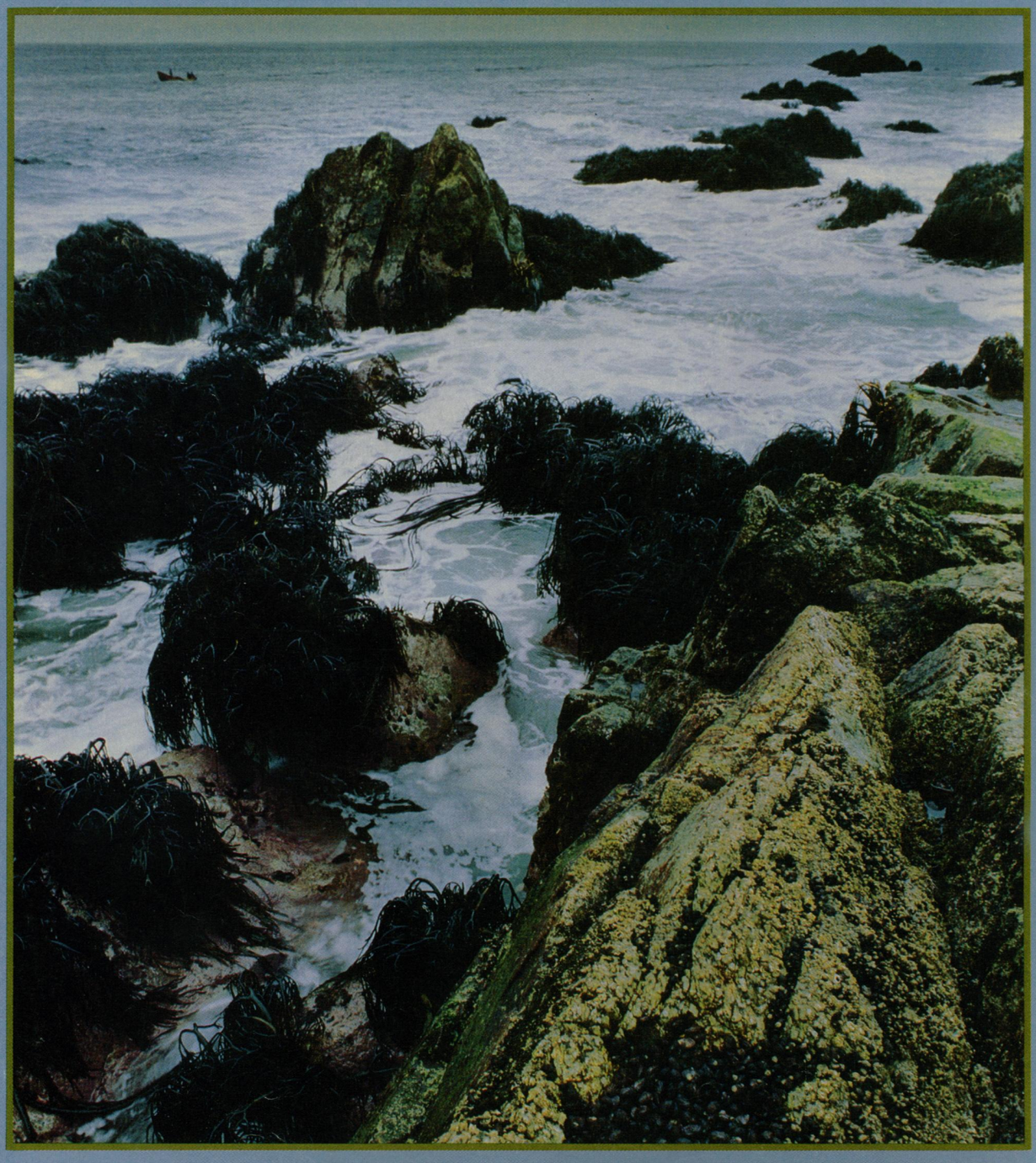
American Association for the Advancement of Science

SCIENCE

23 November 1990 $3.50
Vol. 250 ■ Pages 1061–1184



Preliminary Plasmid Screening With the J-System

DNA Mini Preps Fast and Easy

For quick, reliable preliminary screening of plasmid DNA, you can't beat the Beckman system: the **JA-18.1 rotor** in a **J2-21 series high-speed centrifuge.**

You'll appreciate the large capacity, high *g*-force, quiet operation and refrigerated microcentrifuge capability. And Beckman service and technical support set the standard for the industry.

The J-System. The systematic approach to screening plasmids. Quickly. Efficiently. Only from Beckman. Send for a plasmid DNA preparation protocol. Beckman Instruments, Inc., Spinco Division, 1050 Page Mill Road, Palo Alto, CA 94304. (800) 742-2345. Offices worldwide.

BECKMAN

Circle No. 108 on Readers' Service Card

Nobody has the Current Contents™ combination.

