16 February 1979 • Vol. 203 • No. 4381 $1.50

# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

# Sequencing long proteins or short peptides, the secret's in the spinning cup.

From long proteins to short peptides, the one instrument that can handle all major methodologies in automated sequential analysis is the Beckman Model 890C Sequencer. Day and night, completely automatically, 20 to 24 amino acid residues a day, the Beckman spinning cup Sequencer reduces what used to take man-years to a matter of weeks.

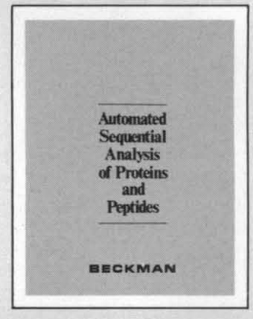
For the now-classic Edman technique, the Sequencer routinely accomplishes 40 to 60 or more degradations for each large protein fragment. The Model 890C's spinning cup gives samples maximum exposure to reactants, which flow over the protein on the sides of the cup in an economically thin film. After extraction of reactants and cleavage product with appropriate solvents, the shortened protein left in the cup is ready for the next automatic cycle. Even detergent-containing samples can be sequenced in this fashion.

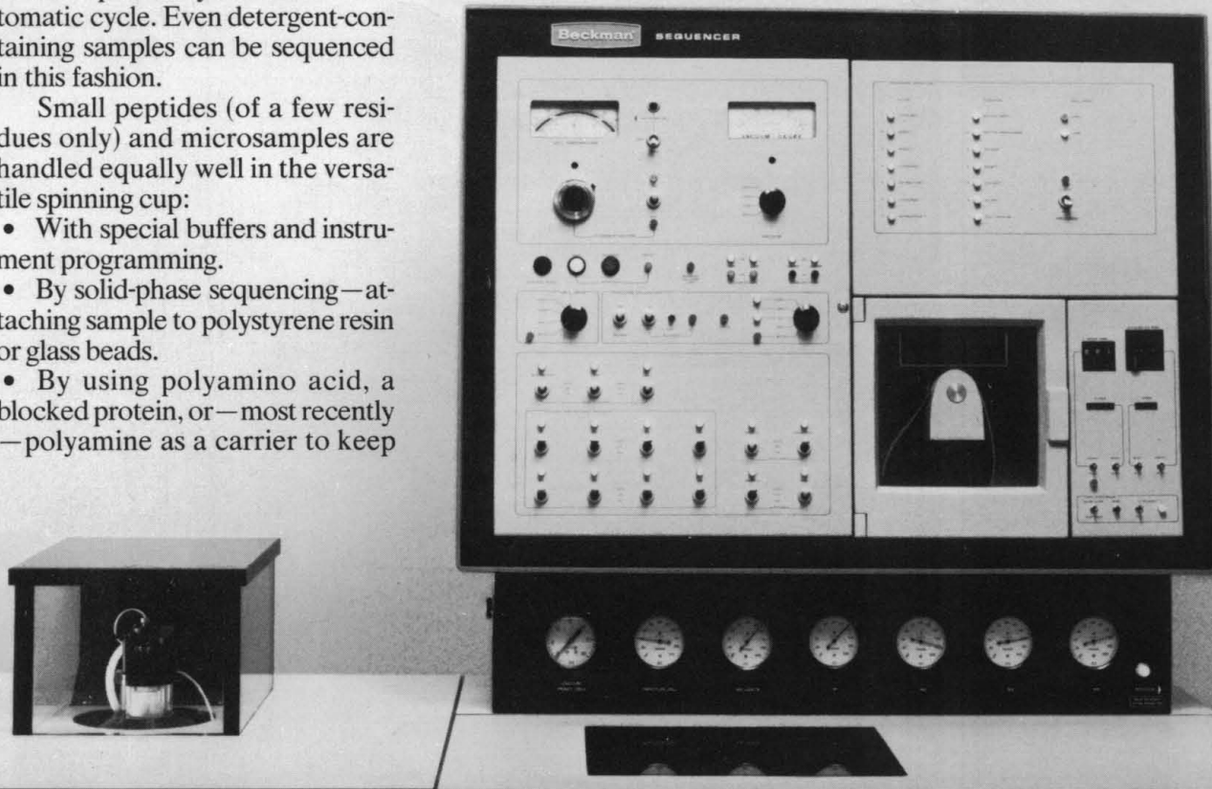
Small peptides (of a few residues only) and microsamples are handled equally well in the versatile spinning cup:

- With special buffers and instrument programming.
- By solid-phase sequencing—attaching sample to polystyrene resin or glass beads.
- By using polyamino acid, a blocked protein, or—most recently—polyamine as a carrier to keep sample in the cup without need for attachment.
- By using radioactive reagents or radiolabeled amino acids to sequence picomole amounts of sample.

With these Sequencer strategies, you never again need to make tedious manual degradations: fragmenting and then isolating a large number of small peptides, determining their structure, and then laboriously piecing together their overlapping information. Just turn the job over to the complete Sequencer, the Beckman 890C.

Nearly a thousand references to automated sequencing techniques using the Beckman spinning cup Sequencer Model 890C are listed in our latest bibliography. Write for a free copy of "Automated Sequential Analysis of Proteins and Peptides" from Beckman Instruments, Inc., 1117 California Avenue, Palo Alto, CA 94304.



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**BIO-RAD Laboratories**

2200 Wright Avenue
Richmond, CA 94804
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Reference
1. Bradford, M., Anal. Biochem., 72, 248 (1976).

