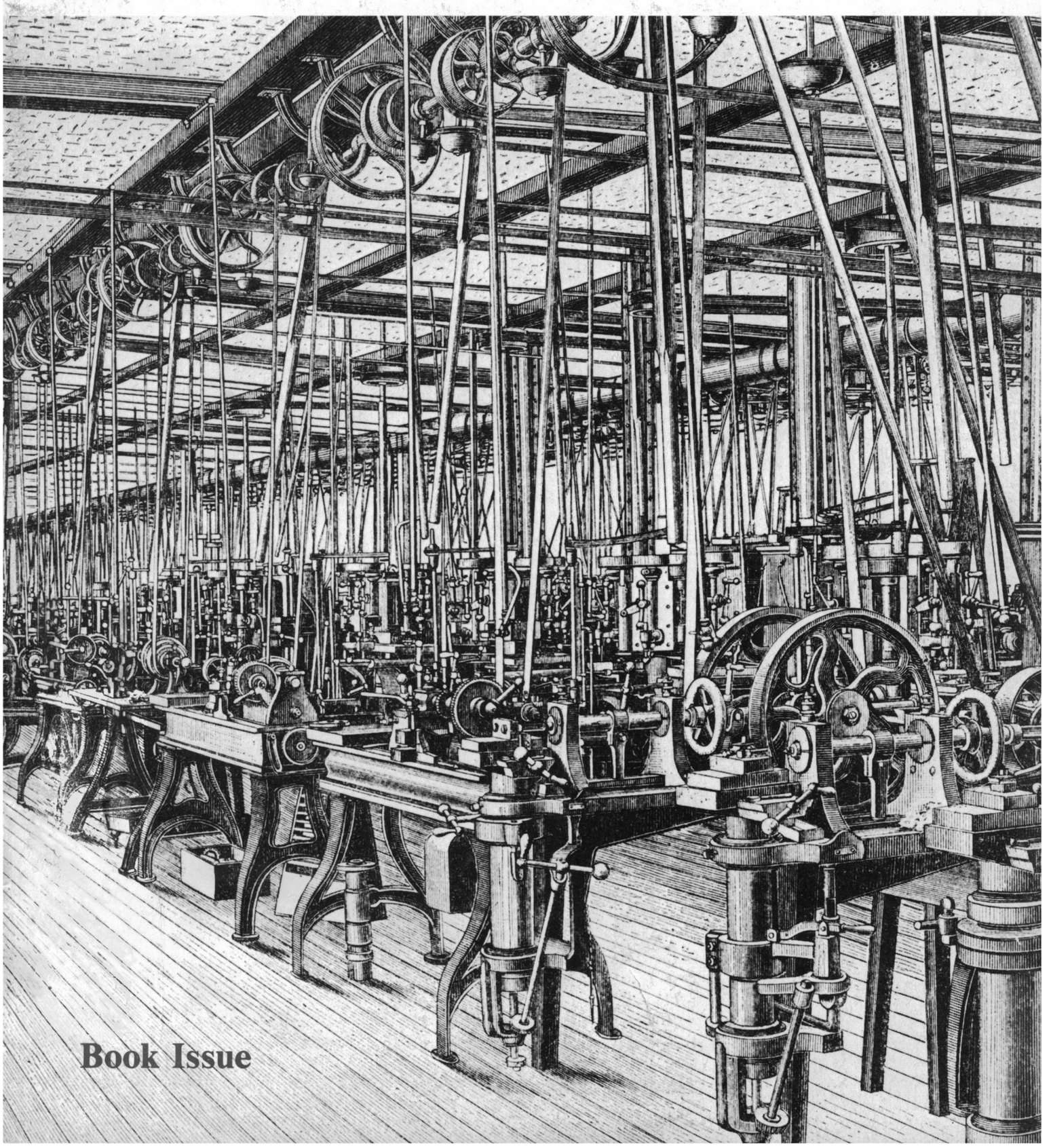
20 MAY 1983 · VOL. 220 · NO. 4599 $2.50

SCIENCE

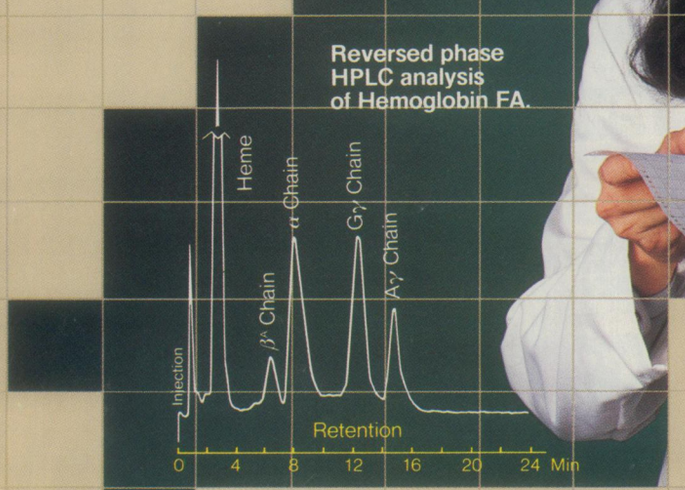
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Book Issue

TEAMWORK:

Protein expert to protein expert

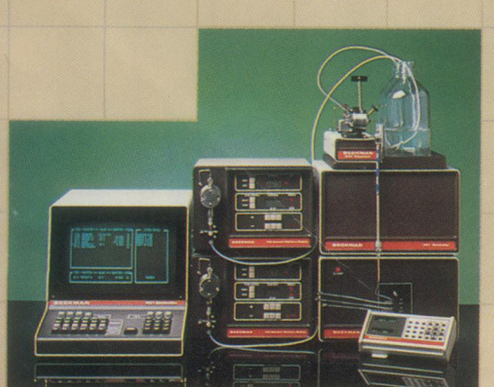


Proteins, Peptides and Amino Acids

You're an expert in protein chemistry. We're HPLC experts in bioresearch analysis. In fact, Beckman is your best choice for supplying your lab with everything needed for today's critical analysis of proteins. We'll provide you with systems and columns. We'll give you better selectivity and resolution in addition to faster protein separations. *Plus,* you'll get the most important benefit of all—Beckman's strong, on-going support program.

HPLC Systems for Improved Protein Separations

Four complete High Performance Liquid Chromatographs offer you isocratic as well as gradient separations with sharp, discrete peaks. And they do it in minutes instead of hours! Each Series 340 system incorporates the Model 112 Solvent Delivery Module which delivers ultra-precise flow rates for highest reproducibility from injection to injection.



Choose the Exact Column to Meet Your Needs

Beckman has developed so many columns specifically for protein chemistry you'll be able to find exactly what you need. Ultrapore™ Reversed Phase Columns with their new C_3 alkyl chain surface chemistry can mean greater mass recovery with increased efficiency for separations of proteins and peptides. Ultrasphere® HPLC Columns give you multiple functional groups such as C_8, C_{18}, CN and silica for peptides and amino acids as well as other biological compounds of interest. For analysis of biologically active proteins, Spherogel™ TSK Ion Exchange Columns offer two different functional groups—DEAE and CM. And Spherogel™ TSK Size Exclusion Columns are available in different pore sizes for increased capability in analysis of large molecular weight species. And you're assured of reproducibility ... column to column.

Let Our Experts Work With Your Experts

So whether you're involved in analyzing biologically active proteins or purifying proteins prior to sequencing, we can help you do more bioresearch and do it better. Your local Beckman Sales Representative and LC Technical Specialist can help you get started. Or contact us directly at Beckman Instruments, Inc., Altex Scientific Operations, 1716 Fourth Street, Berkeley, CA 94710. (415) 527-5900.