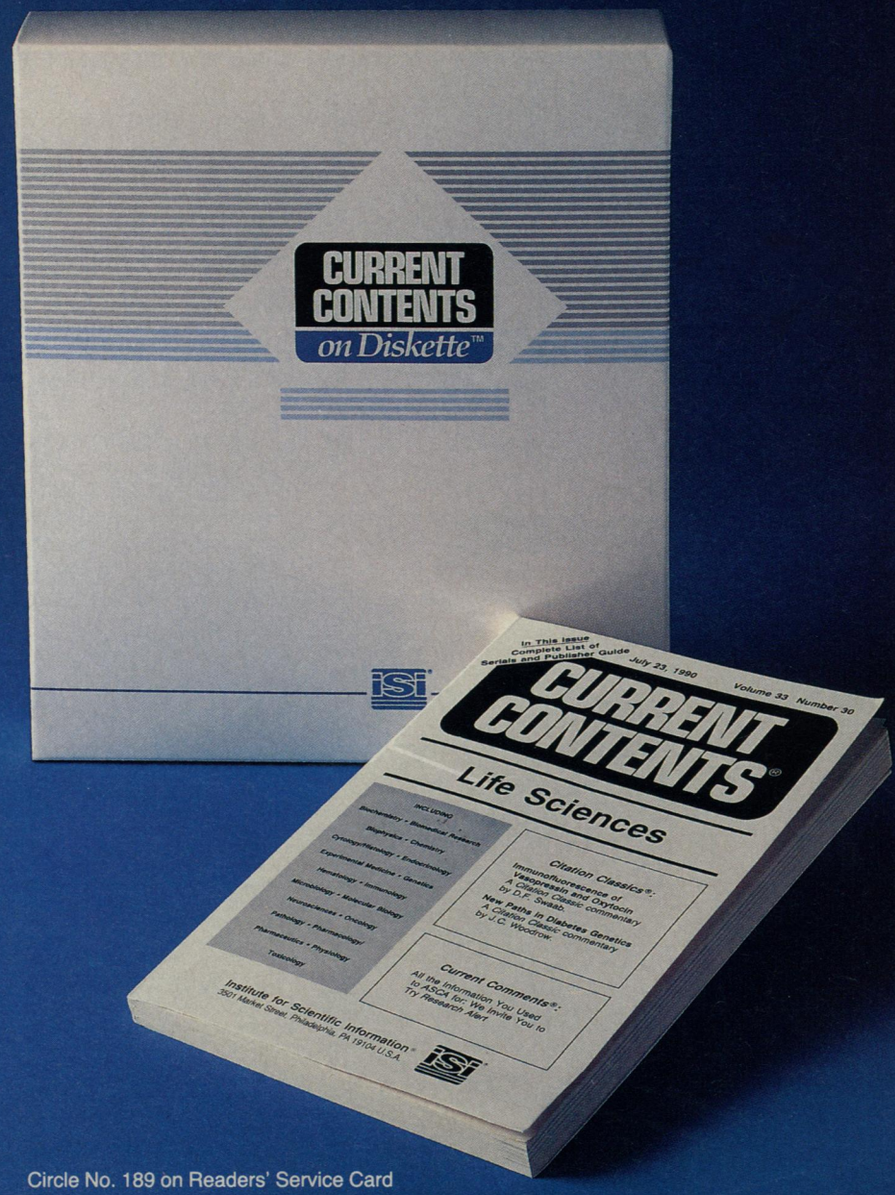
Whether you require the portability of a print edition or the *speed* of a computerized system, ISI has an article retrieval tool that will meet your specific needs.

Available in seven pocket-sized editions — including Life Sciences and Physical, Chemical and Earth Sciences — each weekly issue of ISI's *Current Contents* delivers contents pages from hundreds of the world's leading journals. Articles are indexed by title words, author *and* journal name to maximize search results and minimize search time.

If you need the added capabilities of a computerized system, *Current Contents on Diskette* covers thousands of journals, offers high-speed searching, and features *KeyWords Plus* — ISI's revolutionary retrieval technology. By going beyond author-supplied key words to use key words captured from bibliographies and cited literature, *KeyWords Plus* increases the number of relevant hits per search and ensures retrieval of virtually *every* critical article.

Current Contents and *Current Contents on Diskette with KeyWords Plus*. Two good reasons to join the 300,000 informed scientists that already rely on ISI.

For more details on ISI's *Current Contents* or *Current Contents on Diskette with KeyWords Plus*, call toll free 1-800-336-4474, operator 427.



ISI®

Institute for Scientific Information®
3501 Market Street, Philadelphia, PA 19104 USA
132 High Street, Uxbridge, Middlesex UB8 1DP UK

Circle No. 189 on Readers' Service Card

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE

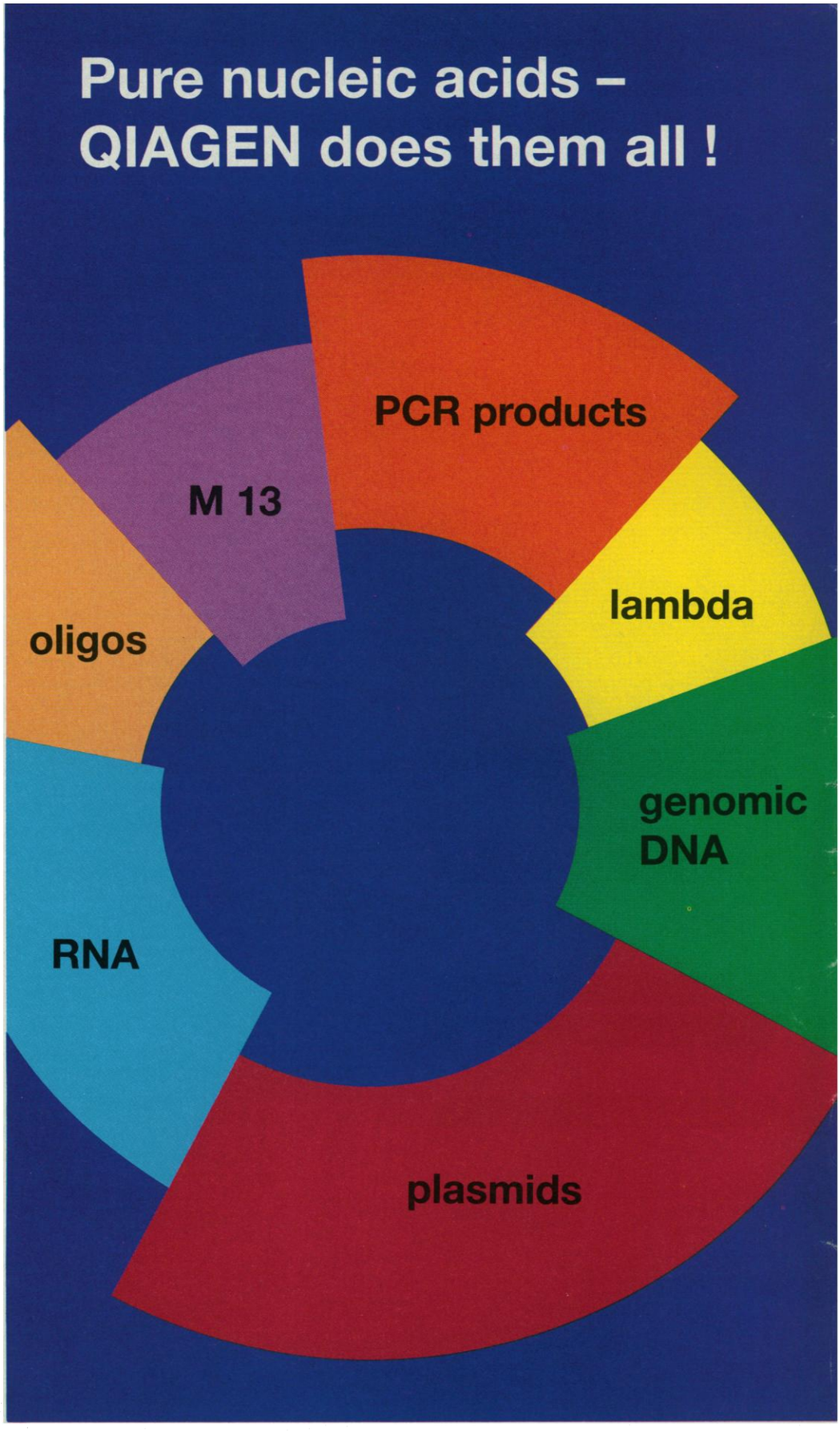
ISSN 0036-8075
23 NOVEMBER 1990
VOLUME 250
NUMBER 4984

