

AMERICAN
ASSOCIATION FOR THE
ADVANCEMENT OF
SCIENCE

SCIENCE

5 DECEMBER 1986
VOL. 234 ■ PAGES 1161-1300

\$2.50



MATCHMAKER



Constant Power for Electrophoresis

- Constant Voltage to 4000V
- Constant Power to 200W
- Constant Current to 200mA

Now, there is a power supply to match the most critical needs in Constant Power separations. The new EC600!

The 3-mode power supply (constant voltage, constant power, or constant current), provides precise readings from a 2-range wattmeter, 4-range voltmeter, and 4-range milliammeter. Output regulation $\pm 1\%$ from zero to full load.

Voltage, current, and power set-point controls for automatic crossover for a programmed run.

More safety features than ever with low level ground leakage detection, manual start button, automatic safety shut down on cell disconnect, and a

CMOS logic memory device which restores programmed operation up to 3 hours after a power interruption.

If your work involves DNA sequencing, isoelectric focusing, isotachopheresis, and general electrophoresis, you need the best power supply available. The EC600...few applications test its full capabilities; no other power supply can match it!

110V Input \$1,995.00

220V Input \$2,095.00

For more information, call Technical Service toll-free at 1-800-624-2232 (in Florida, 1-800-282-7932).



E-C Apparatus Corporation
3831 Tyrone Boulevard N.
St. Petersburg, Florida 33709
813-334-1644 Telex 51-4736 HALA

THEY'RE HERE! **FREE!** 1987 Handbooks & Encyclopedias

OMEGA 1987 COMPLETE TEMPERATURE MEASUREMENT HANDBOOK AND ENCYCLOPEDIA

YOUR SOURCE FOR MEASUREMENT AND CONTROL!

OMEGA ENGINEERING, INC. HANDBOOKS

- TEMPERATURE AND HUMIDITY
- PRESSURE, STRAIN AND FORCE
- FLOW
- pH
- COMPUTERS
- BOOK OF BOOKS
- TOOLS

Get Yours Now!

OMEGA ENGINEERING, INC.

(203) 359-1660

One Omega Drive, Box 4047
Stamford, CT 06907

1167 This Week in *Science*

Editorial

1169 Energy Future

Letters

1170 Cretaceous-Tertiary Dinosaur Extinction: G. RETALLACK AND G. D. LEAHY;
P. M. SHEEHAN AND C. L. MORSE; L. J. BRYANT, W. A. CLEMENS,
J. H. HUTCHISON; R. E. SLOAN AND J. K. RIGBY, JR. ■ Alachlor Removal from
Drinking Water: A. J. KLEIN

News & Comment

1188 Fuqua Leaves 62 Parting Thoughts ■ The Chairman's Wish List
1190 Crop Research Network Makes Some Changes
1191 Astronomer Fasts for Arms Control
1192 Academy Membership Fight Goes Public
1194 Chemical Weapons: A Plan for Europe
1195 Accelerator Labs Face Austere Year
Eiffel Centenary to Put Art in Space

Research News

1196 Halley's Confounding Fireworks
1198 New Drug Counters Alcohol Intoxication
1200 Age Factors Loom in Parkinsonian Research
1202 The Universe in Depth

Articles

1203 Optical Experiments and Weak Interactions: M.-A. BOUCHIAT AND L. POTTIER
1211 Deregulation: Causes and Consequences: E. E. BAILEY
1217 The Molecular Basis of Erythrocyte Shape: A. ELGSAETER, B. T. STOKKE,
A. MIKKELSEN, D. BRANTON

Reports

1225 Uplifted Marine Terraces Along the Alpine Fault, New Zealand: W. B. BULL
AND A. F. COOPER
1228 Polymorphism of Sick Cell Hemoglobin Aggregates: Structural Basis for
Limited Radial Growth: L. MAKOWSKI AND B. MAGDOFF-FAIRCHILD
1231 Petroleum Associated with Polymetallic Sulfide in Sediment from Gorda Ridge:
K. A. KVENVOLDEN, J. B. RAPP, F. D. HOSTETTLER, J. L. MORTON, J. D. KING,
G. E. CLAYPOOL
1234 Estrogen Memory Effect in Human Hepatocytes During Repeated Cell Division
Without Hormone: S.-P. TAM, R. J. G. HACHÉ, R. G. DEELEY
1237 Neuronal Properties of Clonal Hybrid Cell Lines Derived from Central
Cholinergic Neurons: D. N. HAMMOND, B. H. WAINER, J. H. TONSGARD,
A. HELLER

- SCIENCE is published weekly on Friday, except the last week in December, and with an extra issue in February by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005. Second-class postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Now combined with *The Scientific Monthly*® Copyright © 1986 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): \$65. Domestic institutional subscription (51 issues): \$98. 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 \$4 (\$4.50 by mail); Biotechnology issue, \$5.50 (\$6 by mail); classroom rates on request; Guide to Biotechnology Products and Instruments \$16 (\$17 by mail). **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. Authorization to photocopy material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$1 per copy plus \$0.10 per page is paid directly to CCC, 21 Congress Street, Salem, Massachusetts 01970. The identification code for Science is 0036-8075/83 \$1 + .10. **Postmaster:** Send Form 3579 to Science, 1333 H Street, NW, Washington, DC 20005. Science is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.
- The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.



COVER Remnants of uplifted marine terraces are common in the Southern Alps of New Zealand (bottom). Individual (upper left picture) is collecting widely scattered beach pebbles from an exhumed 320,000-year-old shore platform (altitude 1620 meters) at the base of a degraded sea cliff. Highly rounded quartz pebbles (11 to 12 millimeters in diameter) from notched ridge crest have frosted surfaces and impact marks made in a high-energy sedimentary environment. See page 1225. [W. B. Bull, University of Arizona, Tucson, AZ 85721, and A. F. Cooper, University of Otago, Dunedin, New Zealand]

- 1240 Diminished Response of Werner's Syndrome Fibroblasts to Growth Factors PDGF and FGF: E. A. BAUER, N. SILVERMAN, D. F. BUSIEK, A. KRONBERGER, T. F. DEUEL
- 1243 A Selective Imidazobenzodiazepine Antagonist of Ethanol in the Rat: P. D. SUZDAK, J. R. GLOWA, J. N. CRAWLEY, R. D. SCHWARTZ, P. SKOLNICK, S. M. PAUL
- 1247 Age of the Earliest African Anthropoids: J. C. FLEAGLE, T. M. BOWN, J. D. OBRADOVICH, E. L. SIMONS
- 1249 A Critical Period for Macromolecular Synthesis in Long-Term Heterosynaptic Facilitation in *Aplysia*: P. G. MONTAROLO, P. GOELET, V. F. CASTELLUCCI, J. MORGAN, E. R. KANDEL, S. SCHACHER
- 1254 Lactate Transporter Defect: A New Disease of Muscle: W. N. FISHBEIN
- 1256 Energy Sources for Detritivorous Fishes in the Amazon: C. A. R. M. ARAUJO-LIMA, B. R. FORSBERG, R. VICTORIA, L. MARTINELLI
- 1258 Expression of Bovine 17 α -Hydroxylase Cytochrome P-450 cDNA in Nonsteroidogenic (COS 1) Cells: M. X. ZUBER, E. R. SIMPSON, M. R. WATERMAN
- 1261 A G Protein Couples Serotonin and GABA_B Receptors to the Same Channels in Hippocampus: R. ANDRADE, R. C. MALENKA, R. A. NICOLL
- 1265 Regulation of Pro-opiomelanocortin Gene Transcription in Individual Cell Nuclei: R. T. FREMEAU, JR., J. R. LUNDBLAD, D. B. PRITCHETT, J. N. WILCOX, J. L. ROBERTS

AAAS News

- 1270 AAAS Group Hosts Discussion of Ethics and NASA: M. S. FRANKEL ■ Proposed Amendment to AAAS Constitution: M. WHITE ■ 1986 General Election Results ■ Media and Shuttle Transcripts Offered ■ For the Library . . . ■ Grants Available to Foreign Graduate Students to Attend AAAS Annual Meeting ■ *Science Books & Films* Editor Kathleen Johnston Receives ALA Award ■ New Issue Dates for *Science*

Book Reviews

- 1277 The Politics of Uncertainty, reviewed by S. WRIGHT ■ Biotechnology, I. FELLER ■ Collisionless Shocks in the Heliosphere: A Tutorial Review and Collisionless Shocks in the Heliosphere: Reviews of Current Research, L. O'C. DRURY

Products & Materials

- 1280 Plastic Fume Hood ■ Ultrahigh Purity Avidin ■ Shaking Water Bath ■ Anaerobic Bacteria Library Database ■ Neutrally Buoyant Glass Beads ■ Pocket pH, Conductivity Gauges ■ Literature

Board of Directors

Gerard Piel
*Retiring President,
Chairman*

Lawrence Bogorad
President

Sheila E. Widnall
President-elect

Robert McC. Adams
Robert W. Berliner
Floyd E. Bloom
Mary E. Clutter
Mildred S. Dresselhaus
Donald N. Langenberg
Dorothy Nelkin
Linda S. Wilson

William T. Golden
Treasurer

William D. Carey
Executive Officer

Editorial Board

David Baltimore
William F. Brinkman
Ansley J. Coale
Joseph L. Goldstein
James D. Idol, Jr.
Leon Knopoff
Seymour Lipset
Walter Massey
Oliver E. Nelson
Allen Newell
Ruth Patrick
David V. Ragone
Vera C. Rubin
Howard E. Simmons
Solomon H. Snyder
Robert M. Solow

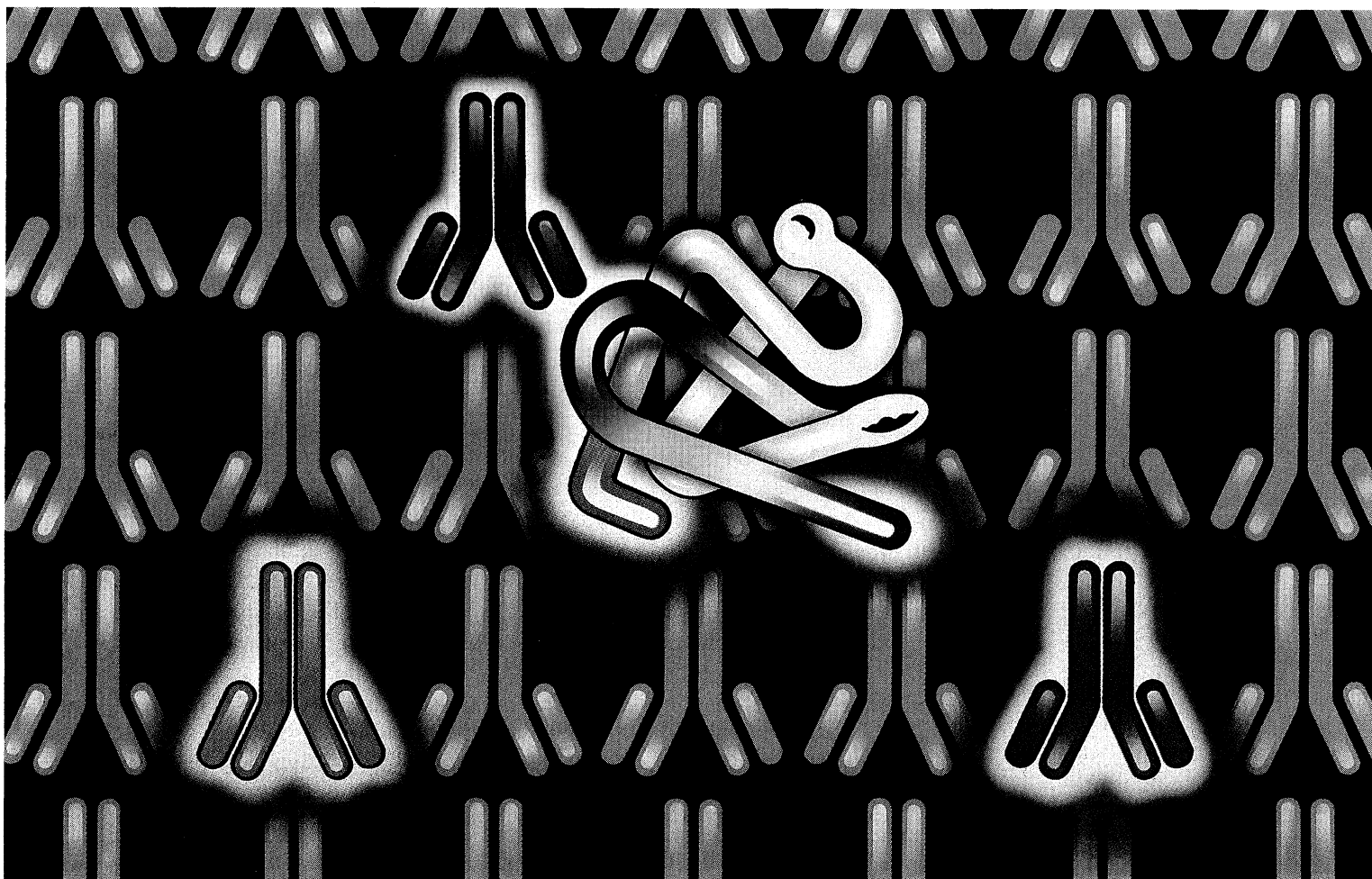
Board of Reviewing Editors

Qais Al-Awqati
James P. Allison
Luis W. Alvarez
Don L. Anderson
C. Paul Bianchi
Elizabeth H. Blackburn
Floyd E. Bloom
Charles R. Cantor
James H. Clark
Bruce F. Eldridge
Stanley Falkow
Theodore H. Geballe
Roger I. M. Glass

Stephen P. Goff
Robert B. Goldberg
Patricia S. Goldman-Rakic
Corey S. Goodman
Richard M. Held
Gloria Heppner
Eric F. Johnson
Konrad B. Krauskopf
Karl L. Magleby
Joseph B. Martin
John C. McGiff
Alton Meister
Mortimer Mishkin
Peter Olson
Gordon H. Orians
John S. Pearce
Yeshayau Pocker
Jean Paul Revel

Frederic M. Richards
James E. Rothman
Thomas C. Schelling
Ronald H. Schwartz
Stephen M. Schwartz
Otto T. Solbrig
Robert T. N. Tjian
Virginia Trimble
Geerat J. Vermeij
Martin G. Weigert
Harold Weintraub
Irving L. Weissman
George M. Whitesides
Owen N. Witte
William B. Wood
Harriet Zuckerman

Oncoprotein Antibodies...

