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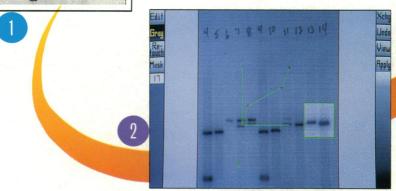


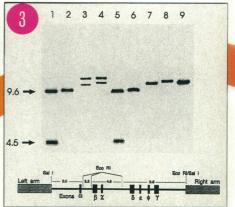
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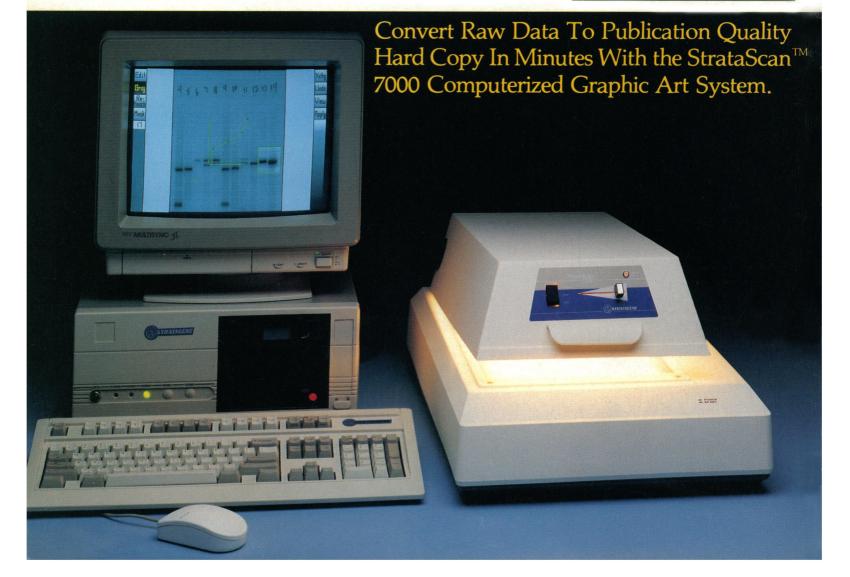


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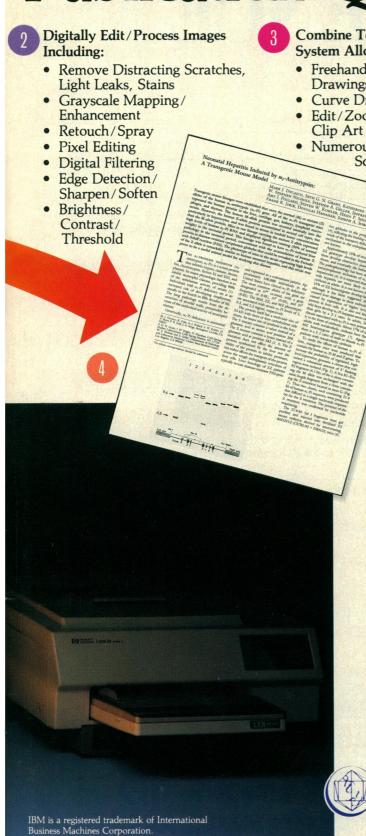
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preciation of the importance and promise of the methods of science in human progress.

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COVER Wiwaxia corrugata, one of the problematic fossils from the 530-million-year-old Middle Cambrian Burgess Shale of British Columbia. The covering of scales and spines was molted at intervals during growth and provided protection from the numerous predators in this remarkable soft-bodied fauna. See page 339. [Photograph by S. Conway Morris]

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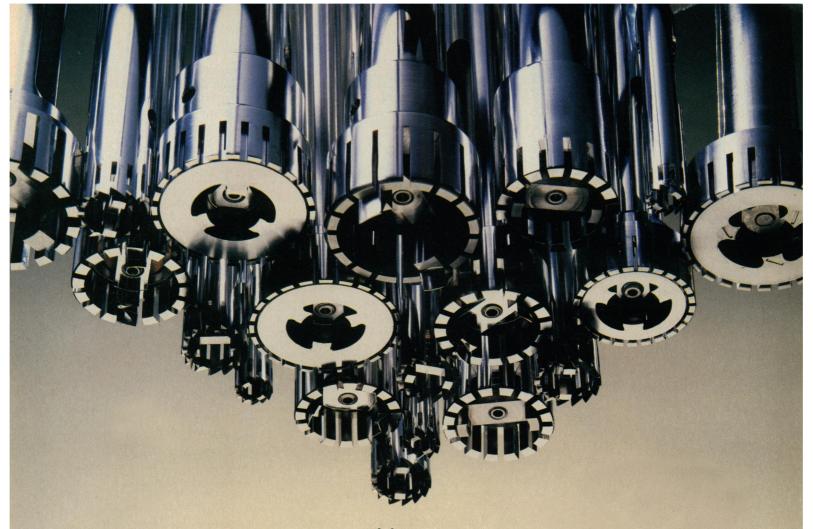
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Science