See us at ASBC Booths K1-K6, K19-K24, J19-J24

BECKMAN

Circle No. 191 on Readers' Service Card

ISSN 0036-8075

20 May 1983

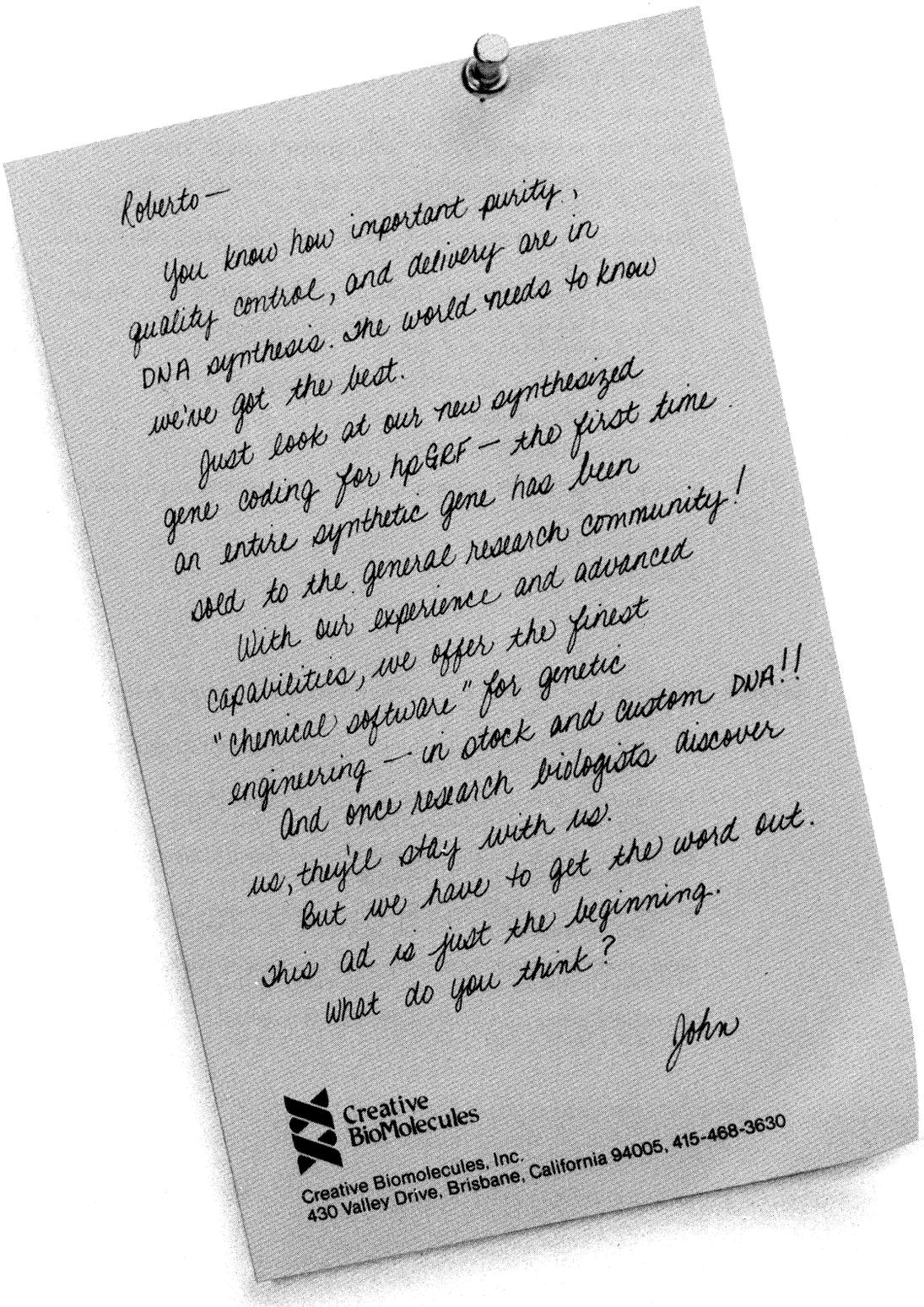
Volume 220, No. 4599

SCIENCE

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly**® Domestic individual membership and subscription (51 issues): $53. Domestic institutional subscription (51 issues): $90. Foreign postage extra: Canada $24, other (surface mail) $27, air-surface via Amsterdam $65. First class, airmail, school-year, and student rates on request. Single copies $2.50 ($3 by mail); back issues $3 ($3.50 by mail); Biotechnology issue, $5 ($5.50 by mail); classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. **Postmaster:** Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

COVER

A shop at the Colt armory in Hartford, Connecticut, around 1880, with slotting machines (foreground), lathes (front, left), and jigging or profiling machines (rear). [From C. H. Fitch, "Report on the Manufactures of Interchangeable Mechanism," in *Report on the Manufactures of the United States at the Tenth Census 1880*, vol. 2 (U.S. Census Office, Washington, D.C., 1883). Smithsonian Institution Negative No. 81-205, reproduced in D. Nelson's contribution to *Yankee Enterprise*, reviewed on page 817]



Aren't you changing yours?