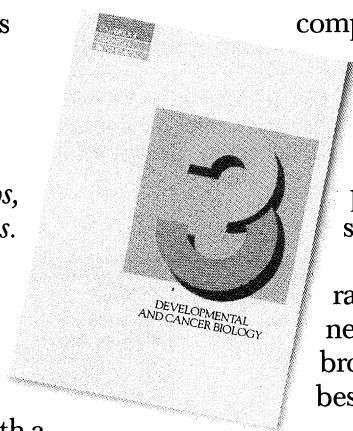


...Site Specific Probes from Cambridge

Cambridge Research Biochemicals announce an exciting new range of polyclonal and monoclonal antibodies to a number of nuclear, membrane and cytoplasmic oncoproteins including antibodies to *N-myc*, *c-myc*, *pan-myc*, *c-fos*, *pan-fos*, *c-myc*, *v-erb B*, *EGF/R* and *v-fms*.

Raised against synthetic peptides these antibodies, of predetermined specificity, are fully characterised by ELISA, immunoblotting and immunoprecipitation procedures.

Each product comes complete with a



comprehensive data sheet detailing antibody characteristics and protocols for use.

Further, a complementary range of matched secondary antibodies is also available together with a full custom peptide synthesis and antibody production service.

For more details of this novel product range simply send now for your copy of the new 'Developmental and Cancer Biology' brochure and discover how we produce the best at CRB.

CAMBRIDGE
RESEARCH
BIOCHEMICALS

UK Cambridge Research Biochemicals Ltd., Button End, Harston, Cambridge, CB2 5NX, England. Tel: Cambridge (0223) 871 674. Telex: 817694 CRB LTD G Fax: 0223 872381.
USA Cambridge Research Biochemicals Inc., PO Box 58, 2005 Park Street, Atlantic Beach, New York 11509, USA. Toll-free Tel: (800) 327 0125. Telex: 971398. Fax: 516 239 2782.

Circle No. 47 on Readers' Service Card

This Week in SCIENCE

Mountain-escalading marine terraces

TERRACES that were formed on the coastline (cover) are prevalent in New Zealand's Southern Alps; they were raised into mountains by crustal uplift where the Pacific and Australian plates converged (page 1225). The terraces, like flights of stairs, were dated by comparing them with terraces in New Guinea that have comparable spacing between "steps"; corals, sediments, and reefs found within the New Guinea terraces had previously been dated. Bull and Cooper plotted the altitudes of terraces and were able to determine the rate of uplift for them; the rate has increased from 3.2 meters per 1000 years to 7.8 meters. This change occurred some time around 135,000 to 140,000 years ago; the slower rate pertained for 200,000 years before that time. The increased rate may be the result of increased convergence between the two plates; if so, the rate would be expected to increase again as the plates continue to collide.

Fibroblasts in Werner's syndrome

SOME of the common signs of Werner's syndrome, a disease characterized by premature aging and death, may result from a defect in patients' fibroblasts (page 1240). Patients are of short statures with stocky trunks but thin limbs; they gray and bald prematurely and develop diabetes, leg ulcers, patchy skin, osteoporosis, and other problems. Fibroblasts from patients grow slowly in culture, divide at a slow rate, and typically die prematurely. Bauer *et al.* describe the growth characteristics of such fibroblasts to various growth factors and their metabolic responses. Patients respond with a normal mitogenic response when stimulated with fetal bovine serum. However, they do not respond as do normal fibroblasts to platelet-derived growth factor (PDGF) (or to fibroblast growth factor) even though they have normal numbers of receptors for the factor and

apparently bind it with normal affinity. Normal fibroblasts respond to PDGF with increased production of messenger RNA for collagenase and with increased production of collagenase (an enzyme that degrades and remodels collagen and may be important in wound healing and other processes); Werner's fibroblasts produce high levels of the enzyme and RNA constitutively but show no increase in production upon PDGF stimulation. These differences may provide clues to the nature of the cellular defects that play a role in Werner's syndrome; they will also be useful for determining how various growth factors interact with cells.

Drug against drunkenness

THE drug Ro15-4513 blocks one of the important biochemical effects of ethanol and some of ethanol's behavioral effects in rats (page 1243). Such an agent would have major clinical significance if it could be shown to inhibit in humans some of the damaging neurobiological effects that are induced by ethanol. Ethanol stimulates uptake of chloride ion by γ -aminobutyric acid (GABA) receptors in brain tissue in vitro. Its action at the GABA-coupled chloride ion channel has been thought to underlie many of its behavioral properties; experiments with Ro15-4513 support this interpretation. Suzdak *et al.* found that ethanol-induced chloride uptake by GABA receptors was specifically blocked by Ro15-4513; the drug also inhibited ethanol-induced behaviors in rats—the signs of drunkenness (general sedation, staggered gait, impaired righting reflex) and anticonflict and anxiety-dispelling activities. Ro15-4513 is one of a group of drugs that is relatively nontoxic; this provides further encouragement for the possibility of developing from it a clinically effective ethanol antagonist. Kolata discusses the development of the drug and the potential benefits and problems that could accompany its use in humans as an antidote to intoxication (page 1198).

Anthropoid ancestors

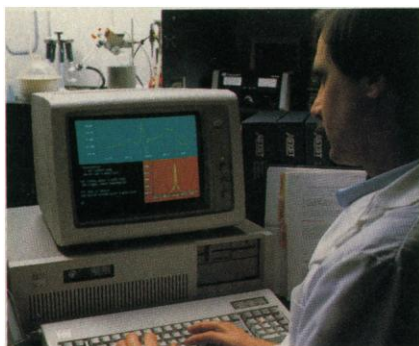
REEVALUATION of the geology and fauna of the Jebel Qatrani Formation in the Fayum depression of Egypt—the source of the earliest African anthropoid primate fossils (monkeys and apes)—indicates that common ancestors of these primates existed perhaps 7 or 8 million years earlier than previously thought (page 1247). This region, once a tropical forest with a monsoonal climate, is rich in fossils of early anthropoids and of many typically African mammals. Dating of volcanic rocks overlying the Jebel Qatrani Formation places it and the fossils back to 31 million years ago, in the early Oligocene Epoch. The revised date expands the temporal gap between the primitive Egyptian anthropoids and monkeys and apes from East Africa. Fleagle *et al.* discuss the evolutionary significance of this new time scale.

Muscle disease

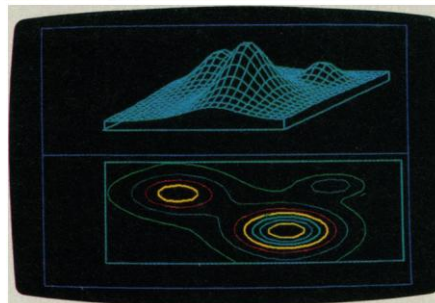
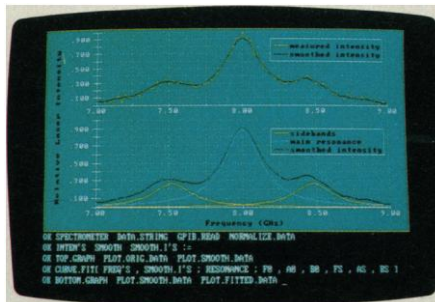
Amilitary drill instructor in "superb physical condition" experienced several episodes of severe chest pain after exercise (page 1254). Fishbein describes the clinical work-up that led to the diagnosis of a lactate transporter deficiency disease in the patient. Lactate is the major organic acid that accumulates inside cells; it is generated in muscles during exercise and rest. Export of this acid is important for proper functioning of the contractile apparatus and energy-yielding pathways in muscles. The patient's striated muscles and red blood cells (both exporters of lactate) did not export lactate efficiently. This created an acidic intracellular environment that, in turn, could lead to degeneration or dissolution of muscle tissue, release of myoglobin into the urine, and high levels of creatine kinase in serum. This deficiency, presumed to be genetic, could affect all lactate transport proteins in the body. Instances of muscle cramps after exercise are common and may in other individuals similarly result from lactate transporter deficiencies.

Still the only integrated scientific analysis, graphics, and data acquisition software.

ASYST™



Macmillan's widely-acclaimed ASYST™ Scientific Software still offers more built-in capabilities than any other PC software. Its unique interactive programming environment includes such functions as FFT, smoothing, integration, differentiation, curve fitting, statistics, differential equations, and matrix and polynomial operations. And all functions are supported by sophisticated graphics, such as error bars, scatter plots, and axonometric plotting.



ASYST's extensive function set provides the building-blocks that let you assemble scientific applications—fast. RS-232 and optional A/D and

GPIO/IEEE-488 support offer interface versatility you just can't get from other products. And all hardware support integrates seamlessly with the full range of ASYST capabilities.

Free technical support. 60 days of free technical support help you design, set up, and fine-tune the perfect system. Ongoing support is available at a nominal cost.

**30-Day No-Risk Offer.
CALL 1-800-348-0033.**

In New York state, (212) 702-3241.

Ask for technical literature, including performance benchmarks.

Macmillan Software Co.

An affiliate of Macmillan Publishing Company
630 Third Avenue, New York, NY 10017

ASYST is a trademark of Macmillan Software Co. ASYST was developed by Adaptable Laboratories Software, P.O. Box 18448, Rochester, NY 14618

American Association for the Advancement of Science

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Publisher: William D. Carey

Editor: Daniel E. Koshland, Jr.

Deputy Editors: Philip H. Abelson (*Engineering and Applied Sciences*); John I. Brauman (*Physical Sciences*); Gardner Lindzey (*Social Sciences*)

EDITORIAL STAFF

Managing Editor: Patricia A. Morgan

Assistant Managing Editors: Nancy J. Hartnagel, John E. Ringle

Senior Editors: Eleanore Butz, Ruth Kulstad

Associate Editors: Martha Collins, Barbara Jasny, Katrina L. Kelner, Edith Meyers, Phillip D. Szuroni, David F. Voss

Letters Editor: Christine Gilbert

Book Reviews: Katherine Livingston, *editor*; Deborah F. Washburn

This Week in Science: Ruth Levy Guyer

Chief Production Editor: Ellen E. Murphy

Editing Department: Lois Schmitt, *head*; Caitilin Gordon, Mary McDaniel, Barbara E. Patterson

Copy Desk: Lyle L. Green, Sharon Ryan, Beverly Shields, Anna Victoreen

Production Manager: Karen Schools

Graphics and Production: John Baker, *assistant manager*; Holly Bishop, Kathleen Cosimano, Eleanor Warner

Covers Editor: Grayce Finger

Manuscript Systems Analyst: William Carter

NEWS STAFF

News Editor: Barbara J. Culliton

News and Comment: Colin Norman, *deputy editor*; Mark H. Crawford, Constance Holden, Eliot Marshall, Marjorie Sun, John Walsh

Research News: Roger Lewin, *deputy editor*; Deborah M. Barnes, Richard A. Kerr, Gina Kolata, Jean L. Marx, Arthur L. Robinson, M. Mitchell Waldrop

European Correspondent: David Dickson

BUSINESS STAFF

Associate Publisher: William M. Miller, III

Business Staff Manager: Deborah Rivera-Wienhold

Classified Advertising: Leo Lewis

Membership Recruitment: Gwendolyn Huddle

Member and Subscription Records: Ann Ragland

Guide to Biotechnology Products and Instruments: Shauna S. Roberts

ADVERTISING REPRESENTATIVES

Director: Earl J. Scherago

Production Manager: Donna Rivera

Advertising Sales Manager: Richard L. Charles

Marketing Manager: Herbert L. Burklund

Sales: New York, NY 10036: J. Kevin Henebry, 1515 Broadway (212-730-1050); Scotch Plains, NJ 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); Chicago, IL 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-337-4973); San Jose, CA 95112: Bob Brindley, 310 S. 16 St. (408-998-4690); Dorset, VT 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581); Damascus, MD 20872: Rick Sommer, 24808 Shrubbery Hill Ct. (301-972-9270).

Instructions for contributors appears on page xi of the 26 September 1986 issue. Editorial correspondence, including requests for permission to reprint and reprint orders, should be sent to 1333 H Street, NW, Washington, DC 20005. Telephone: 202-326-6500.

Advertising correspondence should be sent to Tenth Floor, 1515 Broadway, NY 10036. Telephone 212-730-1050 or WU Telex 968082 SCHERAGO.