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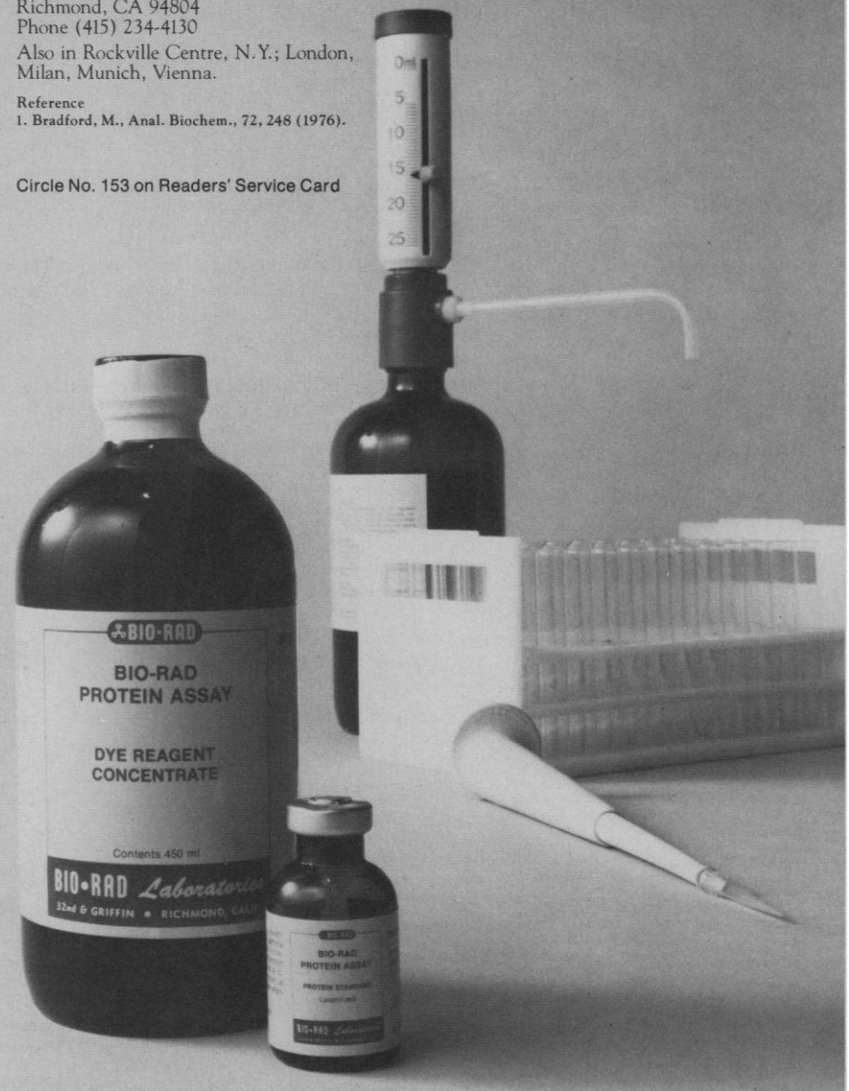


## BIO-RAD BACKS YOU UP.

ISSN 0036-8075

16 February 1979

Volume 203, No. 4381

# SCIENCE





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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

**REPORTS**





**COVER**

Little Salt Spring, Florida. Cross section of the pond and the underwater cavern. Abundant human remains, vertebrate and invertebrate fossils (food refuse), and wood, bone, and shell artifacts have been found in sediments on re-entrants in the cavern and on the floor of the pond and adjacent slough. The site includes an Archaic cemetery 5000 to 6000 years old, with an estimated 1000 burials. See page 609. [Steve Daniels, Department of Administration, State of North Carolina, Raleigh]

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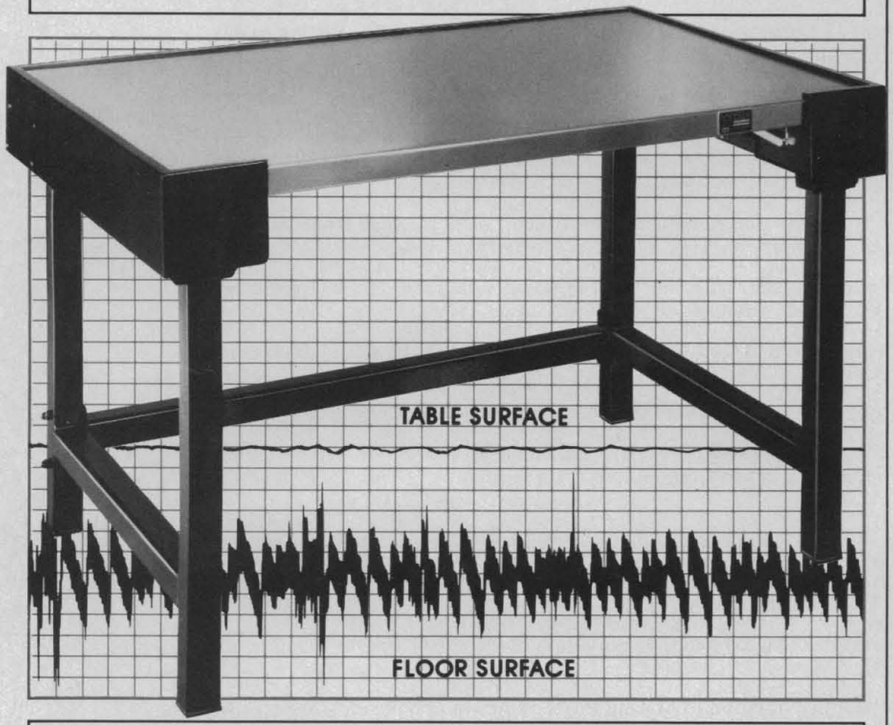


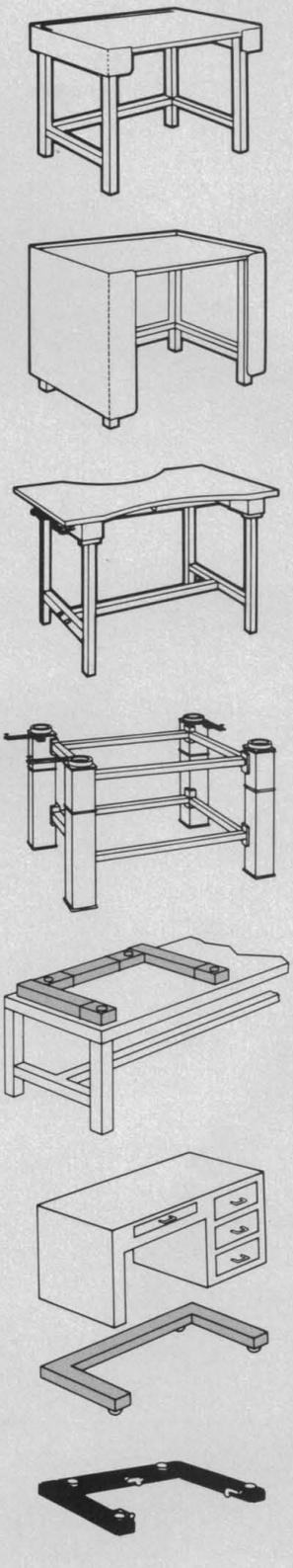

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If you're considering a building vibration survey, remember that you can only hope to quantify a problem that you know exists. The optimum solution is *always* an active, low frequency air system. MICRO-g offers all the best features, including a warranty and an affordable price. So, save the cost of a survey. Take advantage of our Trial Offer Guarantee and get a MICRO-g unit as the first step, rather than the second. You'll solve your problems and save both time and money. There are many standard MICRO-g configurations, plus special designs as required. Call or write for a catalog and price list, or a technical proposal.