Sartorius Series 1600 electronic analytical balances for as little as ~~$2,195~~.

Now $1,995

Aren't you changing your weighs? The cost of progress is now quite affordable with the new electronic weighs—Sartorius Series 1600 Analytical Balances. Advanced high-technology electronics has brought the price of electronic analytical weighing within *your* reach for as little as $2,195. And with ever-expanding applications for electronic balances in industry as well as research, the new weighs are here and now!

For more information or a demonstration, call or write: Brinkmann Instruments Co., Division of Sybron Corporation, Cantiague Road, Westbury, NY 11590 •Tel: 800-645-3050; in New York: 516-334-7500.

Sartorius electronic weighing systems

Brinkmann

SYBRON

BRK-5058

For information circle reader service number 186
For a demonstration circle reader service number 187

Fisher ChemAlert™

NOTHING COULD BE SIMPLER

Laboratories have long depended on the Fisher reagent label. With its clear-cut purity grades, detailed analyses, applicable OSHA, DOT, and ANSI data, first aid instructions. Now this distinguished label becomes more useful than ever. Now it will also carry the Fisher ChemAlert Guide.

ChemAlert is an **instant** guide to storing and handling the reagent in question. A useful supplement to your regular safety program. It condenses a wealth of authoritative material into a uniquely simple three-part format.

☐ One part tells you, with a large uncluttered color bar, how to store the reagent. (For the color-blind, this bar also identifies itself by letter, i.e., for flammable storage it uses an "R" as well as the color red.)

☐ One part rates potential hazards numerically, inside a big bold NFPA "diamond," a symbol selected for its universality. (In fact, many industries, hospitals, and municipalities now require it.)

☐ One part demonstrates how to handle the reagent. What protective gear to wear. Whether to use a fume hood.

Right on the label — there's no more logical place to remind users — old and new — of the correct way to deal with chemicals.

ChemAlert was designed to do this reminding in the most **effective** way possible. Watch for it on your familiar Fisher reagents. Use it, for safety's sake.

For a detailed brochure on new ChemAlert, circle our number on the reply-card. Or give us a call at (412) 562-8543.

Fisher Scientific

An ALLIED Company

Circle No. 133 on Readers' Service Card

FOR TODAY'S FACULTY AND COLLEGE STAFF MEMBERS* FROM 18 TO 80.

Whether you're thinking retirement or not, review the plan that provides for cash withdrawal and/or a lifetime income.

TIAA-CREF Supplemental Retirement Annuities (SRAs) offer you substantial flexibility including cash withdrawal and/or lifetime retirement income. You can even reduce your income taxes now!

You can begin contributions to an SRA at any age and begin benefits at any age up to age 71 unless you are still employed (then you can delay beginning benefits until age 80). For example, you could start contributions at age 25, and choose to begin benefits or withdraw cash at age 34, 40 or 50, regardless of your employment status.

Get your money at any time.

You can receive benefits as a lifetime income or over a fixed period of from 2 to 10 years. What's more, if you need it (even while employed by your current employer), you can withdraw all the money you have accumulated by surrendering your contracts. Or, you can withdraw $1,000 or more every six months. There is never a cash surrender charge.

Contributions are tax-deferred, so you pay less income taxes now.

The federal income tax on your contributions is deferred until they are paid to you as benefits. So, you pay less tax now.

Changing employers? Take SRAs with you.

Since you own your Supplemental Retirement Annuities, you take them with you if you leave your current employer. You can make contributions through any institution that makes Supplemental Retirement Annuities available to staff members. Contributions can be as little as $25 a month.