Energy Future

Events of 1986 have been traumatic for many people associated with the U.S. petroleum and natural gas industries. Prices at the wellhead have plunged, employment has been sharply curtailed, drilling has dropped to near longtime lows. Thus far, effects on production, consumption, and imports have not been great, but a continuation of present trends would lead to nationwide trauma at a later date. Because of longtime constants involved in developing energy sources, this country cannot afford complacency.

At one time, the United States was the world's lowest cost producer of petroleum and a substantial exporter. But the easy-to-find and inexpensive-to-produce oil has been found and exploited. There remains a large amount of oil in place (more than 300 billion barrels), but most of it is costly to produce: \$10 to \$15 a barrel and more.

When oil was selling above \$30 a barrel in 1981 and there was a widespread expectation of even higher prices, 4561 rigs were drilling. In July 1986, with oil at about \$10 a barrel, the number of active rigs dropped to less than 700. In November, when the price rose to \$14, about 850 were drilling.

The large-scale drilling of 1980 to 1985 was barely sufficient to maintain a constant level of production. In 1986 production has dropped from about 9 million barrels a day (mbd) to 8.7. Experts agree that with prices at or near present levels the drop will continue. In the meantime, conservation is passé. Consumption is up, and imports have risen nearly 1 mbd. A Conoco report estimates that in the year 2000 oil imports will rise to 11 mbd. Imports of oil and its products were 4.8 mbd in 1983. Conoco also estimates that in 2000, the United States will be importing about 60 percent of its oil, mainly from the Middle East. Well ahead of that point, the stage would be set for a gigantic price squeeze. With a huge deficit in international trade, how would the United States pay for oil imports?

The drop in drilling is increasing U.S. energy vulnerability through a drop in natural gas reserves. Earlier, adequate gas supplies provided a cushion against shortages of oil. Vestiges of a "gas bubble" remain, but in the absence of large-scale drilling, reserves of gas are being drawn down twice as fast as they are being replaced. An abnormally cold winter could lead to shortages in deliverability.

During the next several years, additional nuclear plants will be generating electricity, but their capacities will be limited. The contributions of fusion and of renewable forms of energy will be comparatively negligible during the next decade. That leaves coal as the source of energy that could be exploited to minimize energy adversities. A considerable amount of oil and gas is burned merely to make heat. New technology permits coal to be burned cleanly for many of these applications. The cost of coal per million Btu's at mine mouth averages about \$1. With residual oil at \$12 a barrel, the cost of heat from it is \$2 per million Btu's. During the last several years, the price of coal has been dropping. Productivity of mines has improved. Accident rates are lower. Competition among the 3000 coal mining companies is intense. Enormous reserves of coal are available.

Coal can be gasified to form methane. It can be liquefied to yield fluids for transportation. Fortunately, progress is being made in both of these applications. The Great Plains methane plant in North Dakota, though not a financial success, is a technical success operating at about 100 percent of design capacity: operators are on a learning curve, and have identified bottlenecks which, if corrected, could enable them to run at 120 to 140 percent of design capacity. Experiments designed to point the way to obtaining transportation fluids from coal are looking very promising. One approach is to co-process coal with residual oil, upgrading the mixture to useful fluids by hydrogenation. In a second approach hydrogenation is achieved through an improved two-step donor solvent procedure.

The United States could lessen oil and gas shortages during the next decade by instituting soon an import fee of \$5 to \$10 a barrel on oil. This would lead to development of more oil and gas while fostering conservation. The nation could achieve a longer term energy security by expediting advanced technology for utilization of coal.

—PHILIP H. ABELSON

concerned with this issue. We find that a significant decline in dinosaur diversity is difficult to prove.

GREG RETALLACK
Department of Geology,
University of Oregon,
Eugene, OR 97403
GUY D. LEAHY
2405 Bailey Hill Road,
Eugene, OR 97405

REFERENCES AND NOTES

1. This has been noted before by B. Brown [*Bull. Am. Mus. Nat. Hist.* 23, 823 (1907)].
2. G. J. Retallack, *Paleobiology* 10, 59 (1984).
3. D. E. Fastovsky and R. H. Dott, *Geology* 4, 279 (1986); D. A. Russell, *Sci. Am.* 246, 58 (January 1982); L. Dingus, *Paleobiology* 10, 420 (1984).
4. J. K. Rigby, Jr., *Bull. Soc. Verrebr. Paleontol.* 135, 17 (1985).
5. A. K. Behrensmeyer, *Paleobiology* 8, 211 (1982); *Am. Sci.* 72, 555 (1984).
6. D. A. Russell, *Sylogens* 53, 1 (1984); *Nature (London)* 307, 360 (1984); T. J. M. Schopf, *Spec. Pap. Geol. Soc. Am.* 190, 415 (1982).

Sloan *et al.* report gradual reduction in both diversity and population density of dinosaurs at the end of the Cretaceous. Their assertion of decreasing diversity during the last 9 million years of the Cretaceous is based on the numbers of genera in progressively younger assemblages. They found 30 genera in the combined Judith River–Oldman–St. Mary River formations; 23, 22,

and 19 genera in progressively younger strata; and finally 12 genera in the upper 16 meters of the Hell Creek Formation. We disagree with the suggestion that diversity was declining because the total of 30 genera in the oldest fauna was obtained by summing total genera from a 2.5-million-year interval, while the other totals were drawn from faunas derived from about 1-million-year intervals (figure 1 of Sloan *et al.*).

A more reasonable approach would be to compare the number of dinosaurs present in the 2.5-million-year time interval at the end of the Cretaceous with the Judith River–Oldman–St. Mary River fauna. Figure 1 of Sloan *et al.* reveals 28 genera present during the last 2.5 million years of the Cretaceous. A decline from 30 to 28 genera seems very modest.

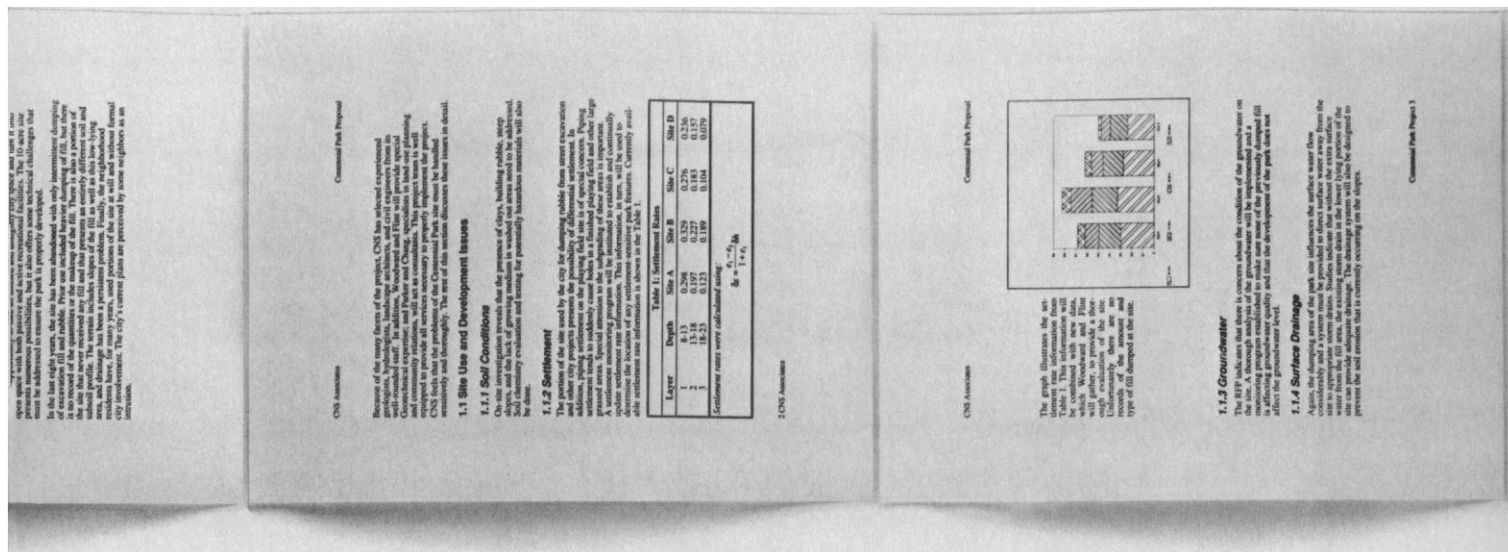
We performed a statistical test of dinosaur diversity changes on data taken from figure 1 of Sloan *et al.* We determined generic diversity at each of the time lines from 76 to 67 million years ago. We selected the two time lines with the highest diversities (23 and 27 genera at 75 and 74 million years ago, respectively) and compared them to diversities at the two most recent time lines (17 and 18 genera at 68 and 67 million years ago, respectively). We then compared the summed diversities of older and younger

samples with the a priori hypothesis of no difference ($\chi^2 = 2.6$, d.f. = 1, $P > 0.10$) and found they did not differ significantly.

Sloan *et al.* also suggest that dinosaur abundance was declining through the Hell Creek Formation. On the basis of a chi-square test, they state that the highest level of the formation had a significantly lower dinosaur abundance than lower levels. However, using data from table 2 of Sloan *et al.* we compared the number of bones in each stratigraphic interval with the number that would be expected if each interval contained the average of 2.63 bones per square kilometer ($\chi^2 = 9.79$, d.f. = 5, $P > 0.05$). The test indicates that no sample (including the youngest) differed significantly from the others. In a second test, we compared the youngest interval with the combined collections of the older intervals ($\chi^2 = 2.86$, d.f. = 1, $P > 0.05$) and found no significant difference.

It appears to us that the data discussed above are consistent with constant diversity and constant abundance of dinosaurs through the last 9 million years of the Cretaceous. That the same data are open to the alternative interpretations of gradual decline and of relative constancy probably reflects the fact that the collections were made from many facies over many years and

Was your word processor designed to write like this?



with many different purposes. Currently available information is not sufficient to establish whether or not the dinosaur extinction was gradual. Carefully designed fieldwork is needed to obtain new collections that specifically focus on patterns of dinosaur diversity at the end of the Cretaceous.

PETER M. SHEEHAN
Department of Geology,
Milwaukee Public Museum,
Milwaukee, WI 53233
CAROLYN L. MORSE
Department of Psychology,
University of Wisconsin,
Milwaukee, WI 53201

Unequivocal evidence is required to support the assertion that dinosaurs were members of Paleocene faunas in Montana. We believe that possible reworking of dinosaur remains into younger channel deposits and their absence in nonchannel earliest Paleocene deposits are critical issues incompletely addressed by Sloan *et al.*

Bug Creek facies channel deposits (1) such as the Ferguson Ranch locality contain transported and reworked material (2). Behrensmeyer (3) analyzed the possibilities of mixing skeletal elements of members of temporally disjunct faunas. Channel lag deposits are concentrations of clasts, whether they

are new additions or winnowed residue from reworked stream banks (2). The undocumented "minimal" abrasion of dinosaur teeth in Paleocene stream channel deposits (age determined palynologically) does not convincingly exclude the possibility of reworking. Limited abrasion is just as easily explained by minimal transport of exhumed teeth (and bones).

Three observations based on 16 years of fieldwork in eastern Montana require explanation. If dinosaurs lived during deposition of the Bug Creek facies channel fills, why have their articulated remains not been found in these deposits? Partial dinosaur skeletons commonly are found in undisputed Cretaceous channel fillings, for example, the type specimen of the *Tyrannosaurus rex*. Articulated remains do occur in the Bug Creek facies, but are invariably those of taxa not limited to the Cretaceous (for example, turtles and crocodiles) (4).

Intensive fieldwork focused on channel and overbank deposits of Paleocene age within the Z coal complex of the basal Tullock Formation has resulted in the discovery of many accumulations of nondinosaur fossil vertebrates, including articulated specimens (4). Purported contemporaneous dinosaur remains from the Bug Creek facies are known only from channel deposits that

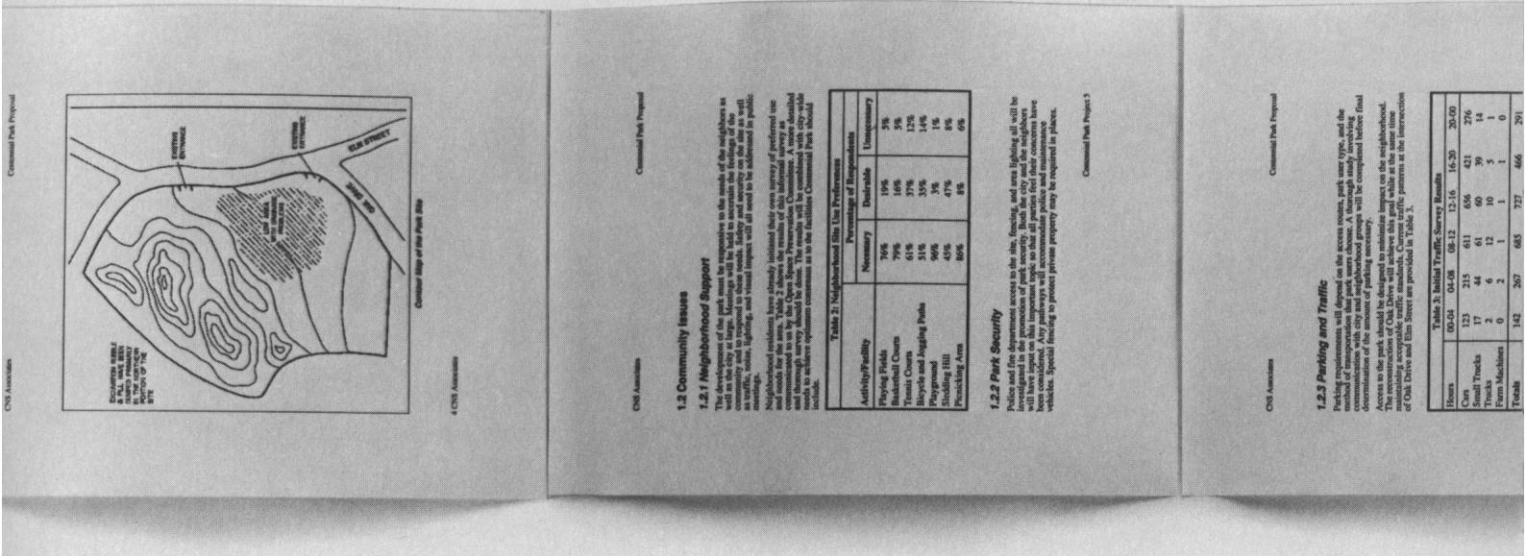
cut into and necessarily rework Cretaceous sediments.