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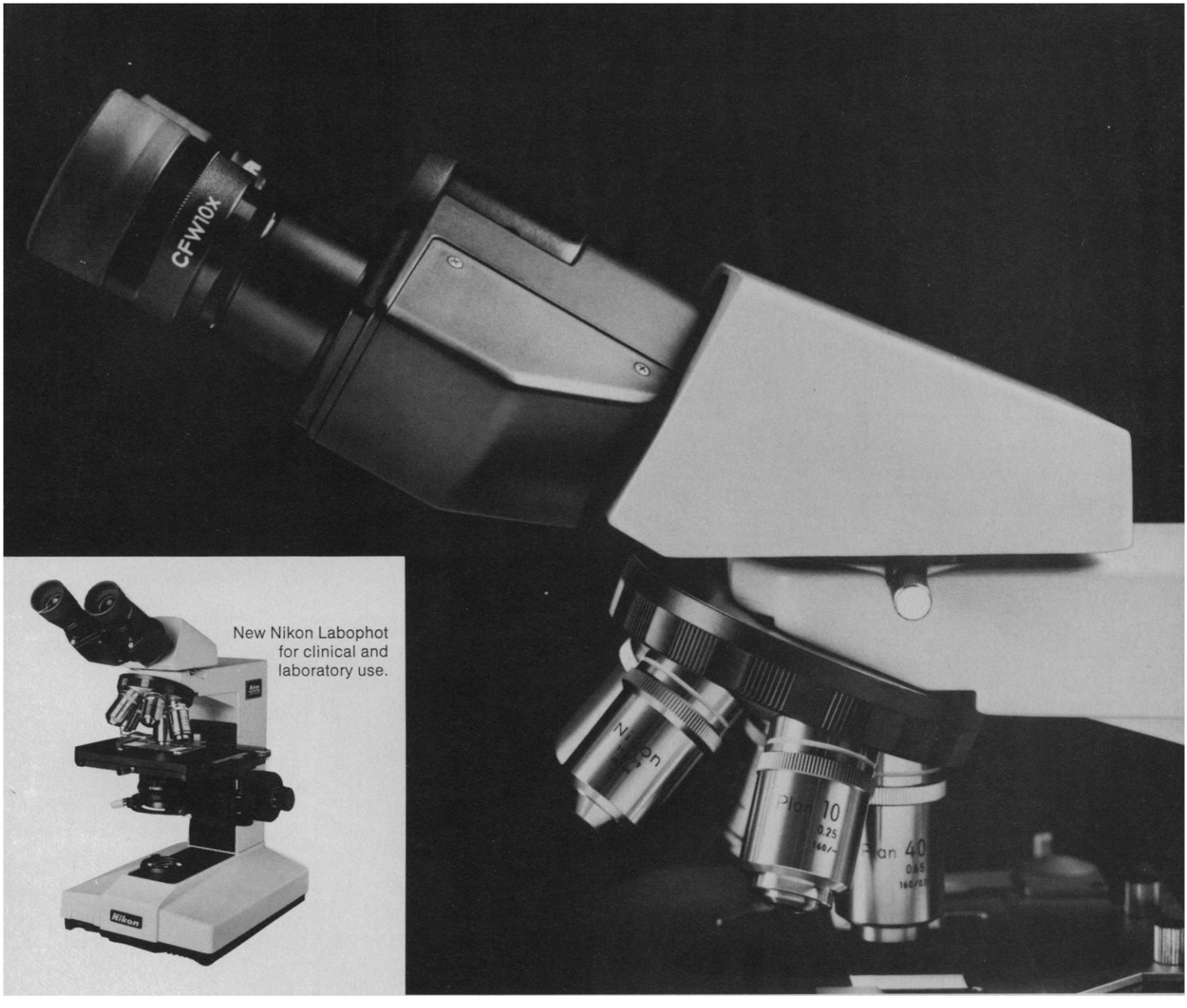





New Nikon Labophot for clinical and laboratory use.

# The new Nikon Labophot.

## A clinical microscope with CF optics. Its design says "clinical." Its optics say "research."

There has never been a clinical microscope like the new Nikon Labophot. It's a new generation of clinical instrument.

For all its simplicity and strength for the day-in, day-out pressures of clinical use, the Nikon Labophot shares many of the features now being offered in Nikon's most advanced research microscopes, including chromatic-aberration-free CF optics.

CF optics are made possible by Nikon's newly developed Extra-low Dispersion (ED) glass, integrated multicoatings, and totally new lens design for unprecedented image quality, brightness, resolution, color fidelity, and freedom from distortion. Nikon CF optics are, quite simply, beyond comparison.

Optics are only part of the Labophot story. Bright, even illumination is provided by a 6-volt, 20-watt halogen Koehler-type system, built into the Labophot's large, stable base. Its entirely new coaxial coarse and fine focusing mechanism glides on roller bearings, is dust-sealed, needs no adjustment. Collapsible rubber eyecups and high-eyepoint eyepieces provide viewing comfort.

Options include a wide range of new Nikon CF objectives with magnifications from 1x to 100x, and a full line of accessories for epi-fluorescence, both halogen and mercury-vapor; phase contrast, dual viewing, photomicrography.

Especially important to a clinical microscope is warranty and service. Nikon provides a five-year full warranty, supported by Nikon's nationwide network of service representatives.

Optics, design, construction — in every way the new Nikon Labophot is a historic advance in clinical microscopes. For complete information and a demonstration, ask Nikon Incorporated, Instrument Division, Ehrenreich Photo-Optical Industries, Inc., 623 Stewart Ave.; Garden City, N.Y. 11530; (516) 222-0200.