■ **SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, 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 additional mailing offices. Domestic individual membership and subscription (51 issues): $80. Domestic institutional subscription (51 issues): $150. Foreign postage extra: Canada $46, other (surface mail) $46, air mail via Amsterdam $85. First class, airmail, school-year, and student rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and 11-digit account number. **Postmaster:** Send change of address to *Science*, P.O. Box 1723, Riverton, NJ 08077. **Single copy sales:** Current issue, $3.50; back issues, $5.00; Biotechnology issue, $6.00 (for postage and handling, add per copy $0.50 U.S., $1.00 all foreign); Guide to Biotechnology Products and Instruments, $20 (for postage and handling add per copy $1.00 U.S., $1.50 Canada, $2.00 other foreign). Bulk rates on request. **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, 27 Congress Street, Salem, Massachusetts 01970. The identification code for *Science* is 0036-8075/83 $1 + .10. *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 objectives 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, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

COVER The rocky intertidal zone of central Chile during a spring low tide showing zonation pattern and dominant sessile invertebrates (*Perumytilus purpuratus* and chthamaloid barnacles) and algae (*Lessonia nigrescens* and lithothamnioids). In this zone, communities of invertebrates are heavily modified by human predation on ecologically critical organisms, affecting dominance, population densities, and the network of species interactions. In spite of the dramatic changes produced by human intervention, the relation between body size of invertebrates and their population density remained unchanged. See page 1125. [Photograph by A. Larrea, Santiago, Chile]

Pure nucleic acids – QIAGEN does them all !



QIAGEN is all you need

No matter what type of nucleic acid you want to isolate – QIAGEN columns are all you need.

It´s this fast

1. **Adsorb** a cell lysate
2. **Wash** away contaminants
3. **Elute** pure nucleic acid

It´s this convenient

Ready-to-use kits for all types of nucleic acids – **4 Column sizes** for any size prep – **Gravity flow alone** results in optimal separations – **Numerous lab-tested protocols** are included in our booklet THE QIAGENOLOGIST.

It´s this pure

QIAGEN-purified nucleic acids are equal in purity to those isolated on CsCl gradients.
Subsequent applications such as transfections, clonings, sequencing, transcription and translation reactions proceed with optimal efficiency.

It´s this versatile

At the heart of the system is a unique anion exchange resin with the broadest possible separation range – QIAGEN.
It enables the selective isolation of the various classes of nucleic acids, including dsDNA, ssDNA and RNA.

For more information

call or write to QIAGEN Inc., DIAGEN GmbH or your nearest distributor.

USA/CANADA: QIAGEN Inc., Chatsworth, CA 91311, Phone (800) 426-8157, (818) 718-9870, Fax (818) 718-2056
GERMANY: DIAGEN GmbH, Niederheider Str. 3, D-4000 Düsseldorf 13, Phone (0211) 79 30 37, Fax (0211) 79 04 44
DISTRIBUTORS: AUSTRALIA: Phoenix Stansens Scient.Div. (3) 544 8022 **AUSTRIA:** Bio-Trade (222) 828 46 94
BENELUX: Westburg B.V. (NL-33) 95 00 94 **FRANCE:** Coger (1) 45 33 67 17 **ISRAEL:** Bio-Lab Laboratories Ltd. (2) 52 44 47 **ITALY:** Genenco (M-Medical) (55) 67 64 41 **JAPAN:** Funakoshi Co., Ltd. (3) 5684 1622
KOREA: LRS 924-8697 **PORTUGAL:** Izasa Portugal, S.A. 758 07 40 **SCANDINAVIA:** Kebo Lab: Denmark: (44) 68 18 00, Finland: (90) 437 56 40, Norway: (02) 30 11 20, Sweden: (08) 621 34 00 **SPAIN:** Izasa S.A. (3) 401 01 01
SWITZERLAND: Kontron Instruments AG (1) 733 5 733 **TAIWAN:** Formo (2) 736 7125 **UK:** Hybaid Ltd. (81) 977 3266

QIAGEN

Circle No. 1 on Readers' Service Card

Hybrid devices

THE field of solid-state electronics has burgeoned since the 1960s but the use of magnetic materials in devices has not kept pace. When magnetism is coupled with electronic and photonic circuitry unique electronic and optical properties can result. The hybridization of semiconductor systems with ferromagnetic metals is the topic of Prinz's review (page 1092); these systems (the best studied is the gallium arsenide semiconductor supplemented with ferromagnetic iron) are being prepared with state-of-the-art thin-film layering techniques, and there is increasing understanding of the structural complexity of the interface of metal and semiconductor and of how structure determines properties. The range of applications of these hybrids is likely to be enormous because magnetic materials have unique properties; one example would be the coupling of radiation fields to the hybrid devices such that microwave signals could be carried through planar circuits.

Bacterial signal recognition particle

SIGNAL recognition particles (SRPs) of mammals, complexes of protein and RNA, target newly synthesized protein molecules to the export pathway of the cell. Bacteria were thought to use protein-export mechanisms that were distinct from and did not involve SRPs, but now bacterial counterparts of the mammalian SRP have been identified (page 1111). The bacterial complexes include the protein Ffh and 4.5*S* RNA molecules (which previously were thought to be involved only in protein synthesis); portions of the protein and the RNA are homologous to portions of protein and RNA components of mammalian SRPs. Poritz *et al*. present proposals to explain how the SRP system and the more commonly observed "translocation" system may complement each other and cooperate inside bacterial cells to move proteins around.

Nanodes

THE performance of an electrode improves inversely with the electrode's electrochemical radius. Thus, the smaller the better. Tiny electrodes with electrochemical radii as narrow as 10 Å have now been made (page 1118); these "nanodes" are capable of recording kinetic rate constants that are two orders of magnitude faster than those that previously could be measured. Penner *et al*. describe the fabrication of the miniature electrodes, beginning with a platinum or platinum-iridium wire that is etched and then coated with glass. Physical features of the nanodes were studied with the scanning electron microscope and their performance and reproducibility tested. The precision of the nanodes was then demonstrated for measurements of the transfer of electrons between redox couples. The clocking of ultrafast electrochemical reactions is but one of the applications of this nanotechnology. The small size of the nanode also provides spatial advantages that make possible measurements of conductivity changes in ion channels and voltages inside tissues and single cells. The tiny monitors will also be of value for scanning tunneling microscopy and nanoscale etching and lithography.