The stratigraphically highest dinosaur fossils preserved in nonchannel deposits lie approximately 2 meters below the base of the Tullock Formation, and, where it has been identified palynologically, the Cretaceous-Tertiary boundary. We know of no vertebrate fossils from this interval, or within 1 meter above the Cretaceous-Tertiary boundary (excluding those in channels that cut through these strata). Thus the sample of dinosaur specimens from the uppermost 9 meters of the Hell Creek Formation (Sloan *et al.*, table 2) is actually derived from an interval with a thickness approximately 75% that of those with which it is being compared. How is this related to the alleged decrease in abundance of dinosaur remains?

The possibility that dinosaur specimens have been reworked and the apparent discrepancies between records from channel and overbank deposits demand further investigation.

LAURIE J. BRYANT
WILLIAM A. CLEMENS
J. HOWARD HUTCHISON
Museum of Paleontology,
University of California,
Berkeley, CA 94720

Was it designed to write a very long, very complex,



REFERENCES AND NOTES

1. J. D. Archibald, *Univ. Calif. Publ. Geol. Sci.* **122**, 1 (1982).
2. D. E. Fastovsky and R. H. Dott, Jr., *Geology* **14**, 279 (1986); R. J. Pettijohn, P. E. Potter, R. Siever, *Sand and Sandstone* (Springer Verlag, New York, 1972).
3. A. K. Behrensmeyer, *Paleobiology* **8**, 211 (1982).
4. Forty-eight localities in the Z coal complex interval, 37 yielding articulated specimens (in the University of California collections); L. J. Bryant, thesis, University of California, Berkeley, CA (1985).

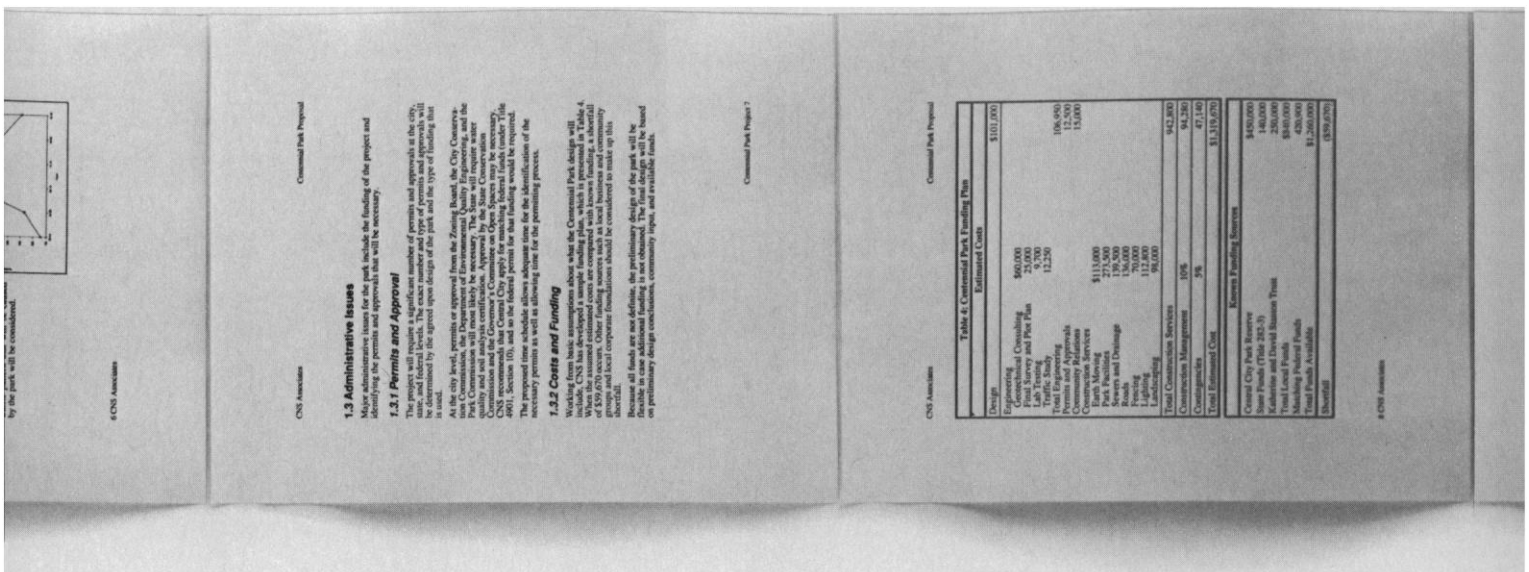
Response: There are six major events recorded in the upper Hell Creek Formation of McCone County, all within chron 29r [the 0.6-million-year reversed magnetic interval, including the Cretaceous-Tertiary (K-T) boundary], and at least four of them are discrete. The oldest is the latest Maastriichtian sea level lowering (1) and consequent minor unconformity; closely associated with this are the introductions of ungulates and of multituberculates of Asian origin and perhaps the introduction of *Leptoceratops* from Asia and *Alamosaurus* from South America. A lowering of sea level would make intercontinental migrations across a filter bridge easier. Also associated with this is part of the reduction of pollen taxa. Retallack and Leahy's interval of deep weathering follows. The next identifiable event is the K-T boundary, marked by the iridium-rich layer in some but not all sec-

tions, principally those in contemporary ox-bow lakes. This is also marked by the abrupt termination of several Cretaceous pollen taxa. Immediately following this is a short stratigraphic interval with an enrichment of fern spores, in turn followed by the great increase in conifer pollen and wood. The next event is the deposition of the continuous upper Z coal, the top of the Hell Creek Formation, followed by the major change in sedimentation type that results in the typical and definitive Tullock shales of distinctly yellowish color. This color change is due to the deposition of many closely spaced layers of siderite cemented clay, separated by layers of light gray clay. These siderite bands are mainly absent from the Hell Creek Formation. We presume this change is due to the Danian sea level rise and consequent change in base level and water table. The final event is the terminal extinction of dinosaurs in Montana. The last dinosaurs occur in a channel that does not cut down into the Hell Creek Formation. Since our report was submitted we have demonstrated that Bug Creek West (BCW), Scmenge Point and Harbicht Hill (HH) are Paleocene channels using the same criteria that we used for Ferguson Ranch (FR). We have also located two more Paleocene localities, By George and Wounded Toe, within the Hell Creek

Formation, and one not yet named in the basal Tullock Formation (2). The K-T boundary thus falls between Bug Creek Ant-hills (BCA) and BCW. Only one dinosaur genus disappeared at the K-T boundary, and 11 dinosaur genera survived into the Paleocene in Montana.

The possible sources for the fossils found in the channels are (i) reworking from older and lower channels, (ii) reworking from adjacent older floodplain deposits, (iii) being swept off the surface of the floodplains, and (iv) drowning in the channels. The question is, Are all of the dinosaur teeth in the Paleocene channels of sources (i) and (ii), or are at least some of them from source (iii)? Source (iv) could of course produce semiarticulated skeletons, but we have not found any in 18 field seasons. A possible reason for the lack of articulated skeletons of dinosaurs is the lower sedimentation rate of the Hell Creek Formation and the lower Tullock formations as compared with the Lance Formation or the Judith River Formation of Alberta containing the classic Oldman fauna. Depositional units in the lower Tullock Formation are only 1 to 10 centimeters thick, too thin for the burial of skeletons other than small vertebrates. The known Tullock fossils come dominantly from coals and the channel sands. The major

very technical document, mixing text and graphics?



source of mammal remains (and we presume dinosaur teeth) in the Paleocene channels is (iii). All the listed channels have dinosaur teeth within them. A minor source for the mammal and dinosaur teeth is (i); we think this is no more than 5% of the included fossils. We think (ii) is unlikely because we have not found teeth in the floodplain shales despite many field seasons of prospecting. The deep cavities of small theropod teeth do not have floodplain sediments in them, only channel sands, as in the interiors of the turtle skulls.

We repeat our assertion that if dinosaur teeth are reworked, so must be the more common teeth of Cretaceous mammals. For example, *Didelphodon vorax*, the largest marsupial, is routinely known from most Cretaceous localities in the Hell Creek Formation, including BCA. It makes up on average, 2% of the number of mammalian specimens and is more common than any theropod dinosaur at most localities in the Hell Creek Formation. It is quite unknown from any of the Paleocene localities in either Garfield (3) or McCone counties. On the other hand *Meniscoessus borealis* is routinely present in all localities through FR, and in fact increases in abundance from BCA to BCW and HH. This is a strange kind of selective "reworking." One would expect reworking to ho-

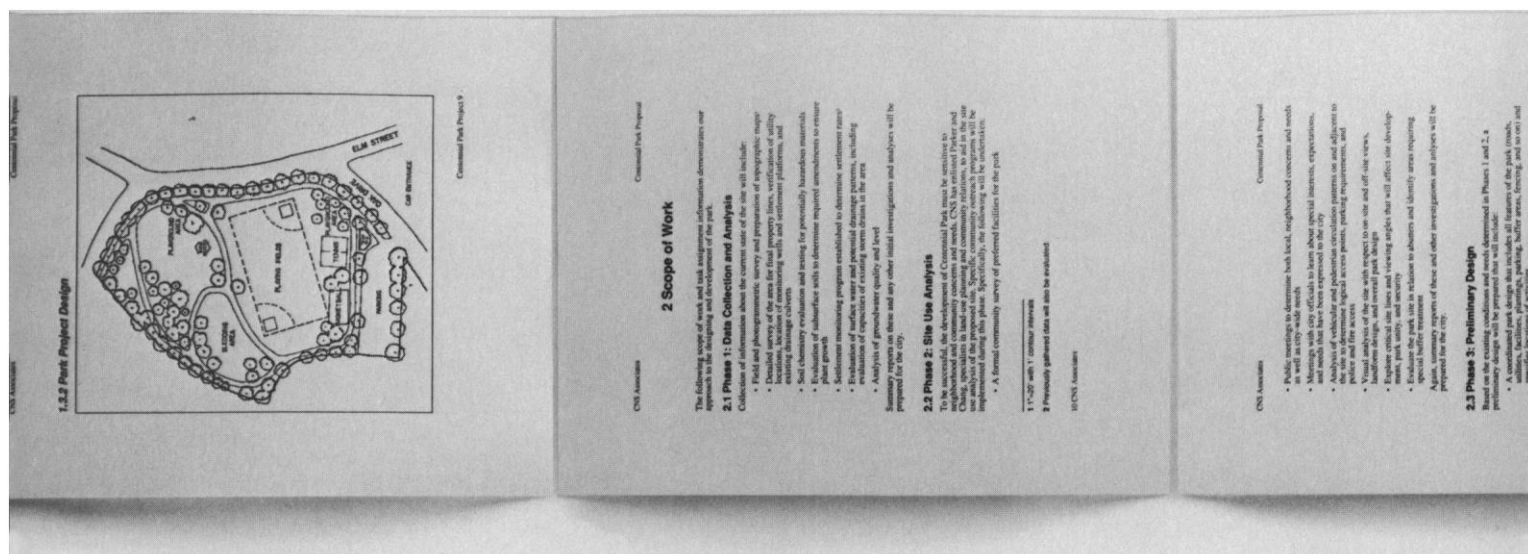
mogenize the relict faunas. Instead, dinosaur teeth are enriched with respect to Lanciaan mammals in the Paleocene channels, and those mammals themselves differ from channel to channel. These faunas are not the result of a progressive dilution of reworked Cretaceous fossils.

Retallack and Leahy present useful new results on the distribution and types of paleosols in the Bug Creek area. We were aware of their work at the time of revision of our report, but could not in good conscience discuss it until they presented it. The FR channel cuts only 3 meters below the event Z, the K-T boundary. This is the interval that Retallack and Leahy point out as bleached by acid soil weathering, in which bones and teeth are missing in the floodplain silts and clays. The FR channel does not cut into a lower channel for at least 1.5 kilometers in the upstream direction. We do not see how the FR dinosaur teeth can be reworked.

On the matter of the bleached zone reducing the interval in which dinosaurs become scarce, we are in the process of reoccupying the University of Minnesota and Milwaukee Public Museum sites of dinosaurs and hand leveling the distance to the K-T boundary. Present results continue to show the trend stated in our report.