**Look to *Nikon***
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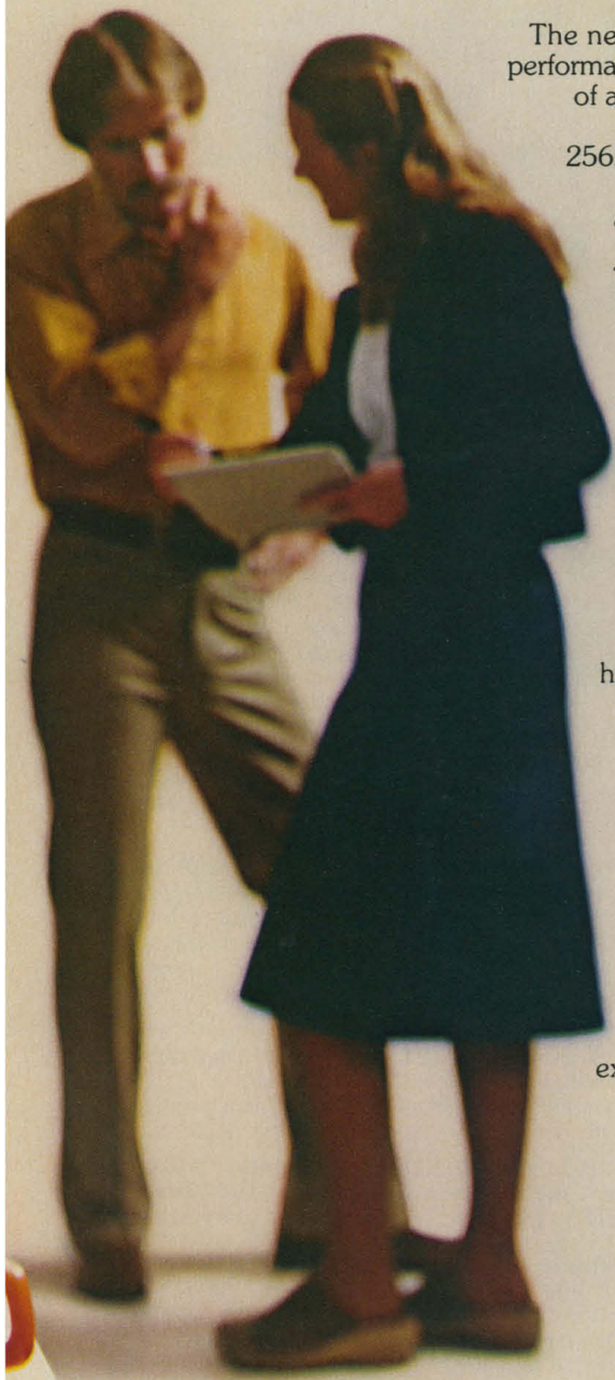
# Introducing HP's System 35.

# Under its friendly exterior lurks the power of a minicomputer.



The new System 35 delivers minicomputer performance while retaining those friendly characteristics of a desktop computer. Consider these features:

**Big Memory**—you choose from 64K to 256K bytes of internal read/write memory, of which all but 12K bytes are available for your programs and data. With 256K bytes, System 35 can manage an array of over 30,000 12-digit floating-point numbers. That's big problem-solving capacity.

**Enhanced BASIC Language** possesses some powerful, convenient features you'd normally find only in FORTRAN or APL. It's the same HP enhanced BASIC used with System 45 so you can step up to a bigger system without having to rewrite your programs.

**Assembly Language** is an option for those who are skilled assembly programmers to provide increased power and speed for data acquisition and control applications.

**Real-time I/O performance** makes System 35 an extremely powerful desktop controller. With direct memory access, buffered I/O, 15 levels of priority interrupt, built-in I/O drivers and standard interface options, System 35 handles data acquisition and control tasks with ease.

Yet with all its built-in performance, System 35 remains a friendly, easy-to-use computer. It integrates essential functions such as alphanumeric display—your choice of 24-line CRT or single line LED—typewriter-like keyboard, and a 217K byte magnetic tape drive in one trim, portable package. If needed, you can easily plug in external HP peripherals such as printers, plotters and floppy discs which, for convenience, use the same mass-storage commands as the built-in tape.

For immediate information on System 35, call your local HP desktop computer representative. For literature, send us the coupon, which will expedite its return, or circle our reader service number.

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For assistance call: Washington (301) 948-6370, Chicago (312) 255-9800, Atlanta (404) 955-1500, Los Angeles (213) 877-1282. Ask for an HP Desktop Computer representative.

- ☐ Please have an HP desktop computer representative call.
- ☐ Please send me general literature.
  - ☐ I am interested in data acquisition and control. Please send the technical supplement.
  - ☐ I am interested in assembly language programming. Please send the technical supplement.

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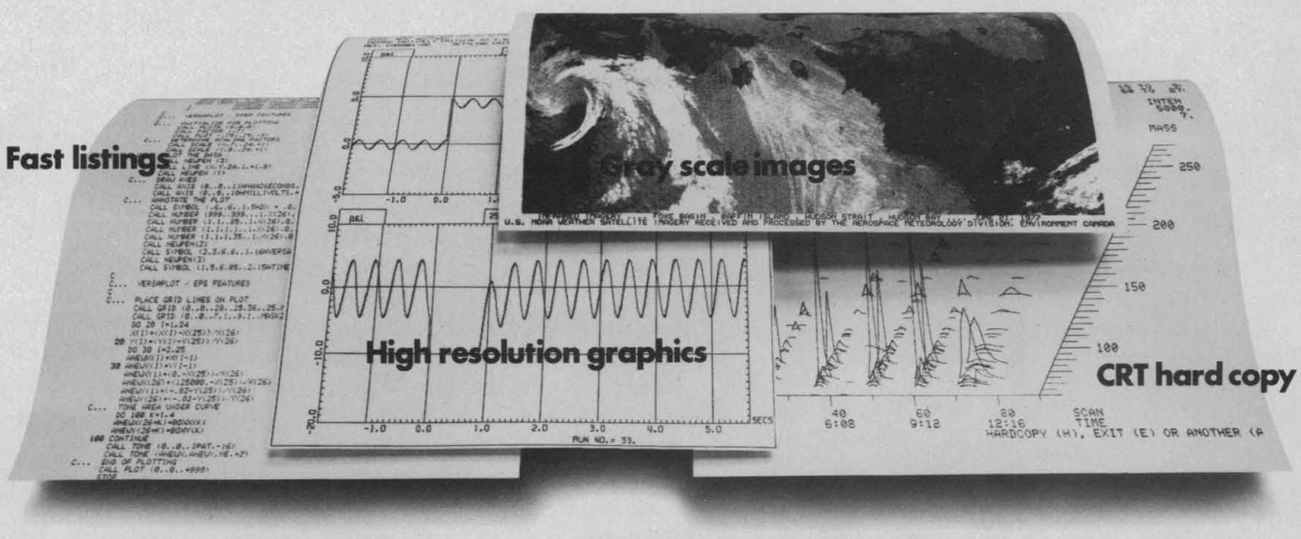
# Researchers see more. With Versatec.




Lawrence Livermore Laboratories sees more with fifty Versatec printer/plotters. Sandia Laboratories sees more with thirty-two. CERN (the European Organization for Nuclear Research) sees more with eighteen. But one Versatec can do it all for you.