Retrovirus in autoimmune disease?

THE production of tears and saliva is turned off in Sjögren's syndrome, and the glands that normally produce these excretions become infiltrated with lymphoid cells. These same symptoms and signs are sometimes seen in patients who are infected with human immunodeficiency virus (HIV). Therefore, the question arose whether HIV or a related virus might be associated with Sjögren's syndrome. Lymphoblastoid cells were exposed to extracts of salivary gland tissue from patients with Sjögren's syndrome; subsequently retroviral particles antigenically related to but distinct in other ways from HIV were detected inside vacuoles in the cells (page 1127). The cells did not actively produce viruses. The particles were doughnut-shaped and looked like A-type retroviral particles found in cells of various other species. Some patients with Sjögren's syndrome have antibodies that cross-react with various HIV proteins, and it may be these particles that stimulate antibody production. Garry *et al*. caution that it is unclear how closely these retroviruses are tied to the development of Sjögren's syndrome—etiologic agents or just opportunistic organisms—but note that other studies have suggested associations of retroviruses with various autoimmune diseases, including multiple sclerosis, Graves' disease, and lupus.

Scientific truths and consequences

HOW significant are the roles of personalities and the climate of the times in the acceptance of scientific truths, frauds, and even errors? Three books that are reviewed this week suggest that subjective variables such as these can have a powerful effect on whether objective scientific data will pass muster (page 1162). One book is about the geneticist Franz Moewus, whose prominence and later fall from grace may have been closely tied to the amount of attention—at times too much, at times too little—paid him by others in his field. The other books are about Piltdown man, anthropology's most celebrated and embarrassing forgery. Skull and jaw fragments from a putative ape-human transitional individual were "discovered" in 1912 and fit nicely with prevailing theories about human evolution; not until 1950 was the "discovery," an outright fake, discredited. The trail to the perpetrator of Piltdown man is growing old and cold, but the case still intrigues from several perspectives, not the least of which is what motivated the forger. Both the Moewus and the Piltdown cases are instructional for the light they shed on the nature of the scientific endeavor.

■ RUTH LEVY GUYER

New from SORVALL®: The fastest little ultra available

Sized down in everything but capability

Ultra fast
At 120,000 rpm, the new RC-M120 significantly speeds up separation time. For some protocols, up to 80% reductions in run time can be achieved. For example, lipoproteins can be separated in 2-3 hours.

Ultra small
One-fourth the size of standard floor models, the new SORVALL micro-ultras fit into tight spaces in your lab. That gives you ready access to an ultracentrifuge...anytime.

Ultra dependable
Drive maintenance is eliminated. We guarantee the drive system for 20 billion revolutions or 3 years and the rotors for 5 years with no derating or logging.

Ultra flexible
Spins up to twenty 0.2 mL tubes or up to eight 5.0 mL tubes with many sizes in between. SORVALL also offers the ultimate in programmability.

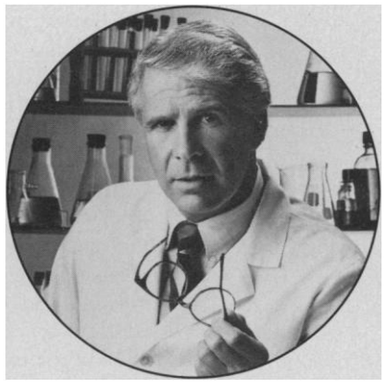
Ultra cost effective
Costs 1/3 less than conventional floor models. Fast run times reduce operating costs and the high-efficiency drive system eliminates the need for external cooling.

And there's more...
Call us today at 1-800-551-2121 for more information about what the RC-M120 or RC-M100 can do for you.

Better things for better living

DUPONT

Circle No. 70 on Readers' Service Card



So Molecular Dynamics bought Sarastro. What's in it for me?

Molecular Dynamics, the fastest growing spatial imaging company in the field of biotechnology instrumentation, has acquired Sarastro, manufacturer of the world's finest confocal laser scanning microscope.

Now, the depth of our engineering and manufacturing expertise will assure the continued high quality and advanced performance you have come to expect from Sarastro. And our worldwide sales, service and support system—as well as our acknowledged expertise in laser scanning instrumentation and spatial imaging software—will stand behind every Sarastro instrument we deliver.

That's what's in it for you.

Molecular Dynamics

Innovative Optical Systems for Molecular Biology.

Molecular Dynamics 880 East Arques Ave. Sunnyvale, CA 94086 800.333.5703 408.773.1222
Molecular Dynamics, Ltd. 0732.62565 Molecular Dynamics, GmbH 2151.801510 Molecular Dynamics, S.A. 1.48441797

Circle No. 178 on Readers' Service Card

The Most Sophisticated System for Maximum Protein Expression...

Is Also the Simplest!

The MaxBac™ baculovirus expression kit is the most efficient means for generating large amounts of recombinant proteins (up to 500mg/L) from cloned genes. The recombinant proteins produced are antigenically and functionally similar to their natural counterparts.

The MaxBac™ expression system offers:

- High level recombinant protein expression.
- Simple visual or immunological identification of recombinants.
- Production of functionally active proteins from cloned genes.
- Unique glycosylation for comparison of proteins from other eukaryotic systems.
- Production of proteins which are better suited to crystallography studies.
- Proper transport and modification of recombinant proteins.
- A sophisticated alternative to prokaryotic and mammalian expression systems.

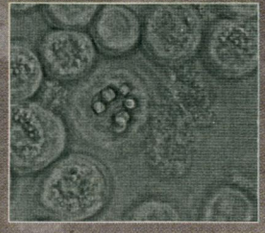


Figure 1. Infected Sf9 insect cells showing viral occlusions.