Sheehan and Morse suggest that it is more reasonable to combine all the Maastrichtian dinosaur faunas we cite as one unit of 3.3-million-years duration and compare them with the late Campanian faunas of 2.5-million-years duration on the basis of similar intervals of time. We do not think this is reasonable for the following reasons. The Oldman fauna includes some 320 semiarticulated dinosaur specimens (4) that have an approximate range in age of 1.5 million years. The slightly older Judith River fauna add three additional genera known only from isolated teeth and as yet not collected from the Oldman fauna, mainly because no extensive sediment-washing operations have been conducted except for those of Richard Fox of the University of Alberta, Edmonton, who has not reported on the reptilian remains. These taxa do occur later in the region. This means the augmented Oldman fauna is 30 genera over 1.5 million years. By combining the Lance, Hell Creek, and Scollard formation samples, the number of Lanciaan semiarticulated dinosaur specimens becomes 139 (4) over a total of 2 million years. To this we add the 52 Milwaukee Public Museum and University of Minnesota specimens and the genera known mainly from teeth. The Lanciaan faunas total 19 genera over a span of 2 million years. The compari-

Was it designed to write a highly-structured document,



son is thus between 30 genera and 19 genera, not 30 and 28. However, there is a great difference between the faunas of the lower and upper parts of the Hell Creek Formation. Our collections of teeth from the upper part of the Hell Creek Formation are significantly larger than any other collections in the world. While not all our specimens are counted as yet, they have been identified. We estimate that more than 3000 dinosaur teeth have been collected from only five of our localities in the upper 20 meters of the formation. Twelve genera are all we can identify in these collections. We invite others to produce a similar body of data from another area for comparison. Lumping data will only confuse the results. Fossils with formation occurrence data only and not stratigraphic position are of little use. We did err in the calculation of χ^2 . The probability is slightly more than 0.05 rather than slightly less.

ROBERT E. SLOAN
*Department of Geology and Geophysics,
 University of Minnesota,
 Minneapolis, MN 55455*
 J. KEITH RIGBY, JR.
*Department of Earth Sciences
 University of Notre Dame,
 Notre Dame, IN 46556-1020*

REFERENCES

1. P. R. Vail, R. H. Mitchum, Jr., S. Thompson, III, *Mem. 26 Am. Assoc. Pet. Geol.* (1977), pp. 83-97.
2. J. K. Rigby, Jr., K. Newman, J. Smit, R. E. Sloan, J. K. Rigby, Sr., *Palaio*, in press; J. K. Rigby, Jr., J. K. Rigby, Sr., R. E. Sloan, *Geol. Soc. Am. Abstr. Program* 18, 730 (1986).
3. J. D. Archibald, *Univ. Calif. Publ. Geol. Sci.* 122 (1982).
4. D. A. Russell, *Geol. Assoc. Can. Spec. Pap.* 13, (1975), pp. 119-136.

Alachlor Removal from Drinking Water

A recent News & Comment article by Marjorie Sun (12 Sept., p. 1143) about the Environmental Protection Agency's (EPA's) proposal for alachlor contains the statement, "alachlor, for the most part, is not eliminated by purification at conventional city water treatment plants or even activated charcoal filters."

David Baker of Heidelberg College in Tiffin, Ohio, has observed significant removal of alachlor and other popular herbicides after water has been treated with granular activated carbon (GAC) filters (1). Laboratory-scale experiments by the Ontario Ministry of the Environment have demonstrated effective removal of alachlor with GAC filters and with powdered activated

carbon (PAC). PAC (25 to 75 milligrams per liter) was successful in removing alachlor and other herbicides from raw water at several southwest Ontario plants in 1985 (2). PAC is commonly used at many community water systems for taste and odor control and, as the Canadian data demonstrate, could be used for herbicide removal without the need for installation of capital-intensive filters. Additional work in Louisiana funded by the EPA has shown quantitative removal of alachlor by GAC filters and substantial removal after ozonation (3).

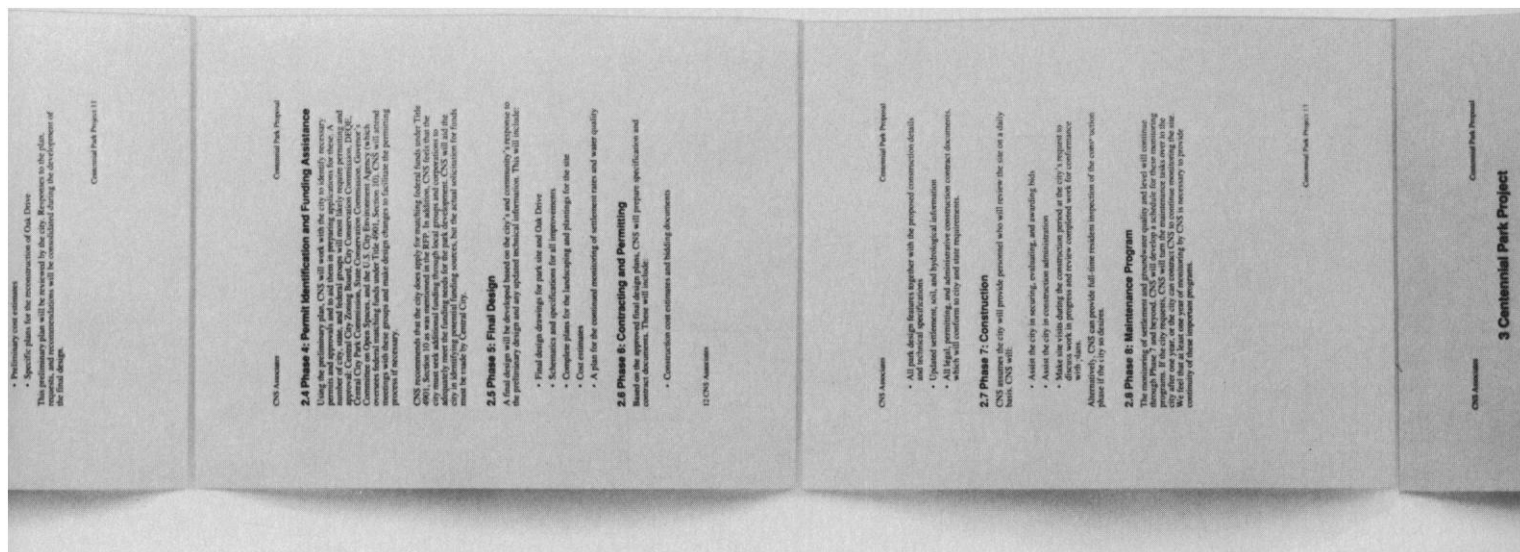
ANDREW J. KLEIN
*Monsanto Company,
 700 Chesterfield Village Parkway,
 St. Louis, MO 63198*

REFERENCES

1. D. B. Baker, *J. Soil Water Conserv.* 40, 125 (1985).
2. *Alachlor Monitoring of Ontario Drinking Water, May-November 1985* (Ontario Ministry of the Environment, Ontario, 1985).
3. B. W. Lykins, Jr., and W. Koffskey, "Alternate disinfectants and GAC effects on trace organic contaminants" (Final Report for EPA Grant 80625, Environmental Protection Agency, Washington, DC, 1985).

Erratum: In the summary of the article "What has happened to productivity growth?" by Martin Neil Bailey (24 Oct., p. 443), the second sentence should have read, "Unless there is an increase in growth, American living standards will remain stagnant and problems such as the budget deficit will plague policy-makers."

with many revisions, as easily as it knocks out a memo?



Sure it's not impossible, but it could be a lot easier.

	1	2	3	4	5	6	7	8	9	10	11	12
Site Characterization and Analysis												
Site Use Analysis												
Preliminary Design												
Final Design												
Construction												
Post-Construction												
Other Activities												
Community Outreach												
Construction and Permitting												
Construction*												

* Construction continues through month 20.

24 CNS Associates

CNS Associates

Communit Park Project

4 Project Management

CNS has assembled a project team of experienced professionals from its staff as well as called on the services of expert consultants. This team has the knowledge and experience to manage the project from start to finish. The project team includes CNS, Central City, and the consulting firms, Woodward Clyde, and the project team. The project team is responsible for the relationship between these groups.

Table 1: Level of Effort			
	CNS	Partner Woodward Clyde	Central City
Project Management	X		
Geotechnical Engineering	O	X	
Environmental Engineering	X		
Landscape Architect	X		
Urban Design	X		
Civil Engineering	X		
Community Participation	O		
Construction Administration	O	X	
Exp/Primary Role, O=Secondary Role			X

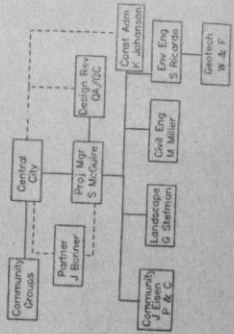
Communit Park Project 1.5

CNS Associates

Communit Park Project

5 Project Team

CNS has chosen experienced geologists, hydrologists, landscape architects, and other professionals to manage the project. This team includes team members and their qualifications. It also includes the names of the team members from Woodward Clyde and Park and Cedar and Cedar.

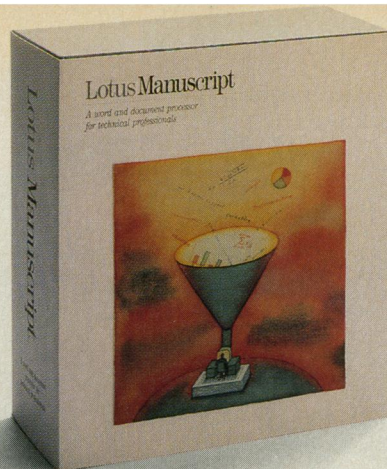


Yes, Lotus Manuscript™ is a very different kind of word processor. Because when you're processing long, technical documents such as proposals, specifications and reports, you have very different kinds of needs.

Needs like mixing text and graphics on the same page. Or, creating complex equations. Or, working with columns and tables. Or, making wholesale revisions.

Very often technical documents require the mixing of text and graphics on the same page. Graphics from Lotus® 1-2-3,® Symphony® and Freelance® Plus. With Manuscript you can import diagrams, and scanned images, as well as spreadsheets and charts.

Another feature designed specifically for the writer of technical documents is Manuscript's integrated Outliner. When you collapse the document you're able to navigate the outline much easier than wading through



the entire piece. You can move a page, or even an entire chapter with just a few keystrokes.

Also, because Manuscript is structured, you can globally format an entire document or format by individual sections. Imagine changing all headlines from 14 point plain text to 16 point bold, all with just one command.

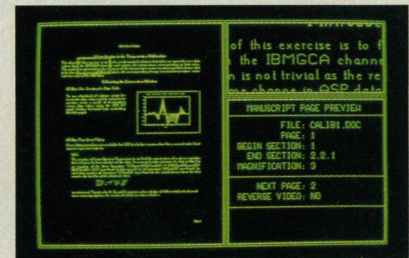
How about the age-old dilemma of proof reading revisions? Manuscript's Document Compare feature highlights changes between revisions. You might call it fool-proofreading.

Also, Manuscript automatically sizes and generates math equations as well as upper and lower case Greek symbols, diacritical marks and brackets. No longer do

you need to literally cut and paste to create complex equations.

With our powerful Print Formatter you can control the look of your document with the creation and editing of tables. You can choose fonts and point sizes from a built-in typeface list. You can even save format information as a template for regular use.

As for the quality of output, Manuscript takes full advantage of today's printing technology, from dot-matrix to laser, including PostScript® printers.

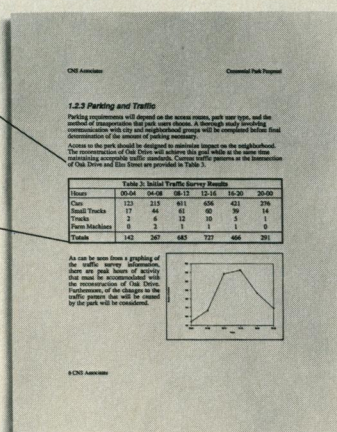


With our Document Preview feature you can see exactly how any page will look before it's printed.

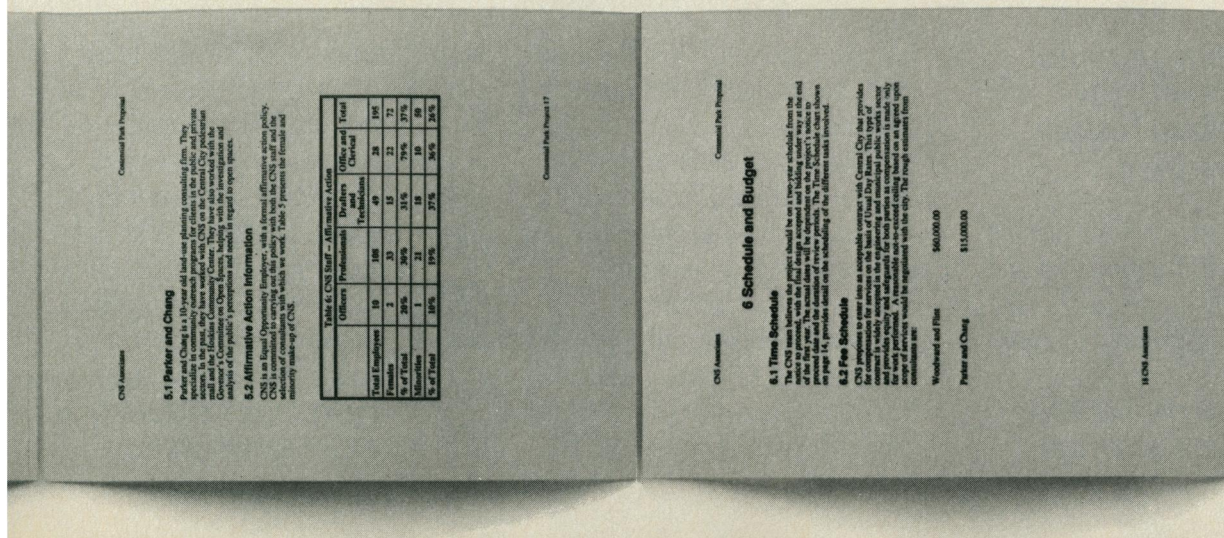
Manuscript is designed to work on most IBM PCs and compatibles. Its familiar 1-2-3 interface makes it easy to use. And our Manuscript evaluation kit makes it easy to try. For \$10.00, you'll get a presentation disk, working software, and a tutorial manual. To get your evaluation kit, call 1-800-345-1043, ask for lot #ED-1450. Or, for more information, see your authorized Lotus dealer, or write Lotus Development Corp., 55 Cambridge Parkway, Cambridge, MA 02142.

