake prediction, energy and mineral resources estimation, reactor hazards evaluation, and a myriad of other applied problems has hinged upon a vast accumulation of geological information. No amount of computer manipulation of a static data base can substitute for vigorous, ongoing research and mapping to increase that base systematically.

One searches in vain in the 1979 Survey yearbook for a discussion of geological mapping or research. Publication policy has been changed drastically. High-quality maps and archival book publications are now practically nonexistent; most results of Survey work are released in open-file reports of uneven quality, available only at relatively high cost. Hard money for basic geological mapping and geochemical, geophysical, and paleontological projects no longer exists in the Survey budget. All such work must now be justified under a mission-oriented, line-item program within a politically tangled system of budget management.

If organized concern is not soon expressed regarding the plight of research in the Survey, I fear that it may go down the drain as a driving force in American science. The scientific community should be alerted to these developments.

PORTER M. KIER

National Museum of Natural History,
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Digital Readouts on Television Pictures

Video systems are increasingly being used for data compilation and analysis in behavioral studies (1). The hardware is relatively inexpensive and portable, and videotapes, unlike conventional motion-picture film, are analyzable by instant playback and are reusable. We have developed a simple display module that allows numerical data to be superimposed on television pictures and recorded as part of the televised information. The device, described in technical detail elsewhere (2), is inexpensive, versatile, and electronically compatible with most closed-circuit television systems. It employs standard, large-scale integrated circuits, commonly used in commercial television receivers to display time and channel number. We have found the device particularly useful in time-motion



Fig. 1. Photograph of a television monitor screen displaying a single frame of a videotape with superimposed digital readouts. The upper readout gives the experiment number, and the lower readout (which also serves as frame marker) gives the time elapsed in minutes, seconds, and sixtieths of a second. The videotape is that of a bioassay with ants given untreated food (upper right and lower left sites) and food treated with a chemical repellent (upper left and lower right). Data for the assay are obtained by counting the ants at the treated and untreated sites every 5 seconds over a period of a minute. The readouts make it easily possible to stop the tape during playback at the desired 5-second intervals to make the counts.

analysis of behavioral events, for which purpose the display module is used to indicate the experiment number and time (Fig. 1). The time readout, given in minutes, seconds, and sixtieths of a second, changes with each video frame and can thus serve as a frame and time marker in playback analysis. Since the module can provide a readout of virtually any numerical variable, it is broadly applicable. The cost of the hardware is approximately \$50.

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2. D. Aneshansley, *Behav. Res. Methods Instrum.*, in press.

Erratum: In the report "The testicular feminized rat: A naturally occurring model of androgen independent brain masculinization" by B. H. Shapiro *et al.* (18 July, p. 418), two relevant references were omitted. These are K. L. Olsen, *Horm. Behav.* **13**, 66 (1979) and K. L. Olsen, *Nature (London)* **279**, 238 (1979).

Erratum: The title of the letter from Andrew T. Weil (12 Sept., p. 1182) should have been "Coca, not cocaine." The second and third sentences of the second paragraph should have read, "I have advocated research on the therapeutic properties of whole coca leaf. Cocaine and coca are quite different substances with very different potentials for abuse and benefit."

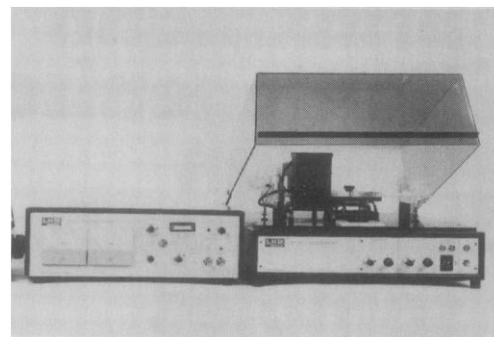
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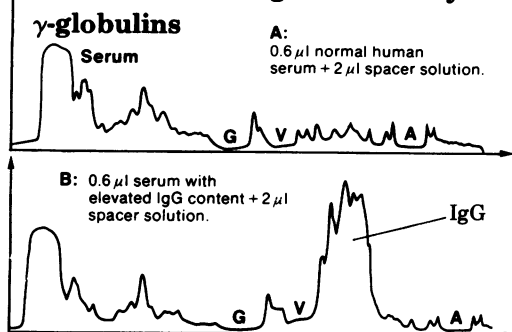
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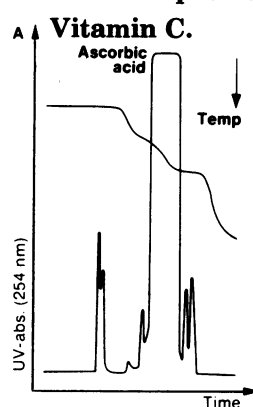


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Delmotte, P., *Science Tools* 24 (1977) 33–41.

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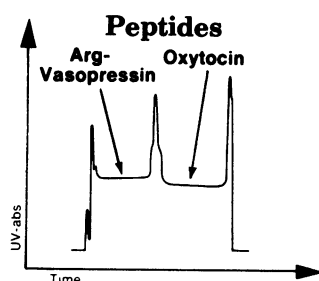


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Baldesten, A., Hjalmarsson, S-G and Neumann, G., *Fres. Z. Anal. Chem.* 290 (1978) 148–149.