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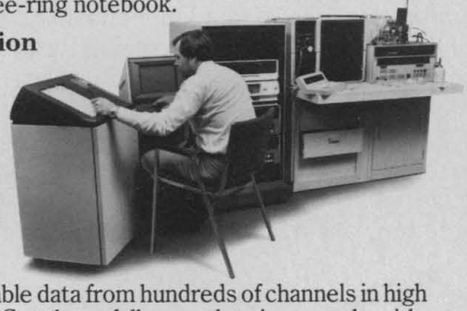

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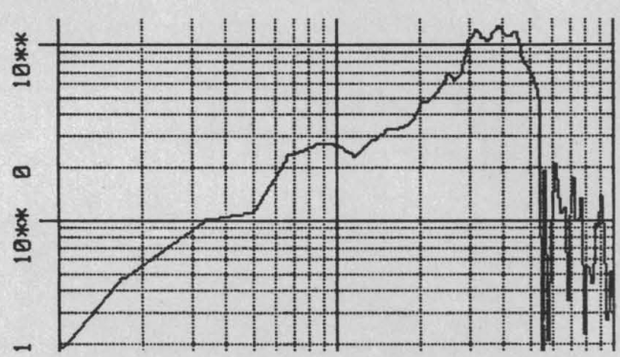


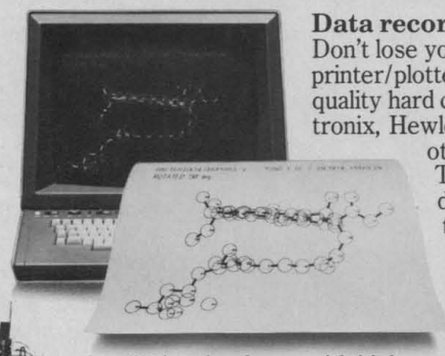

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# CANCER SYMPOSIUM
# AN ACADEMIC REVIEW OF THE ENVIRONMENTAL DETERMINANTS OF CANCER RELEVANT TO PREVENTION

February 28, March 1, March 2, 1979
Waldorf Astoria
New York City

Cancer prevention is one of the most discussed subjects of our age because it is one of the best weapons, in the long run, in the war on cancer. Scientific, *practical* advances have been made in understanding the multiple factors that increase the risk of developing cancers, thus opening the door to more effective prevention, for more people. Despite this progress there is a gap between scientific knowledge and public understanding—a gap that appears to have grown deeper in recent times.

This symposium will attempt to correct this unfortunate situation. It will present national and international experts in medical science offering objective, authoritative assessments of:

- What we really know about the causes of the major lethal cancers.
- What we *don't* know but can learn with a reasonable commitment to research.
- What individuals and society can do *now* to help prevent cancers.

*Who should attend?* The planners of the symposium have developed it for four primary audiences: Federal and state legislators and members of regulatory agencies; editors and reporters who cover cancer and other public health issues; scientists studying cancer causation; and business and labor executives who must deal with this problem.

All of these audiences have important roles in the formation of public policy on cancer prevention. All will find this symposium a needed review, a "scientific pause," as it were, on a vital subject.

The proceedings of the symposium will be published shortly after the meeting and will include summaries in non-scientific terminology.

*This Symposium is being held in cooperation with the*
**AMERICAN CANCER SOCIETY, INC.**

**February 28, 1979 Wednesday Morning** *The Speaker's time includes 5-10 minutes of Specific Discussion*

| | | |
|---|---|---|
| 7:00 a.m. | Distribution of Symposium Materials and Late Registration, continued from Tuesday evening. | |
| Time | Session Topic/Specific Presentations | Participants |
| 8:15- 8:30 | Introduction | ***Joseph Cimino,*** President, New York Medical College, Valhalla, NY; Past Commissioner of Health, New York City |
| | **Session I:** A Review of Some Chemical Mechanisms Involved in Molecular Damage by Carcinogens in the General and Personal Environment | *Chairperson and Moderator:* ***Elizabeth Miller,*** McCardle Laboratories, University of Wisconsin, Madison, Wisconsin |
| 8:30- 9:00 | Prediction of Carcinogenicity Based on Structure, Reactivity and Possible Metabolic Pathways | ***Benjamin Van Duuren,*** NYU Medical Center, New York, NY |
| 9:00- 9:30 | Inhibitors of Chemical Carcinogens | ***Lee Wattenberg,*** University of Minnesota, Minneapolis, Minn. |
| 9:30-10:00 | Mechanisms of DNA Damage and DNA Repair Systems | ***James Cleaver,*** Laboratory of Radiobiology, University of California, San Francisco, CA |
| 10:00-10:20 | Coffee Break | |
| 10:20-10:50 | Mammalian Cell Transformation and Mammalian Cell Mutagenesis (in vitro) | ***Charles Heidelberger,*** USC Cancer Center, Los Angeles, CA |
| 10:50-11:20 | Evaluating Substances for Promotion, Co-Carcinogenesis and Synergy | ***Bernard Weinstein,*** Columbia University, College of Physicians and Surgeons, New York, NY |
| 11:20-11:35 | Summary and Comment | ***Elizabeth Miller,*** *Chairperson and Moderator* |
| 11:35-12:30 | General Discussion | ***Participants and Audience*** |
| 12:30- 1:30 | Luncheon | |
| | **Session II:** Clues to Cancer Causation and Prevention, from Existing Epidemiologic Data in Humans | *Chairman and Moderator:* ***Rulon Rawson,*** University of Utah Research Institute, Salt Lake City, Utah |
| 1:30- 2:00 | The Epidemiology of Health: Its Relevance to Cancer Prevention | ***Rulon Rawson,*** University of Utah Research Institute, Salt Lake City, Utah |
| 2:00- 2:45 | Multiplicity of Factors Involved in Cancer Patterns and Trends | ***John Higginson,*** International Agency for Research on Cancer, Lyons, France |

# AN ACADEMIC REVIEW OF THE ENVIRONMENTAL DETERMINANTS OF CANCER

| | | |
|---|---|---|
| 2:45- 3:05 | Coffee Break | |
| 3:05- 3:35 | Trends in the Incidence and Mortality in the United States | ***Susan Devesa,*** National Cancer Institute, Bethesda, Md. |
| 3:35- 4:05 | Cancer Among the Seventh Day Adventists | ***Roland Phillips,*** Loma Linda University, Loma Linda, Calif. |
| 4:05- 4:20 | Summary and Comment | ***Rulon Rawson,*** *Chairman and Moderator* |
| 4:20- 5:30 | General Discussion | ***Participants and Audience*** |