Manuscript allows you to mix text and graphics on the same page.

You can throw away your scissors and glue, cut and paste are a thing of the past.



May we suggest Lotus Manuscript.



© 1986 Lotus Development Corporation. Lotus, 1-2-3, Symphony and Freelance are registered trademarks and Lotus Manuscript is a trademark of Lotus Development Corporation. PostScript is a registered trademark of Adobe Systems, Inc. IBM is a registered trademark of International Business Machines.



Research

Get the results you want instantly with the Polaroid 35mm Instant Slide System.

If you're looking for the perfect way to keep track of every twist and turn in your R&D programs, here's the instant answer: Polaroid 35mm instant slides.

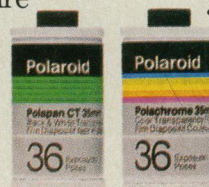
There's simply no more convenient way to document what

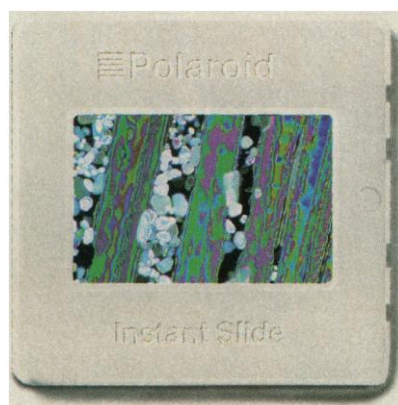
you're doing. And, when the need arises, no quicker way to present your findings.

Use Polaroid 35mm instant slide film with *any* 35mm camera to photograph those objects or procedures you need to capture on the spot. Use it with your most sophisticated test equipment – from CRT screens to microscopes. Or with a copy

stand for slides of small objects or flat art. Capture each phase of step-by-step procedures so you can review them as soon as necessary. Polaroid films let you see your findings in the best light, too. Whether your demand is for black and

white slides, high contrast or continuous tone – or for color – we have what you need for virtually any type of documentation or





and development.

presentation.

Better still, you can do all your own photography, from start to finish, yourself. In house, in complete confidentiality. Without the delays that outside services create.

Which means when it comes to documentation, review, and presentation, there's really no need to experiment with anything else.

In fact, no matter where your research takes you, you can be

certain there's a Polaroid imaging solution to handle any development.

Instantly.

For the Polaroid Professional Film Center nearest you, call toll-free 800-526-7843 ext. 400. In New Jersey, call 800-522-4503 ext. 400.

Polaroid

© 1986 Polaroid Corporation "Polaroid"®

For more information about the Polaroid 35mm Instant Slide System mail this coupon to Polaroid Corporation, Dept. 660, P.O. Box 5011, Clifton, N.J. 07015.

Name

Company

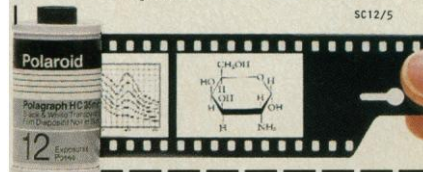
Address

City

State Zip

Telephone

SC12/5



Polaroid
Polagraph HC 200
12 Exposures

Circle No. 16 on Readers' Service Card

Versatile.



The HPLC system for your most demanding applications.

If you're like George, you're responsible for a wide variety of LC tasks. He heads the analytical lab for a company heavily involved in R&D, so he has to be versatile. So does his HPLC system.

That's why George selected an HP 1090 Series M.

Its diode array detector and HPLC ChemStation with fast, interactive color graphics give him rapid access to the information he needs for method development.

They help him quickly identify and quantitate a wide variety of compounds. At low concentrations. In complex matrices.

Because of the system's low external band broadening and versatile solvent delivery system, George has also discovered the benefits of microbore and high-speed LC.

And its automation features save him time optimizing methods and demonstrating reproducibility, so he can concentrate his efforts on his research work.

Whether you need the same kind of versatility that George does or your needs are more specialized, there's a Hewlett-Packard HPLC system to match your requirements. Exactly.

For more information, call the HP office listed in your white pages and ask for an analytical product representative. Or write Hewlett-Packard Analytical Group, 1820 Embarcadero Road, Palo Alto, CA 94303.



TOOLS FOR RESEARCH.

Labeled compounds from Merck Sharp & Dohme / Isotopes.



MSD ISOTOPES – research products that work, bringing results to researchers in biology, chemistry, physics, medicine and related fields.

Did you know that we now offer thousands of compounds labeled with deuterium, carbon 13, nitrogen 15 and other stable isotopes too? And did you know that even if you require a compound which is not available from us immediately 'off-the-shelf', we have the world's best facilities to custom synthesize it for you?

Fact is, that today more scientists around the world are getting more results than ever before with MSD ISOTOPES

'research tools' because of our unprecedented variety, quality and value.

So just call or write to us. Tell us what you need, (or even what you *think* you might need) and we will be happy to send you up to date information on the price and availability of your compound.

MSD ISOTOPES – Labeled compounds are our only business.

MSD

MSD ISOTOPES

DIVISION OF MERCK FROSST CANADA INC., Montreal, Canada

WEST COAST

P.O. Box 2951
Terminal Annex
Los Angeles, CA 90051
Los Angeles Area: (213) 723-9521
Outside State of CA: (800) 423-4977
State of CA: (800) 372-6454

EAST COAST & CENTRAL

4545 Oleatha Avenue
St. Louis, MO 63116
Outside state of MO: (800) 325-9034
State of Missouri: (314) 353-7000

CANADA

P.O. Box 899
Pointe Claire/Dorval, Quebec
Canada H9R 4P7
Telephone: (514) 697-2823

Circle No. 122 on Readers' Service Card

THE SIXTH ANNUAL CONGRESS FOR **HYBRIDOMA RESEARCH**

MARCH 1 – 4, 1987
MOSCONE CENTER, SAN FRANCISCO, CALIFORNIA

Organized by Scherago Associates, Inc. and Mary Ann Liebert, Inc., publishers

Co-Chairmen:

Zenon Steplewski, The Wistar Institute, Philadelphia, PA
Hilary Koprowski, The Wistar Institute, Philadelphia, PA
Joseph Davie, Washington University, St. Louis, MO

PROGRAM

KEYNOTE ADDRESS (Sunday P.M.)

Stephen Goff, Columbia University, Alexander Rich, M.I.T.

ACQUIRED IMMUNE DEFICIENCY SYNDROME (AIDS)

(Monday A.M. - P.M.)

Chairman: Erling Norrby, Karolinska Institutet, Stockholm, Sweden

Speakers: Luke Montagnier, Paris William Haseltine, Boston
Robert C. Gallo, Bethesda Myron Essex, Boston
Jay A. Levy, San Francisco Robin Weiss, London
Simon Wain-Hobson, Paris Dani P. Bolognesi, Durham
Flossie Wong-Staal, Bethesda Bernard Moss, Bethesda

TRANSGENIC MICE AS TOOL IN IMMUNOLOGY (Tuesday A.M.)

Chairman: Davor Solter, The Wistar Institute

Speakers: Rudolf Grosschedl, U.C.S.F.
Ken-Ichi Yamamura, Kumamoto Univ. Medical School
Jean-Claude Weill, Institute Jacques-Monod
Barbara A. Knowles, The Wistar Institute

WORKING GROUP MEETINGS

This year we are planning two Working Groups:

- A. IMMUNOTHERAPY** – Chairman, Michael Mastrangelo
Thomas Jefferson University Hospital
B. IMMUNODIAGNOSIS – Chairman, Edgar Haber
Massachusetts General Hospital

Working groups will meet in closed sessions. It is our intent to select participants actively involved in the above listed research for in-depth discussion of program made recently. The consensus reached by working groups will be presented to the whole Congress and results of these discussions will be published in Hybridoma.

Investigators interested in participating in these Group Meetings should send a short summary to Dr. Zenon Steplewski, The Wistar Institute, Thirty Sixth Street At Spruce, Philadelphia, PA 19104. (215) 898-3924 by January 10, 1987.

ANTI-IDIOTYPE VACCINES (Tuesday P.M.)

Chairman: J. Donald Capra, University of Texas

Speakers: Kathryn Meek, Univ. of Texas Health Science Center
At Dallas
Ronald C. Kennedy, Southwestern Foundation for
Biomedical Research
Dorthee Herlyn, The Wistar Institute
Karl Erik Hellström, Oncogen Inc.
David Sacks, N.I.H.

THE USE OF HYBRIDOMAS IN DETERMINING CYTOKINE STRUCTURES AND FUNCTIONS (Wednesday A.M.)

Chairman: Robert Schreiber, Washington University

Speakers: Robert Coffman, DNAX Research Institute
Frank Fitch, Pritzler School of Medicine
Carl Pierce, Washington University School of Medicine
Robert Schreiber, Washington University

ANTI-CARBOHYDRATE MAB'S IN THE STUDY OF GLYCOLI- PID-MEDIATED CELLULAR EFFECTS (Wednesday a.m.)

Chairman: Jan Thurin, The Wistar Institute

Speakers: David A. Cheresh, Scripps Clinic & Research Foundation
Tomas Brodin, The Wallenberg Laboratory
Bruce Fenderson, Fred Hutchinson Cancer Research Center
Nobuo Hanai, Fred Hutchinson Cancer Research Center

SUMMARY (Wednesday P.M.)

Chairman: Joseph Davie, Washington University School of Medicine

POSTER SESSION AND EXHIBITS

REGISTRATION FEES:

\$450 On-site registration

\$400 ADVANCE REGISTRATION – (Received by Jan. 15) \$150 STUDENT REGISTRATION – Undergraduate, graduate students only. Conf. in writing.

4-7 registrations received together from same organization \$300 each. 8-10 registrations received together from same organization \$200 each.

Larger group rates available upon request. Cancellations must be received in writing by February 1, 1987.

Attendance will be limited. Make checks payable to: **Scherago Associates, Inc., DNA / HYBRIDOMA**

S-12-5

☐ Please reserve _____ space(s): Registration Fee of \$ _____ enclosed.

☐ Please send abstract form.

Name _____

Dept. _____ Organization _____

Street _____

City _____ State _____ Zip _____

Telephone: () _____

Return to: **Hybridoma**; c/o Scherago Associates, Inc. 1515 Broadway, Dept. S-12-5 New York, NY 10036 • (212) 730-1050

**It used to take up to \$15,000
and a video technician to
project real-time PC images.
Now anybody can do it
in five minutes for \$1270.***

- 1.**
Plug the unit into your PC.
- 2.**
Place it on your overhead projector.
- 3.**
Begin your real-time presentation.

New KODAK DATASHOW System

Just think of all the applications.
Call for details:

1 800 44KODAK, Ext 865
(1 800 445-6325, Ext 865)



The DATASHOW System is used with an IBM PC or 100% compatible computer.

*Price shown is Kodak's suggested price only. Actual selling price is determined by dealer.



Eastman Kodak Company
Motion Picture and
Audiovisual Products Division

Circle No. 62 on Readers' Service Card



*In the long run,
performance is best judged at the finish line.*

The strategy for running the marathon is vastly different than for the 100-yard dash.

A successful pension fund has a different investment strategy, too. Far different than the quick return, end-of-quarter performance goals of many investment funds.

While many financial service companies are racing to offer higher risk investments with the hope of higher returns, TIAA and CREF continue to achieve steady growth with broadly diversified portfolios of retirement-oriented investments.

This balanced, long-term investment philosophy is the foundation for building lifetime retirement incomes.

Maintaining the highest yields over 40 years would be comparable to maintaining the speed of the 100-yard dash over the 26-plus miles of the marathon. Highly unlikely.

The key to successful retirement funding is consistency over long time periods, because the investments must provide annuity payments throughout a staff member's entire retired life. A very real reason why over 150,000 retired educators enjoy the rewards of having participated in a TIAA-CREF retirement plan.

When the results are in at retirement, you will find that TIAA-CREF retirees are far ahead.

Send for a free copy of our recent survey among staff members retired from educational institutions. Simply write on your letterhead.