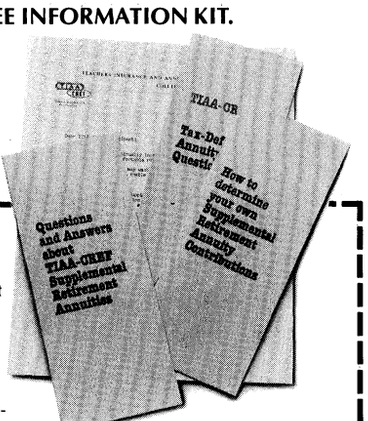
Full information.

Complete and mail the coupon for an SRA Information Kit today. You'll get full details about all the advantages SRAs have to offer, why this plan suits so many financial situations and age groups and how much you may contribute to the plan.

*TIAA-CREF provides annuities and other services for employees of colleges, universities, private schools and certain other nonprofit tax-exempt educational and research institutions.

HELP YOURSELF TO A BRIGHTER FINANCIAL FUTURE ...SEND FOR A FREE INFORMATION KIT.

TIAA CREF



Teachers Insurance and Annuity Association of America—College Retirement Equities Fund
730 Third Avenue
New York, N.Y. 10017

Please send me full details about TIAA-CREF Supplemental Retirement Annuities, the flexible tax-deferred annuity plan that offers the opportunity to accumulate funds for additional retirement income and the option for cash withdrawal.