## March 1, 1979 Thursday Morning *The Speaker's time includes 5-10 minutes of Specific Discussion.*

| Time | Session Topic/Specific Presentations | Participants |
|---|---|---|
| | **Session III:** Cancer Causation: Cigarettes, Urban Factors and Life Style | *Chairman and Moderator:* ***Merril Eisenbud,*** NYU Medical Center, New York, NY |
| 8:30- 9:00 | The Environment and Cancer Prevention | ***Ernst Wynder,*** Naylor Dana Preventive Medicine Institute, Valhalla, NY |
| 9:00- 9:30 | Threshold and Dose Responses in Filtered Cigarettes | ***Gio Gori,*** National Cancer Institute, Bethesda, Md. |
| 9:30-10:00 | The Urban Factor and Air Pollution | ***John Goldsmith,*** Calif. Dept. of Health Services, Berkeley, and Faculty of Health Sciences, Ben Gurion University of the Negev, Beer Sheva, Israel |
| 10:00-10:20 | Coffee Break | |
| 10:20-10:50 | Cancer in New Jersey and Other Complex Urban/Industrial Areas | ***Harry Demopoulos,*** NYU Medical Center, New York, NY |
| 10:50-11:20 | Carcinogenicity of Hair Dye Components | ***Benjamin Van Duuren,*** NYU Medical Center, New York, NY |
| 11:20-11:35 | Summary and Comment | ***Merril Eisenbud,*** *Chairman and Moderator* |
| 11:35-12:30 | General Discussion | ***Participants and Audience*** |
| 12:30- 1:30 | Luncheon | |
| | **Session IV:** Cancer Causation: Disordered Nutrition | *Chairman and Moderator:* ***Vernon Young,*** M.I.T., Cambridge, Mass. |
| 1:30- 2:00 | Lipids and Carcinogenesis | ***Kenneth Carroll,*** University of Western Ontario, London, Ontario |
| 2:00- 2:30 | The Possible Role of Pathologic Free Radical Reactions | ***Harry Demopoulos,*** NYU Medical Center, New York, NY |
| 2:30- 3:00 | Steroids, Fibre, and Related Factors in Carcinogenesis | ***David Kritchevsky,*** Wistar Institute, Philadelphia, Penn. |
| 3:00- 3:20 | Coffee Break | |
| 3:20- 3:50 | Determinants in the Control of Lipid Transport and Metabolism | ***Herbert Kayden,*** NYU Medical Center, New York, NY |
| 3:50- 4:20 | Nutritional Deficiencies | ***Paul Newberne,*** M.I.T., Cambridge, Mass. |
| 4:20- 4:35 | Summary and Comment | ***Vernon Young,*** *Chairman and Moderator* |
| 4:35- 5:30 | General Discussion | ***Participants and Audience*** |

## March 2, 1979 Friday Morning *Please Note the 8:00 a.m. Start, and Combined Discussion Periods.*

| Time | Session Topic/Specific Presentations | Participants |
|---|---|---|
| | **Session V:** Cancer Causation: Major Additives in Food and Beverages | *Chairman and Moderator:* ***Vernon Young,*** M.I.T., Cambridge, Mass. |
| 8:00- 8:25 | Nitrites and Nitrosamines | ***Steve Tannenbaum,*** M.I.T., Cambridge, Mass. |
| 8:25- 8:50 | Saccharin and Cyclamates, In Perspective | ***Panel Review*** |
| 8:50- 9:00 | Summary and Comment | ***Vernon Young,*** *Chairman and Moderator* |
| 9:00- 9:30 | Discussion, Specific and General | ***Participants and Audience*** |
| 9:30- 9:50 | Coffee Break | |

| | | |
|---|---|---|
| | **Session VI:** Cancer Causation: Medical and Occupational | *Chairman and Moderator:* ***Bernard Wagner,*** Columbia University, College of Physicians and Surgeons, New York, NY |
| 9:50-10:15 | Administration of Therapeutic Agents | ***Richard Adamson,*** National Cancer Institute, Bethesda, Md. |
| 10:15-10:40 | Pre-Existing, Non-Malignant Disorders Associated with Increased Cancer Risk | ***Alexander Templeton,*** St. Vincent's Hospital, Worcester, Mass. |
| 10:40-11:05 | A Review of Occupational Exposures, Past and Present | ***Philip Cole,*** Harvard School of Public Health, Boston, Mass. |
| 11:05-11:20 | Summary and Comment | ***Bernard Wagner,*** *Chairman and Moderator* |
| 11:20-12:00 | Discussion, Specific and General | ***Participants and Audience*** |
| 12:00- 1:00 | Luncheon | |
| | **Session VII:** Risk Assessment | *Chairman and Moderator:* ***Marvin Kuschner,*** SUNY, Stony Brook, NY |
| 1:00- 1:25 | A Review of Past Risk Assessments and Extrapolation Problems with Radiation | ***Panel Review*** |
| 1:25- 1:55 | The Relationship of Bio-Assay of Chemicals to Human Risk | ***Henry Pitot,*** McCardle Laboratories, University of Wisconsin, Madison, Wisc. |
| 1:55- 2:05 | Summary and Comment | ***Marvin Kuschner,*** *Chairman and Moderator* |
| 2:05- 2:35 | Discussion, Specific and General | ***Participants and Audience*** |
| 2:35- 2:55 | Coffee Break | |
| | **Session VIII:** New Potentials for Prevention, and Conference Conclusions | *Chairman and Moderator:* ***Joseph Cimino,*** New York Medical College, Valhalla, NY |
| 2:55- 3:20 | Chemical Prevention of Carcinogenesis | ***Paul McCay,*** Oklahoma Medical Research Foundation, Oklahoma City, Okla. |
| 3:20- 3:45 | Retinoids in Cancer Prevention | ***Michael Sporn,*** National Cancer Institute, Bethesda, Md. |
| 3:45- 4:15 | Conference Conclusions Relevant to Comprehensive Prevention of Cancer | ***Panel Review*** |
| 4:15- 4:45 | Discussion, Specific and General | ***Participants and Audience*** |