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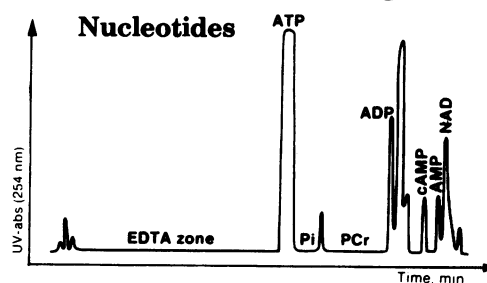


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Gower, D.C. and Woledge, R.C., *Science Tools* 24 (1977) 17–21.

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Science and Engineering

The national debate about U.S. science and technology, although triggered by self-doubts caused by falling productivity and an increasingly adverse balance of trade, may have some lasting positive results. In his column in this space, Branscomb* discussed the need for a national commitment to excellence in science. I would like to discuss the need for a national commitment to closer ties between science and engineering.

If science is defined as the systematic knowledge of the physical world, then engineering may be defined as the knowledge of how to apply science for the use of mankind. It follows that engineering cannot exist without science and, conversely, that science supported with public funds must be mindful of the needs of engineering. In the past, engineering has drawn heavily on the physical sciences; for example, integrated circuits and computers have benefited greatly from solid-state physics and mathematics. It seems inevitable that new branches of engineering will emerge based on pioneering work in fields ranging from microbiology to geology.

There are historical, cultural, and other differences between scientists and engineers. Scientists commonly cooperate as individuals on a worldwide scale. Engineers tend to work more in teams within the same organization. A scientist is honored by having a natural phenomenon named after him. An engineer is promoted to head his team or company. Scientists publish, engineers patent their results. Relatively more scientists than engineers work in universities, perform research, and are supported with public funds.

Nevertheless, such distinctions are becoming blurred; engineers are publishing their results and scientists are patenting new organisms. I would like to see a conscious effort to forge a closer alliance between scientists and engineers. This would be in the national interest and should take place at different organizational levels. Mutual understanding and cooperation can be fostered either informally, by joint meetings and activities and overlapping individual memberships, or more formally, by written agreements and joint organizations. For example, the National Science Foundation could provide the focus for engineering that it already provides for science. Alternatively, this focus could be provided by a National Engineering Foundation closely connected to the NSF by interlocking directorates (that is, boards of directors with overlapping memberships).

On 13 December 1979, the engineering societies formed an umbrella organization called the American Association of Engineering Societies (AAES), which could in time develop joint activities with the AAAS. There is already cooperation between the Engineering Manpower Commission and the Scientific Manpower Commission, and there is a semiautonomous Engineers' and Scientists' Joint Committee on Pensions, for which AAES supplies the secretariat. Several engineering societies have followed the lead of the AAAS and established Congressional Fellowships. The annual analysis of the federal R & D budget by the AAAS was performed last year with the participation of other scientific and engineering societies.

These cooperative endeavors are excellent, but are still few and far between. Science and engineering play different but interlocking roles, both geared to improving the quality of life. A high-priority objective for both scientists and engineers should be that of improving the understanding of science and engineering by corporation boards and company management as well as by government agencies and offices. This can be achieved by educating those already in place, by increasing the number of scientists and engineers in decision-making positions, and by placing more emphasis on science and engineering in high school and college, where minimal standards of technical literacy should be required of all who aspire to graduate. These are goals to which all scientific and technical societies can dedicate themselves.—LEO YOUNG, *President, Institute of Electrical and Electronics Engineers, Inc., New York 10017*

*Lewis M. Branscomb, *Science*, 8 August 1980, p. 641.

BUCHLER GENERATION II INSTRUMENTS

Designed for zero maintenance— New Variable Speed Rotary Flash Evaporator

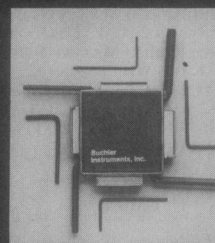
Buchler flash evaporators are built to the highest standards to protect your work investment—their reliability insures perfect evaporations the first time. And now, there's an even more reliable sealing system. The special seal is machined from a special low friction Teflon® composite, so there's no thin, wear-prone coating to deteriorate. It's unconditionally guaranteed for 6 months—regardless of how much it's used. That's reliability you can depend

on...and the rest of the unit is just as well designed. The shaft is supported on a full 24 bearings and the motor is permanently lubricated. And since it's manufactured in the U.S. by Buchler, you can be assured of local parts and service in the very unlikely event you should ever need them.

Buchler has always designed with the working laboratory in mind—that's why this unit takes up a minimum of valuable bench or hood space—just over 2 sq. ft. That's over a third less area than some competitors.

Call your nearest dealer or contact Buchler direct for complete information.

Tools to say thanks.



Get this handy metric hex wrench set when you receive a demonstration of the Flash Evaporator. Contact Buchler or your participating lab dealer for details.

Buchler

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