Name_____

Address_____

City_____

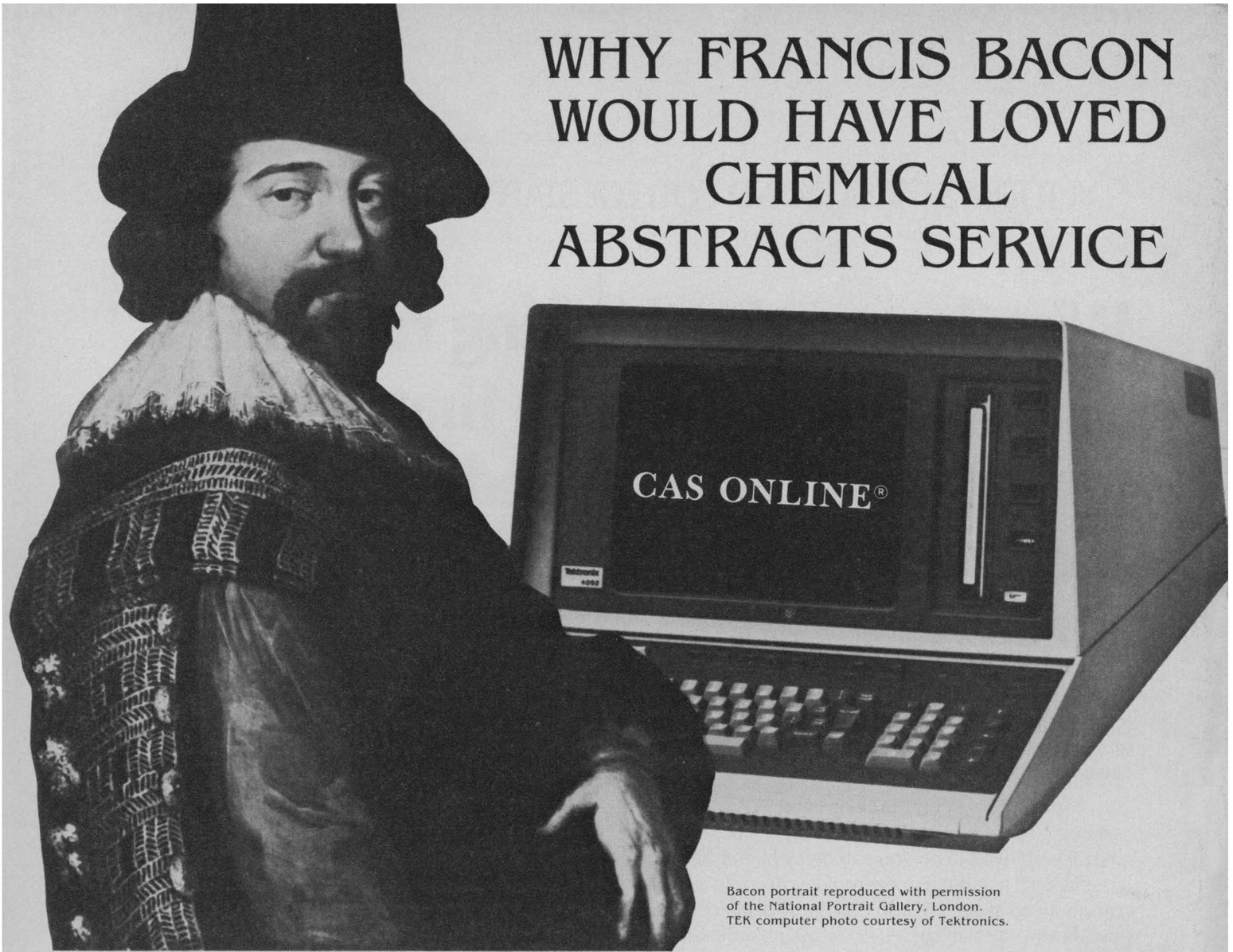
State_____ Zip_____ Date of Birth_____

Name of Institution_____

Please let us know if you are participating in a TIAA-CREF retirement plan at your institution. ☐ YES ☐ NO

S52083

WHY FRANCIS BACON WOULD HAVE LOVED CHEMICAL ABSTRACTS SERVICE



Bacon portrait reproduced with permission of the National Portrait Gallery, London.
TEK computer photo courtesy of Tektronics.

Even in Francis Bacon's time (1561-1626), there was too much literature to keep up with. He knew the solution was to be selective.

As Bacon put it, "Some books are to be tasted, others to be swallowed." Sometimes, he continued, the reader should rely on "extracts" (or abstracts) of the original literature.

Chemical Abstracts (CA) was created to give scientists just what Bacon suggested-a taste of the relevant literature. And the concept is still evolving at Chemical Abstracts Service (CAS).

With the abstracts in CA, researchers can taste the world's scientific literature and decide what they want to read. And to make abstracts even more accessible, we've recently made them available online. All CA abstracts from mid-1975 to the present can now be retrieved at remote terminals through our CAS ONLINE® system.

CAS will continue to explore the computer's potential to bring you closer to the literature you need. If you can imagine a better way of finding essential scientific information... chances are, we're already working on it.

Chemical Abstracts Service
A Division of the American Chemical Society
P.O. Box 3012
Columbus, OH 43210
(614) 421-3600

For more information, write Marketing, Dept. 31283

How 5 new Nalgene® filter units solve the most common problems of tissue culture filtration.

Problem: Cytotoxicity

Contamination is the enemy of every tissue culture experiment.

The Nalge Solution: The new Nalgene type TC Tissue Culture Sterilization Filter Units surpass existing standards for cell toxicity testing. They alone incorporate a membrane that is inherently hydrophilic; it has *no* surfactants, plasticizers or wetting agents (it's Triton-free) to contaminate culture media. It is extremely low in extractables. The proven design of Nalgene Filter Units reduces the chance of contamination. And our specially selected method of radiation sterilization eliminates any possible EtO residue on the membrane.

Problem: Mycoplasma Contamination

The Nalge Solution: These new Nalgene units are the *only ready-to-use* tissue culture filter units that come with either a 0.1- or 0.2-micron membrane. You can use the 0.2-micron membrane unit when *Mycoplasma* contamination is not a problem. If it is, you can follow with the 0.1 membrane unit to be sure you have no problem.

Problem: Inconvenience

Setup, cleanup and repeated sterilization of reusable filter holders consume valuable time and effort. Some ready-to-use filters make you provide the sterile receiver.

The Nalge Solution: The new Nalgene TC Filter Unit is completely self-contained, with an integral receiver, and is pre-sterilized for immediate use. Its ready-to-use, disposable design simplifies your total procedure.

Top, Type LTC 500 mL 0.2 membrane

Center right, Type TC 115 mL 0.1 or 0.2 membrane

Bottom, Type STC 30 mL 0.1 or 0.2 membrane

Several filters solve *some* of your problems. Only ours solves *all* of them. Order from your Authorized Nalgene Labware Dealer. For more information, write Nalgene Labware Department, Nalge Company, Box 365, Rochester, NY 14602 or call Nalge Technical Service at 716-586-8800.