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**Symposium Committee:**

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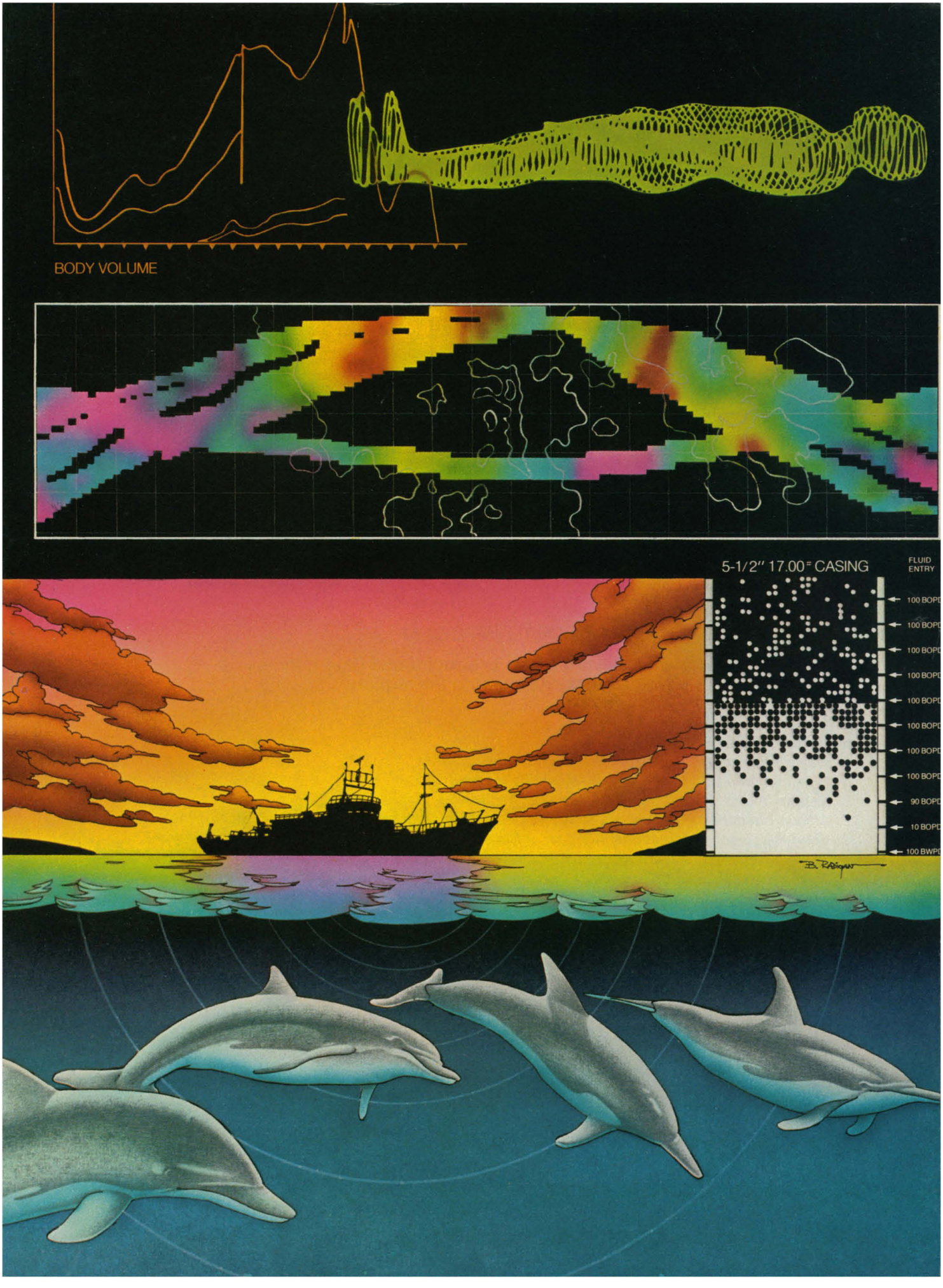
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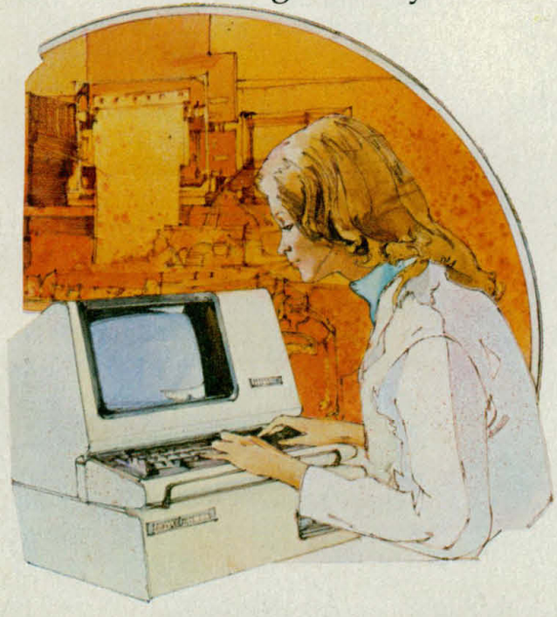

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ner. However, for the record, some points need clarification or correction.

I am a former consultant to Petróleos Mexicanos (Pemex) and have been involved with the Chiapas-Tabasco (Reforma)–Gulf of Campeche discoveries since 1972. The data from these discoveries have been released to Francisco Viniegra Osorio, former exploration manager of Pemex (now retired) and the discoverer of Mexico's new giant fields. They will be published in an article by Viniegra to appear during 1979 in the *Journal of Petroleum Geology*. Viniegra and I will present a summary of the Pemex discoveries at the forthcoming American Association of Petroleum Geologists annual meeting in Houston, 1 to 4 April 1979.

On 14 September 1978, Jorgé Díaz Serrano (president of Pemex) and I were among those who presented a review of the new discoveries on "The MacNeil/Lehrer Report." We reported that, in the approximately 35 structures then drilled, 57 billion barrels of oil had been found—20 billion *proved* and 37 billion *probable*. The 200-billion-barrel estimate cited in Metz's article is a projected (that is, *potential* or *speculative*) volume for the drilled *and undrilled* structures together—35 drilled and 100 to 150 undrilled. It is undesirable at this time to project reserve volumes beyond actual knowledge. In addition, on the basis of reservoir performances and production records, Viniegra and I have since downgraded the 57-billion-barrel figure to 47 billion barrels—still a giant reserve by any standard.

I also wish to correct the statement that Pemex's Ixchel-1 well was a "gusher." As of 22 December 1978, the date of this letter, Ixchel-1 has *not* been drilled, despite recurrent reports in trade journals that it has been. My statement that the well has not been drilled is based on letters received today from (i) the Pemex office in Mexico City and (ii) my coauthor Viniegra, who joins me in asking that the official record be set straight.