The MaxBac kit contains all of the materials needed to reliably generate recombinant proteins, including the recently developed BlueBac transfer vector. The BlueBac vector imparts a blue color to recombinants grown on indicator media, allowing fast, accurate differentiation and plaque purification. Find out why MaxBac, the most sophisticated system for protein expression, is also the simplest. To get more information on the MaxBac kit, custom baculovirus expression or individual MaxBac components call toll free:

1-800-544-4684

Invitrogen CORPORATION

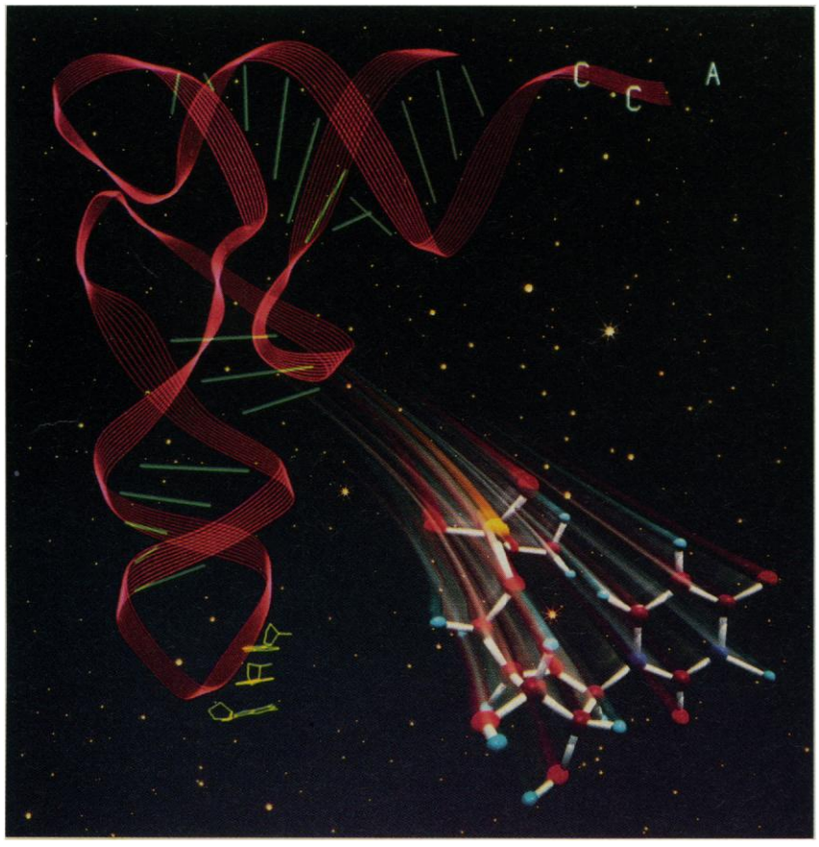
11588 Sorrento Valley Road, #20,
San Diego, CA 92121

(619) 259-4868 FAX: (619) 259-8683

BRITISH BIO-TECHNOLOGY LIMITED, UK, TEL: 44-865748747 • AMS BIOTECHNOLOGY, UK, TEL: 44-993822786 • BIO-TRADE, Austria, TEL: 43-2228284694 • FUNAKOSHI PHARMACEUTICALS, Japan, TEL: 81-32932352 • FINNZYMES OY, Finland, TEL: 358-154375312 • CELBIO, Italy, TEL: 39-24048646 • KEBO LAB AB, Sweden, TEL: 46-86213400 • GENOFIT GmbH, FRG, TEL: 49-6221303923 • GENOFIT-SA, Switzerland, TEL: 41-227948400 • BDH INC., Canada, TEL: 800-268-2129 • SANBIO by, Nederland, TEL: 31-413251115 • TDI, Madrid, TEL: 34-14091251 • MEDOS COMPANY PTY LTD, Australia, TEL: 61-38089077

Luckow, V. and Summers, M. (1988) Biotechnology 6, 47-55

Circle No. 114 on Readers' Service Card



MilliGen/Biosearch gives RNA synthesis a quantum push forward.

MilliGen/Biosearch, in collaboration with the industry's key investigators, pioneered the research and development of RNA synthesis. Our complete RNA Synthesis Package is the only one available today.

We've dramatically improved the quality of automated RNA synthesis by producing the industry's purest monomers and reagents. (High resolution mass spectroscopy and elemental analysis attest to the purity of our monomers, while the isomeric purity of every batch of RNA amidites is proven by NMR.) Only chemistry of this quality – proven by T_2RNAse digest and NMR – can assure biologically active RNA.

Give your RNA work a quantum push forward in such areas as antisense and ribozyme research, tRNA structure and function studies, direct expression studies, as well as improved hybridization assays.

Free tRNA-shirt or RNA synthesis cartridge. Mention this ad with your order for an RNA amidite kit and receive a tRNA-Shirt (s,m,l,xl). Orders of $2000 also receive a cartridge pre-programmed with the RNA synthesis protocol for the MilliGen/Biosearch Cyclone™ Nucleic Acid Synthesizer. Contact us today: call **1-800-872-0071**, or write to MilliGen/Biosearch, 186 Middlesex Turnpike, Burlington, MA, U.S.A. 01803.

MilliGen/Biosearch
Division of MILLIPORE

PHOTO LARRY KEENAN, WALDO BASCOM ©1990 tRNA ILLUSTRATION JANE RICHARDSON ©1990

Circle No. 147 on Readers' Service Card

AAAS *Travels*

Exclusively for members and friends of AAAS by BETCHART

COSTA RICA

Wildlife & Ecology Expedition
April 6–17, 1991

For 12 days, led by excellent naturalists. Explore **rainforest parks** from the Pacific to the Caribbean, volcanic peaks, **Monteverde Cloudforest**, and **La Selva Tropical Research Station**. $1,990 (plus air fare).

Also in 1991...

• **Galapagos Islands & Ecuador**, July 9–20. Eight days aboard *M/V Santa Cruz* exploring the Galapagos, including Charles Darwin Research Station, Quito and highland Ecuador. See Lima, Cuzco, and Machu Picchu on **Peru Extension** to July 25.

• **Alaska**, June 27–July 9. See Glacier Bay, Nome & Bering Land Bridge, Fairbanks, and Denali (Mt. McKinley) National Park. Eagles, grizzlies, and more!

BETCHART EXPEDITIONS INC.

A leading operator of travel for non-profits since 1981

(800) 252-4910

21601 Stevens Creek Blvd., Cupertino, CA 95014

Hard Copy your PCR products with one-step TA Cloning™...

A Universal System for Cloning PCR Products

Direct hard copy cloning of PCR* products into the multifunctional pCR2000™ vector is now possible with the new TA Cloning kit from Invitrogen. This system eliminates inefficient, time consuming reactions normally involved in cloning PCR products and allows direct cloning of amplified nucleic acids from genomic DNA, cDNA or recombinant lambda, cosmids and YACs.