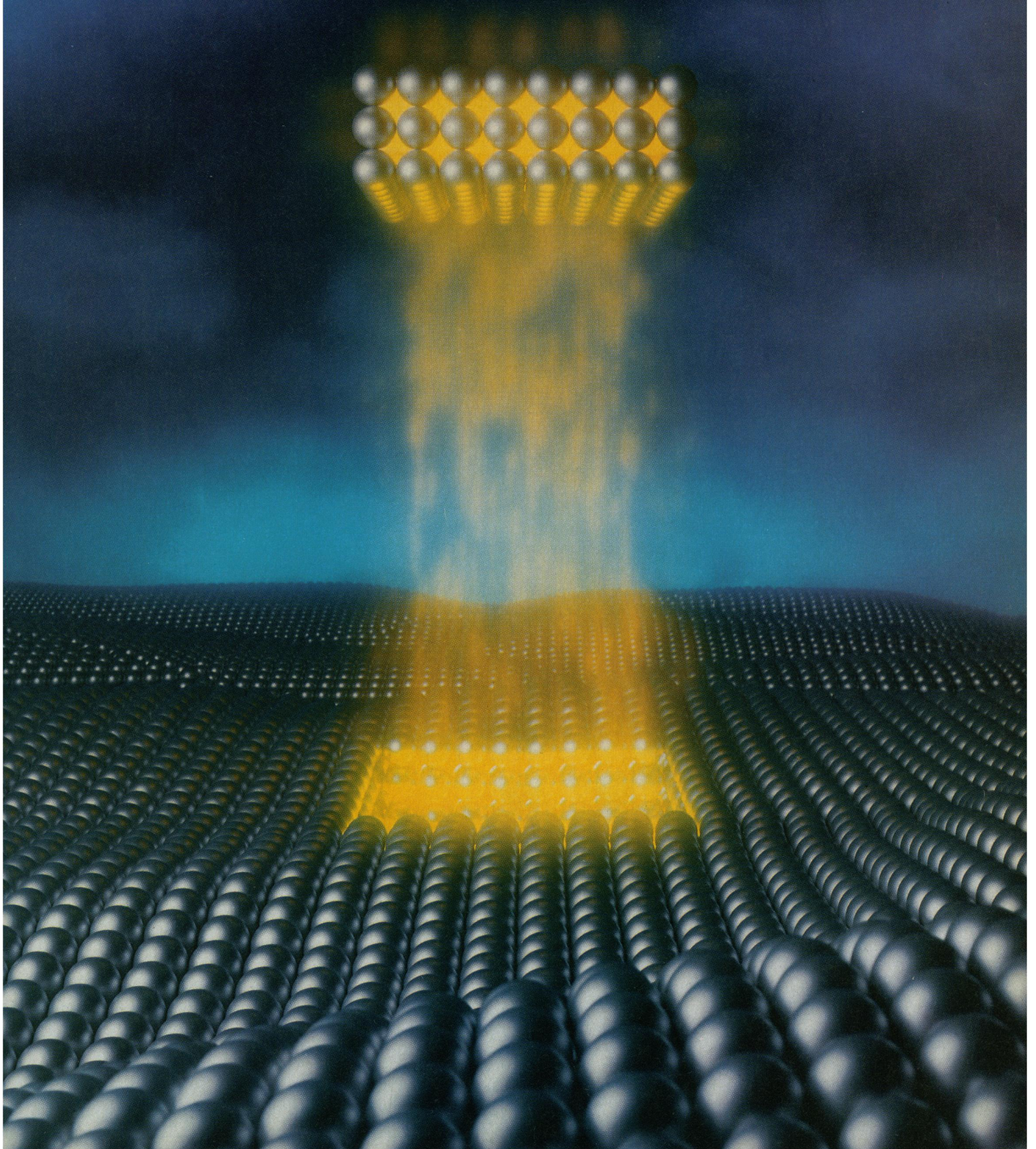
TIAA-CREF. You can count on us today... and for tomorrow.



Teachers Insurance and Annuity Association
College Retirement Equities Fund

730 Third Avenue, New York, NY 10017

The Pressure Extrapolation



The Pressure Extrapolation

Modern automotive catalytic converters contain rhodium which promotes chemical reactions to remove pollutants from a car's exhaust. Scientists at the General Motors Research Laboratories have recently made discoveries about one such chemical reaction, the reaction between nitric oxide and carbon monoxide, pointing the way toward new or improved catalysts.

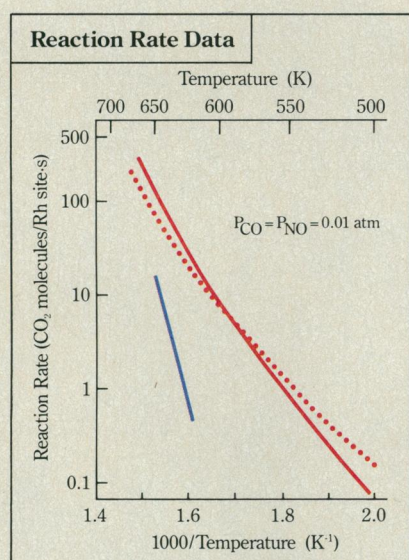


Figure 1: Rate comparisons for the NO-CO reaction. Measured data over single crystal Rh(111) (solid red line) and over supported Rh (blue line); model predictions (dotted red line).

Figure 2: Schematic representation of the elementary intermediate steps for the NO-CO reaction.

MOST FUNDAMENTAL catalytic studies using surface science techniques require an ultrahigh vacuum environment (10^{-13} atm). They are best suited for studying well characterized materials, such as metal single crystals. Catalytic reactions of practical interest, however, involve polycrystalline materials, in the form of small metal particles dispersed on supports. And they take place at atmospheric pressures rather than in an ultrahigh vacuum.

Now Dr. Galen B. Fisher and Dr. Se H. Oh have demonstrated how the wealth of chemical information obtained from ultrahigh vacuum (UHV) studies of ideal, single-crystal catalysts can be applied to the understanding of real-world systems that have different catalyst environments and that operate at much higher pressures.

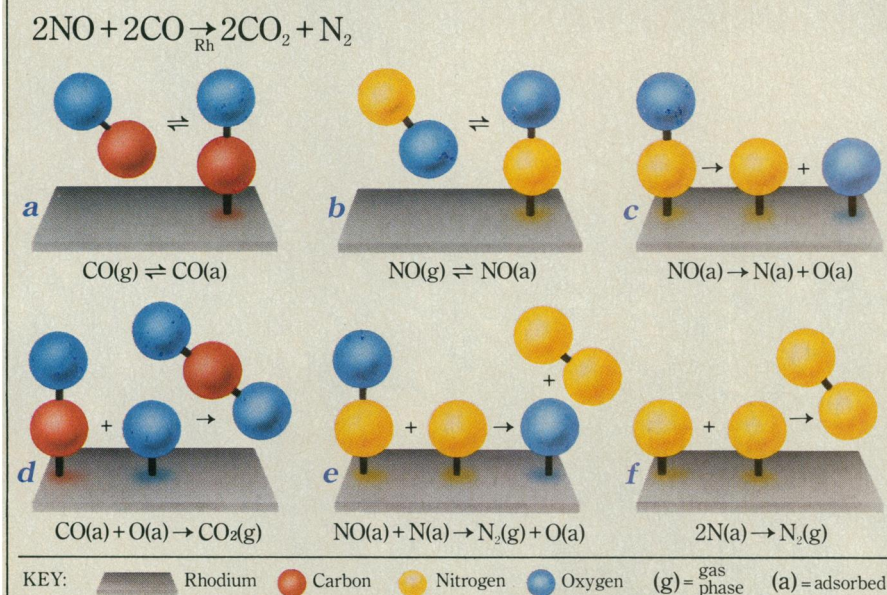
These researchers concen-

trated their studies on the many chemical reactions that occur in modern automotive catalytic converters. One such reaction is the reduction of nitric oxide (NO) by carbon monoxide (CO) over a rhodium (Rh) catalyst to yield carbon dioxide (CO_2) and nitrogen (N_2) (Figure 2).

Dr. Fisher used various surface science spectroscopies in ultrahigh vacuum to study all of the elementary reactions over a rhodium single crystal [Rh(111)] that might be involved in this specific reaction. Over several years he measured the rates and determined the activation energies of each of these reactions. For most of these reactions, this was the first time these parameters had been measured. Based upon these results, Dr. Fisher hypothesized that the elementary reactions shown in Figure 2(a-f) were the significant steps involved in the NO-CO reaction and that nitrogen recombination and desorption (Figure 2f) was the rate-controlling step on Rh(111).

Dr. Fisher and Dr. Oh also initiated kinetic studies of this reaction at realistic reactant partial pressures and temperatures using two different catalysts—one was a rhodium single crystal [Rh(111)], and the other consisted of rhodium particles supported on alumina [$\text{Rh}/\text{Al}_2\text{O}_3$]. The rhodium concentrations on the support were similar to those used in an automotive catalytic converter. The studies with the single crystal at realistic, high pressures were done in collaboration with Dr. D. Wayne Goodman of Sandia National Laboratories.

At the same time, Dr. Oh devised a mathematical model for this reaction. The model consists



of steady-state conservation equations for the surface species, based on the reaction mechanism and the rate expressions for the individual reaction steps determined in Dr. Fisher's UHV studies. Overall reaction rates could then be computed from the surface concentrations satisfying the conservation equations. The reaction rates predicted by this model, which depend only on reactant partial pressures, are shown in Figure 1 (dotted red line).

The kinetics of the NO-CO reaction measured over a rhodium single crystal using realistic reactant partial pressures are shown in Figure 1 (solid red line). The agreement with the model predictions indicates that Drs. Fisher and Oh had correctly identified all of the intermediate reaction steps and confirms that, in this case, nitrogen recombination and desorption (Figure 2f) is the rate-controlling step on Rh(111). The fact that the agreement is so good also indicates that the rates of the elementary reactions measured under UHV conditions are still valid at realistic reactant partial pressures—a pressure extrapolation of more than ten orders of magnitude.

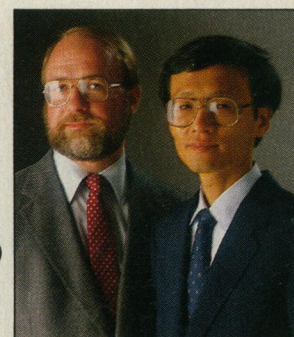
THE KINETICS of the NO-CO reaction measured over the supported rhodium catalyst (Figure 1, blue line), however, were much slower than predicted by the model. In addition, infrared studies have shown that NO is the predominant surface species on the catalyst, suggesting that in this case NO dissociation (Figure 2c) is the rate-controlling step. In fact, if the

rate constant for NO dissociation measured under UHV conditions and used in the model is reduced by a factor of 2000, the kinetics of the NO-CO reaction measured over the supported rhodium catalyst are correctly predicted.

The difference between the kinetics of the NO-CO reaction measured over a rhodium single crystal and the kinetics measured over supported rhodium shows that this reaction depends on the environment of the rhodium in the catalyst. The reaction model strongly suggests that the NO dissociation reaction is the reaction step most sensitive to the rhodium environment.

"While our reaction model cannot tell us why NO dissociation is slower on supported rhodium," observes Dr. Oh, "it can help identify the kinds of studies necessary to clarify the origins of such sensitivity." Comparative kinetic studies can also provide useful insights for developing improved NO reduction catalysts. "Our studies have already told us," adds Dr. Fisher, "that one possible path to improving automobile catalysts is to make modifications that increase the NO dissociation rate."

THE MEN BEHIND THE WORK



Dr. Galen B. Fisher (left) and Dr. Se H. Oh are both Group Leaders in the Physical Chemistry Department at the General Motors Research Laboratories.

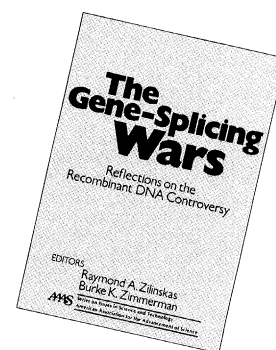
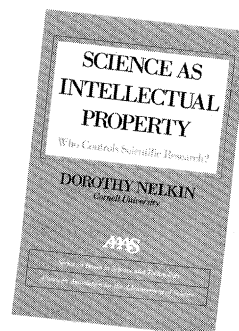
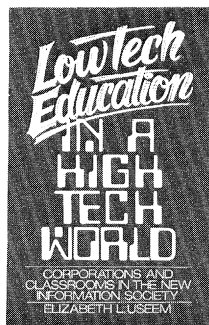
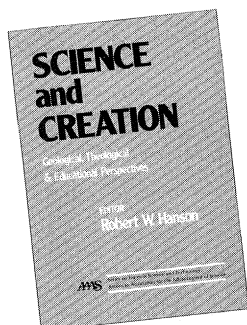
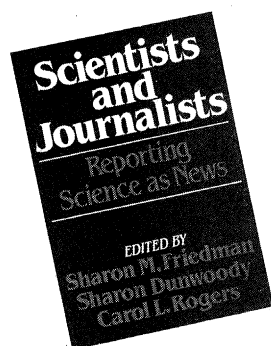
Dr. Fisher holds the title of Senior Staff Research Scientist, and heads the Surface Chemistry and Corrosion Science Group. He attended Pomona College as an undergraduate and received his graduate degrees from Stanford University in Applied Physics. Before coming to General Motors in 1978, he did post-doctoral studies at Brown University and worked at the National Bureau of Standards. Since then, his research has been involved with surface science studies of various catalytic reactions.