Available in three capacities: 30 mL, with 0.1-micron (Cat. No. 152-2010) or 0.2-micron (Cat. No. 152-2020) membrane; 115 mL, with 0.1-micron (Cat. No. 150-4010) or 0.2-micron (Cat. No. 150-4020) membrane; and 500 mL, with 0.2-micron membrane (Cat. No. 151-4020).

For laboratory use only.
Not for in-vitro diagnosis or parenterals.

SYBRON

Nalge

Circle No. 175 on Readers' Service Card

HOT OFFER

Buy any Corning® Hot Plate, Stirrer, or Hot Plate/ Stirrer and get a classic CORNING WARE® teapot at a remarkably low price! Cornflower design, only $5.95 with purchase. Spice O' Life® design, only $6.95 with purchase.

Hot plate top is chemically durable Pyroceram®. Heats and cools quickly. Cleans easily. Overhangs to protect insides from spills. Easy to read control dials resist corrosion from condensation. Direct control models are UL, CSA listed. 35 or 100 sq. in. surface.

YOU GET MORE FOR YOUR MONEY FROM CORNING

HOT OFFER

Buy any Corning Hot Plate, Stirrer or Hot Plate/Stirrer and get a CORNING WARE® teapot with Cornflower emblem for only $5.95! Or choose Spice O' Life® design for only $6.95!

Please send me:

_____ (quantity) Blue Cornflower Teapots @ $5.95 each (total) $_____

_____ (quantity) Spice O' Life® Teapots @ $6.95 each (total) $_____

Mail to:
CORNING WARE® Teapot Hot Offer
P.O. Box 725
Dept. 245, Lubbock, Texas 79491

Offer expires December 31, 1983. Offer good only in the USA or its territories. Void where prohibited or restricted by law. Please allow 8 weeks for delivery.

☐ Please send '83 Corning catalog

SE-05-83-HP

Enclosed is $_____ (check or money order only payable to "CORNING WARE® Teapot Hot Offer") plus one Proof of Purchase from any Corning® Hotplate, Stirrer, or Hotplate Stirrer for each teapot ordered. (Proof of Purchase is the specification label from the side panel of any Corning Hotplate or Stirrer box.) Texas residents add 5% sales tax.

NAME _____

ORGANIZATION _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

The Most Trusted Tools Of Science

CORNING

Circle No. 168 on Readers' Service Card

TEK 4113A COMPUTER DISPLAY TERMINAL
4691 COLOR GRAPHICS COPIER

THE GRAPHICS STANDARD

Tek color: Now on-screen. On-paper. And off-line.

Introducing the first color terminal/color copier engineered for each other—for flicker-free display, outstanding copy quality, and push-button simplicity.

With its exclusive 150 dots/inch ink jet technology, Tektronix's new 4691 Color Graphics Copier copies any 4113A terminal display in brilliant colors. In A or B sizes. Down to the last detail.

The 4113A lets you access true zoom and pan and powerful segments manipulation. Add Tek's new Local Programmability package, and you can go from program creation to final copies completely independent of the host. Or connect the 4691 directly to the host via its high-speed 8-bit parallel interface.

Now complete your picture like never before: For 4113A/4691 literature or the address and phone number of the Tek office nearest you, call:

1-800-547-1512.

In Oregon, call 1-800-452-1877.

Demand The Graphics Standard.

Circle No. 193 on Readers' Service Card

Tektronix®
COMMITTED TO EXCELLENCE

20 May 1983, Volume 220, Number 4599 **SCIENCE**

High Technology and the Social Sciences

The recent AAAS colloquium on "R & D, High Technology, and Economic Recovery" provided multiple analyses of and justifications for the Administration's 1984 budget for research and development. The scientific and research management communities heard numerous assessments justifying defense priorities. They were also assured that substantial increases in funding of basic research in the physical sciences and engineering, primarily by the National Science Foundation, would lead to innovations in high technology and contribute to economic expansion and employment growth.