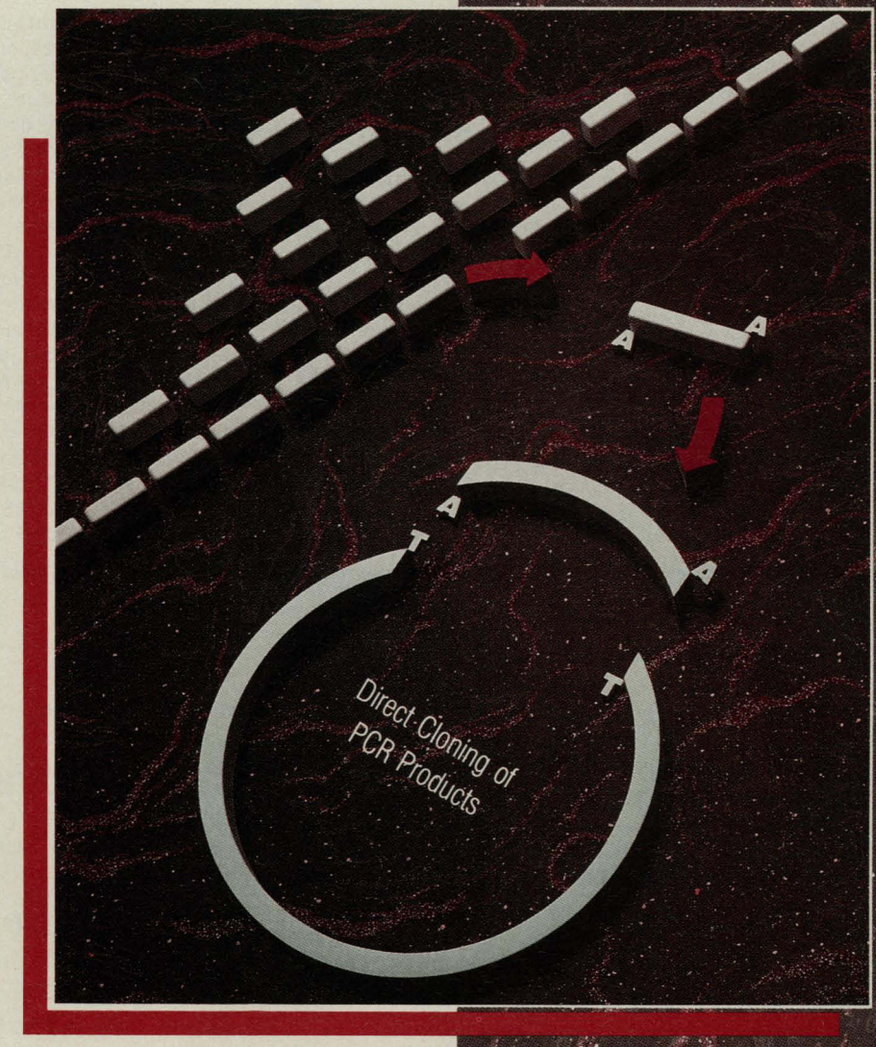
TA Cloning requires:

- NO purification of PCR products
- NO modification of primers to incorporate restriction sites
- NO restriction enzyme digestion
- NO modifying enzymes
- NO sequence information

The TA Cloning system from Invitrogen allows blue/white color selection of recombinants from the pCR2000 vector and is useful for most PCR reactions including:

• Symmetric PCR • Inverse PCR • Alu PCR • Sequence independent PCR • mRNA PCR • Sequence Tagged Site PCR • Anchored PCR

TA Cloning is an ideal system for direct sequencing and expression of PCR products and provides a means of safeguarding precious samples for future analysis, probe generation or other manipulations. The prepared pCR2000 vector is designed to take advantage of the universal ragged ends generated by the terminal transferase activity inherent in thermophilic polymerases. Each kit contains prepared pCR2000 vector, ligation reagents and competent *E. coli* for 20 reactions. For more information on these and other PCR products call;



Toll Free **1-800-544-4684**
11588 Sorrento Valley Road • #20
San Diego, CA 92121

Invitrogen CORPORATION

BRITISH BIOTECHNOLOGY LIMITED, UK, TEL: 44-865748747 • AMS BIOTECHNOLOGY, UK, TEL: 44-993822786 • BIO-TRADE, Austria, TEL: 43-2228284694 • FUNAKOSHI PHARMACEUTICALS, Japan, TEL: 81-32932352 • CELBIO, Italy, TEL: 39-24048646 • KEBO LAB AB, • Sweden, TEL: 46-86213400 • GENOFIT GmbH, FRG, TEL: 49-6221303923 • GENOFIT-SA, Switzerland, TEL: 41-227948400 • BDH INC., Canada, TEL: 800-268-2129 • MEDOS COMPANY PTY LTD, Australia, TEL: 61-38089077

*PCR is covered by U.S. Pat. #'s 4,683,202 and 4,683,195 issued to Cetus Corporation.

Circle No. 115 on Readers' Service Card

AAAS Minority Scholars Workshop on Values and Ethical Issues in Science and Technology

The American Association for the Advancement of Science (AAAS) invites minority scholars in academic or other institutions to apply for participation in a workshop of intensive study on the values and ethical issues associated with science and technology. The workshop will be held from July 28 to August 4, 1991 near Washington, D.C.

Workshop participants will explore in depth various minority perspectives on science and technology, how they compare to prevailing perspectives, and the different influence that these perspectives can have on scholarship, individual practices, and policy decisions regarding science and technology. The workshop will also review important theoretical work and research methodologies in ethics and values research, as well as publishing outlets and resources that can help support scholarship in this field.

While persons of any minority group may apply, preference will be given to applicants from the following groups: Asian/Pacific Islander, Black/African-American, Hispanic/Chicano/Latino, or Native American/American Indian. Persons holding an advanced degree in any field of science, engineering, or the humanities may apply. Participants will receive expenses for travel to and from the workshop, and for accommodations and meals.

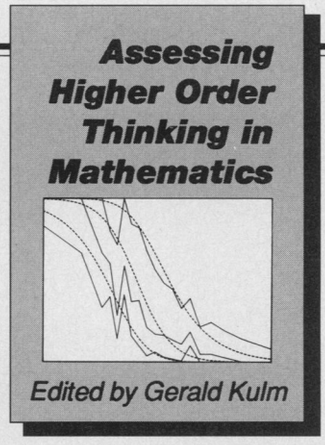
For further information or to request an application form, contact A. Crumpton, Directorate for Science and Policy Programs, AAAS, 1333 H Street, N.W., Washington, D.C. 20005; (202) 326-6798.

Deadline for receipt of applications is February 8, 1991.