Dr. Oh is a Senior Staff Research Engineer, heading the Catalytic Kinetics Group. He received his undergraduate degree from Seoul National University and holds a doctorate in Chemical Engineering from the University of Illinois. Dr. Oh did post-doctoral work at the University of Toronto prior to joining GM in 1976. Since then, he has been involved in measuring and modeling the kinetics of catalytic reactions.

General Motors



New Titles Available from AAAS



Scientists and Journalists: Reporting Science as News

*Edited by Sharon M. Friedman,
Sharon Dunwoody, and Carol L. Rogers*

The public is interested in science and depends largely on the mass media for the latest information. But how well do scientists and journalists connect to communicate to the public? This book examines the human aspect of the links between scientists and journalists through the eyes of both.

1985, 352 pp., hardcover; \$24.95, AAAS members \$19.95

Science and Creation: Geological, Theological, and Educational Perspectives

Edited by Robert W. Hanson

The creation/evolution controversy is examined by scientists, theologians, educators, and historians. These authors view the controversy as a false dichotomy and as an attempt to force a choice between two ideas that are not mutually exclusive. Includes case studies from several states.

1986, 240 pp., hardcover; \$24.95, AAAS members \$19.95

Low Tech Education in a High Tech World: Corporations and Classrooms in the New Information Society

Elizabeth L. Useem

Are students in the U.S. developing the skills necessary for a high technology society, or will it be technological boom, educational gloom? Useem examines education in California's "Silicon Valley" and Boston's Route 128, two of the country's leading high tech centers, and suggests ways for education and industry to forge a stronger partnership for the future.

1985, 256 pp., hardcover; \$19.95, AAAS members \$15.95

Science as Intellectual Property: Who Controls Scientific Research?

Dorothy Nelkin

Who controls research? A growing number of legal and administrative disputes raise critical issues of professional sovereignty, scientific secrecy, and proprietary rights. Nelkin offers cases illustrating the dilemmas that arise as the interests of scientists, the rights of citizens, and the security needs of government and industry come into increasing conflict.

1984, 130 pp., softcover; \$10.00, AAAS members \$8.00

The Gene-Splicing Wars: Reflections on the Recombinant DNA Controversy

*Edited by Raymond A. Zilinskas and
Burke K. Zimmerman*

Questions of safety and ethics about recombinant DNA techniques continue to surface. This book takes a look at historical, political, industrial, scientific, and international aspects of these issues. The authors show how lessons learned from the experience can be used to cope with similar issues in the future.

1986, 256 pp., hardcover; \$24.95, AAAS members \$19.95



All orders must be prepaid. VISA, MasterCard, and Choice accepted; include account number, expiration date, and signature.

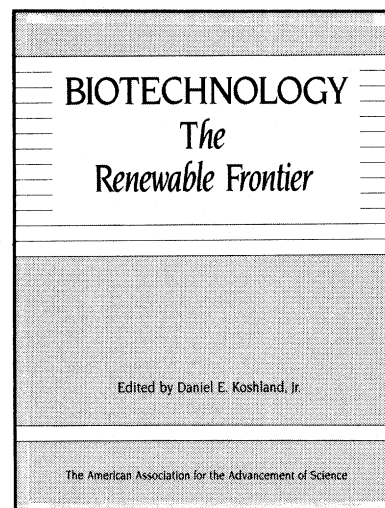
Send orders to: AAAS Marketing, 1333 H Street, NW, Dept. M, Washington, DC 20005. Please add \$1.50 postage and handling per order. Allow 4-6 weeks for delivery.

*Published by Macmillan, Inc., for the American
Association for the Advancement of Science*

The new frontiers in biology today are the frontiers of biotechnology tomorrow

BIOTECHNOLOGY: The Renewable Frontier

Edited by
Daniel E. Koshland, Jr.
Editor, *Science*



Discoveries in the modern biology laboratory are of great practical importance in industry today, as they have been in medicine for many years. This volume clearly illustrates the extraordinary cross-disciplinary aspects of modern biology and its tremendous impact on the future. Like its 1984 predecessor, this collection presents the latest and most important topics at the forefront of biological research. Compiled from papers in *Science*, 1985.

Contents

I. New Techniques

In Vitro Mutagenesis
Novel Genomes of Large DNA Viruses
Heterologous Protein Secretion from Yeast
Genetic Linkage Map of the Human X Chromosome
Protein Insertion into & Across Membranes

II. Immunology

Transfectomas to Novel Chimeric Antibodies
Histocompatibility Antigens on Murine Tumors
Factors in Protein Antigenic Structure

III. Developmental Biology and Cancer

Spatially Regulated Expression of Homeotic Genes
in *Drosophila*
Plasticity of the Differentiated State
Oncogenes in the Cytoplasm & Nucleus
Granulocyte-Macrophage Colony-Stimulating Factors
X-Ray Structure of Displatin with DNA
Immunoglobulin Heavy-Chain Enhancer:
Tissue-Specific Factors

IV. Hormones and Metabolism

Atrial Natriuretic Factor
The LDL Receptor Gene
Human von Willebrand Factor

V. Biotechnology

Biotechnology & Food
Drug Biotechnology: The Japanese Challenge

VI. Virology

Nucleotide Sequence of Yellow Fever Virus
Three-Dimensional Structure of Poliovirus

VII. Plant Sciences

Arabidopsis thaliana & Molecular Genetics
Safety & Genetic Engineering in Agriculture

VIII. Behavior and Sensory Phenomena

The Cellular Basis of Hearing
Insect Colony Sociogenesis
Neurotrophic Factors

1986; 400 pp., comprehensive index, 125 illustrations and tables

Hardcover \$29.95; AAAS members \$23.95 ISBN 0-87168-314-7

Softcover \$17.95; AAAS members \$14.35 ISBN 0-07168-283-4

VISA, MasterCard, and Choice accepted; include account number, expiration date, and signature. Order from American Association for the Advancement of Science, Marketing, Dept. F, 1333 H Street, NW, Washington, DC 20005. Please add \$1.50 postage and handling per order. Allow 4–6 weeks for delivery.

5-PARAMETER
ANALYSIS

PLUGS
RIGHT IN!

COMPACT
SIZE

AIR-COOLED
LASER

AUTOMATIC
SET UP

APPLICATIONS
SOFTWARE



INTRODUCING FACScan™

*The flow cytometer
that fits in every lab*

There's room in every laboratory for FACScan.

FACScan takes a minimum of bench space, yet it delivers the performance of larger, more expensive instruments.

Like larger flow cytometers, FACScan uses an argon-ion laser for 5-parameter analysis.

Unlike larger instruments, FACScan plugs right in. You don't need an external compressed air or water supply.

FACScan is also easy to use. You can readily perform a variety of clinical research applications, including lymphocyte phenotyping, immune monitoring, DNA analysis, reticulocyte counting, and platelet studies.

Set up and operation are automated with CONSORT™ 30 applications software. And you can even automate sample introduction with the FACS™ AutoMATE™.

Of course, FACScan is supported by Becton Dickinson's complete line of Leu monoclonal reagents, training and applications specialists, and expert field service.

FACScan. The flow cytometer that fits in every lab.

Contact your Becton Dickinson Immunocytometry Systems Representative for complete information. Or call the toll-free number below.

**BECTON
DICKINSON**

Superior Quality

Becton Dickinson Immunocytometry Systems
P.O. Box 7375
Mountain View, CA 94039
Toll Free (800) 223-8226
In CA, call (800) 821-9796

Denderstraat 24
B-9440 Erembodegem
Belgium
Tel 053/787830

For research use only. Not for use in diagnostic or therapeutic procedures. © 1986 Becton Dickinson

Circle No. 120 on Readers' Service Card

DNASTAR PULSE™ **Resolve Your Largest** **DNA Molecules**

Electrophoretic separations of DNA molecules up to a million base pairs can be achieved using the DNASTAR FIELD INVERSION GEL ELECTROPHORESIS CONTROLLER, DNASTAR PULSE™.

This technology also SIGNIFICANTLY IMPROVES separations of DNA molecules in the 15 to 75 Kb range.

- * Fully programmable--varies pulse ramps in forward and reverse directions.
- * Attaches to your present electrophoresis apparatus and power supply.
- * Runs up to 4 gels simultaneously.
- * Requires a minimum of lab space.
- * Includes DNASTAR PULSE™ Program, driver interface card, computer and up to four solid state switch modules.

As described by Carle, G.F., Frank, M., and Olson, M. Science 232:65.

AVAILABLE ONLY FROM DNASTAR
1801 University Ave. 8 Walpole Gardens
Madison WI 53705 USA London W4 4HG ENGLAND
(608) 233-5525 (UK) 1-994-0619

DNA*

Manufactured and distributed by DNASTAR, Inc.
in cooperation with Field Inversion Technologies
of St. Louis, Missouri.

Circle No. 179 on Readers' Service Card

HELLMA®

There are no better CELLS.

Ask for our literature on Cells, Filters, and Optics. Also UV and Laser Light Sources.

For over 20 years . . .

HELLMA
tomorrow's designs today.

Hellma Cells Inc.
Box 544, Borough Hall Station
Jamaica, New York 11424
Telephone (718) 544-9534



Circle No. 128 on Readers' Service Card

BURN YOUR REFERENCE CARDS!

REF-11™

Computerizes your REFERENCES
and prepares your BIBLIOGRAPHIES

- ☐ Maintains a data base of references
- ☐ Searches for any combination of authors, years of publication, reference title (or any words in the title), and topics covered by the reference
- ☐ Formats bibliographies exactly as you want them
- ☐ Alphabetizes references
- ☐ Menu driven dialogue
- ☐ Abbreviates journal titles
- ☐ Compact storage format
- ☐ Runs on any video terminal
- ☐ 20 lines of comments for each reference
- ☐ Runs on any video terminal and printer

IBM PC/XT/AT, MS-DOS, CP/M 80 . . . **\$195⁰⁰**

RT-11, TSX-Plus, RSX-11, P/OS . . . **\$250⁰⁰**

VAX/VMS (native mode) . . . **\$350⁰⁰**



ANY MANUAL **\$15⁰⁰**

ANY MANUAL & DEMO **\$20⁰⁰**

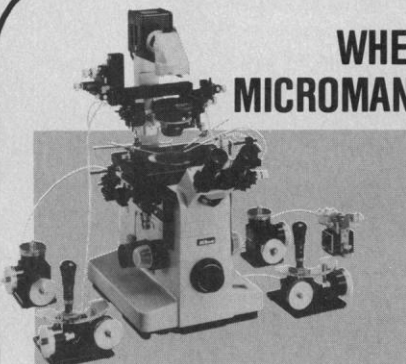
322 Prospect Ave., Hartford, CT 06106
(203) 247-8500

Connecticut residents add 7½% sales tax.

Circle No. 9 on Readers' Service Card

WHEN YOU THINK MICROMANIPULATION...

THINK MEDICAL SYSTEMS CORP.



Now you can mount manipulators onto your inverted microscope. Eliminate stage clutter while enhancing stability for micromanipulation.

Look to Medical Systems Corp. . . for all your micromanipulator needs.

For more information, call us or return the coupon.

Send more micromanipulation information to: 5-12-6

Name _____

Institution _____

Address _____

City _____ State _____ Zip _____

Phone () _____

Medical Systems Corp.

ONE PLAZA ROAD, GREENVALE, NEW YORK 11548 • 516-621-9190
TELEX: 645031 MEDSYSTEMS • OUTSIDE N.Y. STATE 800-654-5406

Circle No. 132 on Readers' Service Card

THE ESSENCE OF SPECIFICITY

BORN OF A PROUD TRADITION

FisherBiotech Immunological Reagents

The Fisher Biotechnology Group announces the introduction of a growing line of FisherBiotech immunological reagents, available January 1987. Produced for Fisher by Southern Biotechnology Associates Inc.

Polyclonal antibodies are affinity purified for superior activity, specificity and binding affinity. They're available unlabeled or conjugated with the fluorochrome labels fluorescein isothiocyanate, tetramethylrhodamine isothiocyanate, Texas Red™ and R-phycoerythrin. With the enzyme labels alkaline phosphatase, β -galactosidase and horseradish peroxidase. Or with biotin.

Monoclonal antibodies for both human and veterinary research come highly purified or in supernatant and ascites form. Three separate clonotyping systems allow the screening and characterization of murine hybridomas.

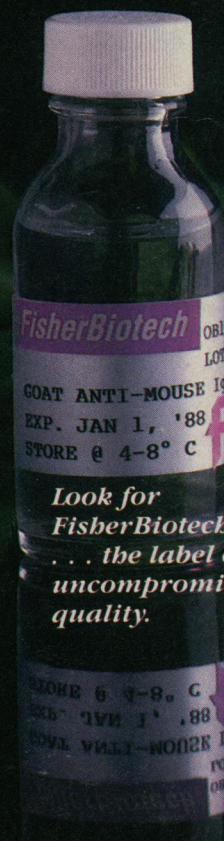
Of course, every reagent is backed by the Fisher tradition of quality and service, including applications support specialists and a dedicated technical hotline: 1-800-431-1861.

For literature on the new FisherBiotech immunological reagents as well as products for electrophoresis, molecular biology, cell biology and fermentation/bioprocessing, please use the reader reply card; write us at 711 Forbes Avenue, Pittsburgh, PA 15219; or call 412-562-8543.



**Fisher
Scientific**

Circle No. 180 on Readers' Service Card



Texas Red is the registered trademark of Molecular Probes, Inc.