ARTHUR A. MEYERHOFF
*Post Office Box 4602,*
*Tulsa, Oklahoma 74104*

On 31 December, Pemex doubled its figure for proved reserves and raised its figure for probable reserves, so that the total for both categories is now 84 billion barrels—up considerably from the 57 billion figure quoted by Meyerhoff. The status of drilling in the Ixchel area is an important indicator of the oil potential in far-offshore areas that have been little explored. Successful drilling in the Ixchel area was first reported on 5 July

# Congressional Science Fellowships

The American Association for the Advancement of Science (AAAS), which coordinates the Congressional Science and Engineering Fellow Program, is pleased to announce that the American Society of Zoologists (ASZ) and the Biophysical Society (BS) [in conjunction with the American Society for Photobiology (ASP)] have joined 17 other professional societies seeking applications for a Congressional Science Fellow for 1979–1980. The AAAS will also select and sponsor one Congressional Science Fellow; persons in all fields of science and engineering are invited to apply.

Fellows spend 1 year working as special legislative assistants on the staffs of various members of Congress or congressional committees. Stipends for the AAAS, ASZ, and BS/ASP Fellowships are approximately $18,000 per annum plus a nominal sum for travel and relocation expenses. The $18,000 stipend is in addition to any other source of support available to the Fellow, such as sabbatical salary.

Applicants should write directly to the appropriate society listed below. Deadlines for the three Fellowships range from mid-March to March 31. Information about the entire program and the addresses of all 21 participating societies are available from AAAS.

**Dr. E. L. Hess, The Biophysical Society, 9650 Rockville Pike, Bethesda, Maryland 20014.**

**Dr. Robert Higgins, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.**

**Mr. Charles A. Mosher, Congressional Science Fellow Program, AAAS, 8th Floor, 1776 Massachusetts Ave., NW, Washington, D.C. 20036.**

1978 in the *Wall Street Journal*. At a press breakfast the next day in Mexico City, Pemex president Diaz Serrano discussed the new well, going over its spelling and location several times with reporters. According to Charles Green of the Associated Press, who attended the breakfast and based an AP story on it, Diaz Serrano left no doubt the Ixchel well had been drilled and said that it "indicates a considerable platform" of oil. Whether Pemex designated that well Ixchel-1 could not be determined. More detail was given in the September 1978 newsletter of the international oil reporting service Petroconsultants, S.A., in Geneva. Specifying a discovery well with the surname Ixchel drilled by May 1978, Petroconsultants issued a field record giving the well's location (92°22′ west; 21°47′ north), geological features, gravity, and sulfur content. Petroconsultants president J. Dixon told *Science* he had no doubt at all that oil had been discovered at the site—that a field record was authoritative. Not only does Petroconsultants stand by its original report, but the firm reported another discovery in late 1978 made in the same vicinity.

—WILLIAM D. METZ

### Editorial Writers

Concerning Rochelle Semmel Albin's letter (19 Jan., p. 228) on the selection of *Science* editorial writers, I hope that the uses to which the editorial page is put will continue to be based on (i) the appropriateness of the subject and (ii) the credentials of the author to handle the subject in a competent and readable manner. This does not lend itself to quotas based on the sex of the author.

I prefer to believe that it is only coincidence that the 19 January editorial is signed by Lucy W. Sells.

BURTON C. BELDEN
*Box 611, Cranford, New Jersey 07016*

As an occasional author of *Science* editorials, I would like to share my experience with Rochelle Semmel Albin; it may sound too simple, but nothing more was involved than writing an editorial and sending it to the editor. While I have no idea how many editorials are received, I suggest that Albin give the same procedure a try—as I assume was the case with the editorial by Lucy W. Sells, published in the same issue of *Science*.

JURGAN SCHMANDT
*Lyndon B. Johnson School of Public Affairs, University of Texas, Austin*

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16 February 1979, Volume 203, Number 4381 SCIENCE



# The Burden of Competitive Grants

In 1960, when U.S. science was beginning to depend heavily on grants and contracts for research support, Leo Szilard wrote a fanciful story.* In it he suggested that if some person or some group should ever want to bring research progress to a standstill, they could do so by establishing a competitive grants system under which all researchers would be required to prepare written proposals describing what they wished to work on. The commitment of time by the research community in writing, reviewing, and supervising such a universal grant system would effectively halt research progress. It may be that now, in the late 1970's, we should ask ourselves whether the load of the competitive grant and contract system is becoming excessive and whether it is time to seek alternatives.

The numbers of research proposals submitted to the principal federal granting agencies in 1978 were as follows: 28,000 to the National Science Foundation, 13,000 to the National Institutes of Health, 3,500 to the Department of Energy, 1,000 to the Environmental Protection Agency, and 2,000 to the Department of Agriculture. This makes a rough total of 47,500 proposals in 1 year.

Calculating the amount of time it takes to write a proposal is not easy, but 3 weeks would be a conservative estimate for the average time invested in each proposal. Thus last year, on the order of 2700 man-years were invested in proposal writing. This is probably a low estimate, since it often takes 3 months to write a proposal, and proposals by groups can take as much as 3 man-years.

Any estimate of the time investment must include those involved in the reviewing process. Allowing 3 man-days for review adds another 575 man-years, making a total estimated investment by the research community of approximately 3300 man-years during 1978. Since most research scientists are in the academic community, where perhaps half their time is available for research, the figure of 3300 man-years of research time may, in fact, represent the entire research time of 6600 academic persons during 1978.

The preparation and even the review of research proposals does have an educational effect. An essential part of the preparation of the research proposal is the examination of the literature and consideration of research directions that might be most profitable. But the cost in time to the research community is nevertheless a very heavy burden.

The problem is exacerbated by the fact that in every competitive program the majority of the proposals are rejected. The rejection rate can vary from 60 percent in some programs to 95 percent in others, but in general, it ranges between 70 percent and 85 percent. Thus roughly three of every four proposals fail to obtain funding for the researchers.

In the early days of federal support of research, when support was increasing year by year, distribution of grants on the basis of competition was an effective means of getting money to competent and productive persons. In the late 1960's, however, the amount of money (corrected for inflation) available for the support of research began to level off, and the growth period has now ended. Competition has become increasingly keen and the proportion of proposals that can be funded has declined. The investment of research time in the proposal system, however, may continue to increase.

With the investment of an estimated 6600 persons' research time in writing and reviewing proposals, perhaps it is now appropriate to ask whether Szilard's fanciful story is turning into a serious matter. Should consideration be given to ways of providing research support without adding to the heavy burden of our present grants and contracts system?—A. CARL LEOPOLD, *Boyce Thompson Institute for Plant Research, Ithaca, New York 14853*

*L. Szilard, *The Voice of the Dolphins, and Other Stories* (Simon & Schuster, New York, 1961), p. 100.

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## BOOK REVIEWS

*(Continued from page 642)*

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