Inevitably, these analyses also raised a series of fundamental research questions about the training and supply of scientists and engineers, the problems of organizing research groups for innovation, the diffusion of knowledge and transfer of basic research from the laboratory to marketable technologies, and about the process of job creation associated with high-technology development. Each of these questions, posed at the colloquium by representatives of the Office of Science and Technology Policy, Office of Management and the Budget, and by other speakers, is central to the domain of social science. These questions, taken together, outline an agenda for basic social science research. Not all the participants in the colloquium, however, seemed to recognize the social scientific nature of these questions and the research efforts needed to understand the conditions conducive to technological innovation and the likely consequences of such change.

The challenge to the research community lies in providing research-based answers to these kinds of questions. Psychologists, sociologists, and economists have addressed these questions in studies of national laboratories, careers of scientists including Nobel Laureates, and the rise and productivity of specific industries, such as the semiconductor industry and agriculture.

A key question concerns the impact that organizational size and complexity, bureaucratic structure, and regulatory procedures have on productivity and innovation. Some analyses suggest support for small, high-technology firms will lead to higher rates of innovation and increases in employment; and policies have been proposed to support the individual small firm. But, is it the critical mass of many small firms on Route 128 in Massachusetts or in Silicon Valley that provides a creative environment? In such an environment ideas diffuse rapidly and spin-off growth of new firms is accelerated. A definitive answer concerning the relation between job creation and size of firm still remains elusive.

We need to understand the impacts of technological change in economic and social terms. Typically, economic benefits are estimated but potential costs ignored. Technological innovation in one area often means technological obsolescence in others. This can affect community tax bases as well as the demand for products of some firms and for skills of some workers.

These research questions represent only a few dimensions of the social science research agenda, yet research in such areas remains severely hampered by the reductions (despite partial restorations) of funds for social, economic, and behavioral science research in NSF and other agencies. The importance of the research questions and needed answers should justify support. The record of performance also warrants it. The value, significance, and yield of basic research in the social and behavioral sciences, concluded a 1982 report of the National Academy of Sciences*, justifies continued public investment as a national resource. Like basic research in physics and engineering, basic social science research is an indispensable part of the effort to achieve and sustain economic growth.—JAMES J. ZUICHES, *Associate Director, Agricultural Experiment Station, College of Agriculture and Life Sciences, Cornell University, Ithaca, New York 14853*

*Committee on Basic Research in the Behavioral and Social Sciences, *Behavioral and Social Science Research: A National Resource* (National Academy Press, Washington, D.C., 1982).

When solutions are problems... turn to Brinkmann.

Büchi Rotavapor R-110 and RE-120

Proven performance worldwide.
Büchi joins Brinkmann to bring you *the most versatile and widely used* rotary evaporation systems throughout the world, combining proven safety and reliability with innovative technology.

The R-110 and RE-120 are equipped with electronically controlled sparkless induction motors having variable speeds up to 220 rpm. Each model has a chemically inert Teflon*-coated vacuum seal, which can easily be inserted and removed by hand. The unique pear-shaped flask provides more surface area for evaporation and simplifies access to dried residue. And a choice of three assemblies makes the R-110 and RE-120 the most versatile, compact, and efficient rotary evaporators to meet your evaporation needs.

Take a turn for the better with these high-performance rotary evaporation systems. For more information about the Büchi Rotavapor R-110 and RE-120, call or write: Brinkmann Instruments Co., Division of Sybron Corporation, Cantiague Road, Westbury, NY 11590, Tel: 800-645-3050; in New York, 516-334-7500. In Canada: 50 Galaxy Blvd., Rexdale, Ont. M9W 4Y5, Tel: 416-675-7911.

*Teflon is a trademark of the E.I. Du Pont Co.

Choice of three assemblies makes the R-110 and RE-120 even more...

Versatile: Standard assembly with continuous-feed feature is ideal for general laboratory use.

Compact: B assembly with continuous feed and vertical space-saving design is well suited for high-boiling solvents.

Efficient: C assembly with two-piece cold-trap condenser provides the most efficient means of condensing solvent vapors and low-boiling solvents.

rotary evaporation systems
Brinkmann

SYBRON

BRK-5J29

For information circle reader service number 184
For a demonstration circle reader service number 185