New education books from AAAS

Assessing Higher Order Thinking in Mathematics

Edited by Gerald Kulm



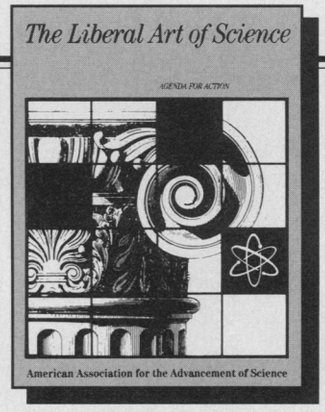
Teaching higher order thinking is essential in today's world. And what is taught must be tested. Unfortunately, most mathematics tests focus primarily on rote computational skills and memorized facts rather than on higher order thinking. This book addresses such concerns. The authors explore new approaches to mathematics assessment, provide directions for reforming mathematics testing, and give examples of innovative test items. It is especially valuable for teachers, test publishers, researchers, and federal and state educational policy makers.

Topics include: A new world view of assessment in mathematics; power items and the alignment of curriculum and assessment; assessing student growth in mathematical problem-solving; computer-based mathematics assessment; calculators and mathematics assessment; students' theories about mathematics and their mathematical knowledge; assessing schema knowledge for arithmetic story problems; critical evaluation of quantitative arguments; investigation of structured problem-solving items; and new directions for mathematics assessment.

1990; 216 pp.; indexed
***#89-27S** - softcover; $24.95*
(AAAS members $19.95)

The Liberal Art of Science

Agenda for Action



This report presents the conclusions and recommendations of the AAAS Project on Liberal Education and the Sciences. It discusses the level of scientific understanding necessary for optimal participation in 21st century life and the type of undergraduate science education required to achieve such a level of understanding. In addition, this volume supports the idea that science is a liberal art and should be taught as such. It recommends goals for liberal education in the sciences, outlining the multidisciplinary curriculum and teaching strategies necessary to achieve them.

An appendix includes descriptions of existing courses and programs, offered at institutions nationwide, that are consistent with the project's recommendations. This report is of particular interest to undergraduate science educators as well as to all people committed to quality science education.

Topics include: Agenda for action; faculty responsibility; resource commitment; teaching materials and technologies; assessment instruments; the nature of scientific explanation; historical context; pedagogical techniques; integrating multidisciplinary content; programmatic approaches to liberal education in science; and liberal education for special groups such as future science teachers, the underrepresented in science, people with disabilities, and science and engineering majors.

1990; ca. 130 pp.
***#90-13S** - softcover; $12.95*
(AAAS members $10.30)

Order from: AAAS Books, Dept. A4, P.O. Box 753, Waldorf, MD 20604 (FAX: 301-843-0159). To order by phone (VISA/MasterCard only), call 301-645-5643 (9am-4pm ET) and ask for AAAS. Individuals must prepay or use VISA/MC. For institutional purchase orders, add $3.50 postage/ handling. Please specify item #, and allow 2-3 weeks for delivery. For shipments to CA, add applicable sales tax.

American Association for the Advancement of Science

Gordon Research Conferences — *"Frontiers of Science"*

	Colby-Sawyer College (N) New London, NH	Colby-Sawyer College (S) New London, NH	New Hampton School New Hampton, NH	Kimball Union Academy Meriden, NH	Tilton School Tilton, NH
June 10-14	Genetic Toxicology R. Albertini	Mammary Gland Biology D. Medina	Nucleic Acids L. Schulman C. Pabo	Second Messengers & Protein Phosphorylation R. Reed J. Rose	Animal Cells & Viruses M. Martin
June 17-21	Catalysis G. Lester	Proteins J. King/A. Kossiakoff	Atmosphere Chemistry M. Molina	Atherosclerosis P. Davis/G. Getz	Molecular Pharmacology E. Ross
June 24-28	Nuclear Chemistry J. Garrett	Structural Macromolecules: Collagen K. Kuehn/F. Ramirez	Analytical Pyrolysis K. Voorhees Estuarine Processes R. Biggs	Lipid Metabolism C. Kent	Carbohydrates C.P.J. Glaudemans
July 1-5	Fiber Science A.S. Abhiraman	Immunochemistry & Immunobiology J. Allison	Three Dimensional Electron Microscopy of Macromolecules J. Frank	Enzymes, Coenzymes & Metabolic Pathways F. Raushel/R. Armstrong	Polymer Colloids M. El-Aasser
July 8-12	Elastomers G. Holden	Origins of Solar Systems A.G.W. Cameron	Heterocyclic Compounds D. Hart	Bones & Teeth R. Baron	Muscle: Excitatiion & Contraction Coupling E. Stafani G. Meissner
July 15-19	Corrosion: Dry N. Birks	Chemotherapy of Experimental & Clinical Cancer M. Colvin	Organic Reactions & Processes T.V. RajanBabu	Molecular & Genetic Basis for Cell Proliferation C.D. Stiles	Hydrogen - Metal Systems R. Cotts R. Kirchheim
July 22-26	Free Radical Reactions D. Tanner	Applied & Environmental Microbiology D. Eveleigh	Natural Products R.P. Volante	Mechanisms of Toxicity W. Berndt	Nuclear Physics J. Vary
July 29- August 2	Coatings & Films G. Pilcher	Hormonal Carcinogenesis G. Stancel	Statistics in Chemistry & Chemical Engineering W. Meeker	Elastin F. Keeley	Epithelial Differentiation & Keratinization B. Dale
August 5-9	Medicinal Chemistry P. Anderson	Parasitism, Molecular & Biochemical Aspects of D. Despommier	Analytical Chemistry J.L. Glajch	Hormone Action J. Rosen/S. McKnight	Molten Salts & Liquid Metals F. Hensel
August 12-16	X-Ray Physics B.W. Batterman	Ion Containing Polymers R.D. Lundberg	Adhesion, Science of S. Senturia	Chemical Oceanography C. Lee	Quantitative Structure Activity Relationships J. M. Blaney
August 19-23					

Tentative 1992 Winter Schedule — California

	Doubletree Hotel	**Casa Sirena Resort**
Jan. 6-10	Polymers	Fundamentals of Diamond & Cubic Boron Nitride Film Formation
Jan. 13-17	Composites	Sensory Transduction in Microorganisms
Jan. 20-24	Electrochemistry	Nondestructive Evaluation
Jan. 27-31	Metals in Biology	Plant Herbivore Interaction
Feb. 3-7	Oxygen Radicals in Biology	Prolactin
Feb. 10-14	Peptides, Chemistry & Physics of	Macromolecular & Polyelectrolyte Solutions
Feb. 17-21	Marine Natural Products	Angiotensin
Feb. 24-28	Organic Thin Films	Polymers for Biosystems
March 2-6	Superconductivity	Electronic Materials
March 9-13	Magnesium in Biochemical Processes Isotopes in the Physical & Life Sciences	Chemotheray of AIDS
March 16-20	Not Available	Neuroendocrinimmunology
March 23-27	Thrombolysis	Particle Physics in the 90's

The 1992 Winter Gordon Research Conferences, as shown above, will be held January 6 - March 27, 1992 in California. Fixed Conference fees and host sites have not been established at this time.

The chair of each conference is requested to have the detailed program in the Director's office September 1, 1991 and the detailed Winter program will be published in the October 4, 1991 issue of *Science*.

GENERAL INFORMATION

The Summer Gordon Research Conferences will be held June 10-August 16, 1991 in New Hampshire and June 17-August 23, 1991 in Rhode Island. GORDON RESEARCH CONFERENCES ADMITS SCIENTIFICALLY QUALIFIED CONFEREES OF ANY SEX, RACE, AGE, COLOR AND NATIONAL ORIGIN.

The chair of each conference is requested to have the detailed program in our office January 1, 1991, and the entire Summer program with application will be published in the March 1, 1991 issue of *Science*.

Requests for applications to the Summer Conferences, or for additional information should be addressed to: Dr. Alexander M. Cruickshank, Director, Gordon Research Conferences, Gordon Research Center, University of Rhode Island, Kingston, RI 02881-0801. Tel.(401)783-4011 or (401) 783-3372. FAX No.: (401) 783-7644.

1991 Schedule — New Hampshire & Rhode Island

Proctor Academy Andover, NH	Holderness School Plymouth, NH	Brewster Academy Wolfeboro,NH	Plymouth State College (N) Plymouth, NH	Plymouth State College (S) Plymouth, NH	Salve Regina College Newport, RI
Hemostasis J. Suttie	Physical Organic Chemistry S. Staley	Condensed Matter Physics G. Thomas	Plant Cell & Tissue Culture M. Crouch	Calcium Oxalates L. Smith	Not Available
Plant Molecular Biology C. Lamb	Biological Regulatory Mechanisms L Rothman-Denes P. Nurse	Liquid Crystals N. Clark	Gravitational Effects in Materials & Separation Processes F. Rosenberger	Holography & Optical Information Processing J. Walkup	Polyamines C. Porter/N. Seiler
Developmental Biology H. Weintraub T. Schupbach	Phagocytes J. Gallin	Polymers H.J. Harwood	Mycotoxins & Phycotoxins W. Carmichael	Periodontal Diseases R. Ranney	Molecular Mechanisms Microbial Adhesion P. Kolenbrander C. Svanborg-Eden
Cell Contact & Adhesion C. Buck	Hydrological/Geochemical Biological Processes in Forested Catchments M.R. Church	Atomic Physics W. E. Cook	Thermosetting High Performance Materials J. McGrath	Extrachromosomal Elements D. Bastia J. Broach	Oscillations & Dynamic Instability in Chemical Systems K. Showalter
Molecular Membrane Biology P. Walter	Bioenergetics R. Cross	Neural Plasticity R. Zigmond	Matrix Isolated Species, Physics & Chemistry of V. Bondybey	Inorganic Thin Films M. Olmstead	Purines, Pyrimidines & Related Substances M. Robins
Organic Photochemistry D. Eaton	Drug Metabolism G. Miwa	Magnetic Resonance R. Griffin	Laser Diagnostics in Combustion L. Rahn	Crystal Growth M. DiGiuseppe	Organometallic Chemistry A. Sattelberger
Plant & Fungal Cyctoskeleton, Cellular & Molecular Biology of C. Silflow	Biocompatibility & Biomaterials D. Williams	Nonlinear Optics & Lasers H. Haus	Population Biology & Evolution of Microorganisms A. Campbell	Biological Structure & Gene Expression G. Stein	Bioanalytical Sensors J. I. Peterson
Photosyntheses, Physico-Chemical Aspects of R. Blankenship	Solid State Studies in Ceramics M. Harmer	Inorganic Chemistry R. Adams	Reverse Osmosis, Ultrafiltration & Gas Separation L. Errede	Physical Metallurgy W. Boettinger J. Perepezko	Molecular Genetics: Human F. Collins
Dynamics of Gas-Surface Interactions P.J. Estup	Fertilization & Activation of Development B.T. Storey	Metals & Semi-Conductor Clusters M. Mandich	Red Cells N. Mohandas	Solar Plasma & MHD Processes R.N. Sudan R. Rosner	Staphylococcal Diseases G.C. Stewart
Pineal Cell Biology M. Zatz	Liquids, Chemistry & Physics of H.C. Anderson	Molecular Electronic Spectroscopy D. Levy	Mechanisms of Membrane Transport R. Frizzell	Barrier Function of Mammalian Skin R.O. Potts	Cancer R. Kerbel
					Reactive Polymers, Ion Exchangers & Adsorbents R. L. Albright

FIXED CONFERENCE FEES, 1991

Fixed Fees (New Hampshire Sites)

Conferee (double occupancy).....$400
($350 if postmarked 3 weeks prior to conference)
Non-Resident Conferee (meals, no room).....$360
($310 if postmarked 3 weeks prior to conference)
Guest (room and meals).....$310
($260 if postmarked 3 weeks prior to conference)

Fixed Fees (Rhode Island Site)**

Conferee (double occupancy).....$415
($365 if postmarked 3 weeks prior to conference)
Non-Resident Conferee (meals, no room).....$360
($310 if postmarked 3 weeks prior to conference)
Guest (room and meals).....$325
($275 if postmarked 3 weeks prior to conference)

Single room if available will be an extra charge.

Children under 12 years of age are not permitted in the meeting rooms, dining rooms, or dormitories at any host sites.
**All rooms at the Rhode Island site are double with bath.

1. Full fixed fee charged regardless of time conferee attends Conference. Please note fees.
2. Fixed fee cannot be prorated or reduced for anyone (speakers, discussion leaders, conferees).
3. Non-resident conferees are expected to eat all meals in the conference Dining Room and, therefore, the Fixed Fee for non-residents includes the full meal charge.
4. Refunds — See General Information under cancellations.

PAYMENT:

The full fixed fee will be required IN ADVANCE of *ALL* PARTICIPANTS AND GUESTS. Attendance and/or accommodations will NOT be reserved unless this fee is received in our office 3 weeks prior to the Conference. Foreign participants will also be required to pay Gordon Research Conferences in advance in U.S. dollars payable by wire only to a U.S. bank. Checks drawn on Canadian banks and foreign banks cannot be accepted and will be returned. Scientists in Canada must use a bank draft obtained from their bank payable in U.S. dollars and drawn on a U.S. bank. Remittance information on the transfer must include the conferee's name, conferee number and Conference title. Detailed information on payment, travel etc. mailed with registration material.