Burgess Shale faunas

OME 565 million years ago, large numbers and many kinds of multicellular organisms evolved; this "Cambrian explosion" stands in striking contrast to the earlier Ediacaran times from which few metazoans have been found. The richest identified assemblage of Cambrian metazoans is the Burgess Shale fauna in the Canadian Rockies of British Columbia; it was discovered in 1909 (page 339). More than 73,000 well-preserved fossil specimens of exotic ancient soft-bodied organisms have been collected in Burgess Shale quarries; similar Cambrian faunas are preserved at other locations in North America, China, Australia, Poland, and Siberia. Soft-bodied organisms are only infrequently preserved in the fossil record, but, when they are, they provide a unique (and broader) perspective on species diversity. Conway Morris describes the bizarre Burgess Shale organisms (cover) and argues that the availability of a "vacant ecology" may have contributed to the proliferation of types; he discusses how concepts of species evolution, preservation, and extinction are affected by the Burgess Shale faunas. In last week's issue of Science, Briggs and Fortey focused on the diversity of one group of metazoans—the arthropods—that lived in the Cambrian (page 241).

Volcanism on Venus

OLCANIC activity on Venus has been extensive; it has helped to shape the planet's surface and, as noted by Campbell et al., could have contributed significantly to heat loss from the planet's interior (page 373). In the summer of 1988, high-resolution radar images of the surface were made from the Arecibo, Puerto Rico, radar facility. Various styles of volcanism, in conjunction with rifting, apparently produced mountains and smaller edifices, plains, flows, and craters. The relative paucity of craters (some of which form from impacts) in the plains compared with the highlands suggests

that the plains regions are younger. NASA's Magellan spacecraft, which was launched on 4 May and is scheduled to arrive at Venus in August 1990, will return additional high-resolution radar images of the surface of Venus; with these images, the volcanic and tectonic histories of Venus can be further assessed. Venus and Earth may have had similar tectonic and volcanic histories; thus, the study of how these processes have affected Venus can provide new insights into evolution and control of volcanism and tectonism on Earth.

Plasmodesmata and movement protein

Чне interiors of adjacent plant cells are linked to each other by strings of cytoplasm that pass through cell walls; these structures are called plasmodesmata, and they are thought to facilitate cell-to-cell communication. Plasmodesmata may serve as conduits for nutrients that are passing from cell to cell, may carry chemical and electrical signals between cells, and may be the intercellular links through which viruses or their genetic material spread throughout the plant. Wolf et al. evaluated the role of a viral protein, called movement protein, in plasmodesmata functioning (page 377). This protein is known to affect the spread of viruses between plant cells. In the absence of movement protein, plasmodesmata accommodated particles in the range of only 700 to 800 daltons; when movement protein was being made, particles with molecular masses up to 9400 daltons readily passed between cells. Whether movement protein triggers the widening of plasmodesmata directly or indirectly remains to be determined.

Leukemia-associated gene alteration

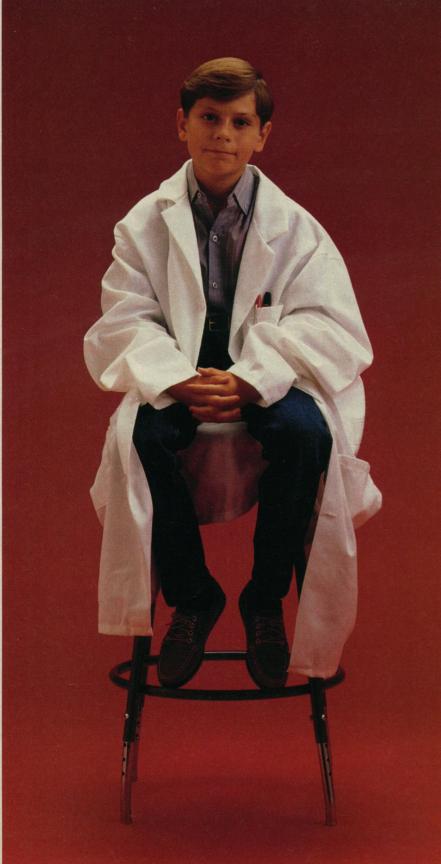
ANY children with acute lymphoblastic leukemia have the same distinctive chromosome abnormality: an exchange of genetic material has occurred between chromo-

some 19 and chromosome 1. The genes that map to the breakpoints on these two chromosomes (and particularly to chromosome 19) are therefore of interest: when the sequence of the genetic material is altered, atypical messenger RNA molecules and protein products may be produced, and development of disease may be a direct outcome of the production of these aberrant molecules. Mellentin et al. have identified one gene at the breakpoint on chromosome 19 (page 379); disruption of the gene was associated with the formation of unusual messenger RNA molecules. The target gene encodes an immunoglobulin enhancer binding factor that plays an important part in the regulation of expression of one chain of immunoglobulins. Determination of which gene is disrupted in acute lymphoblastic leukemia might provide clues both to the nature of disease pathogenicity and to intervention strategies.

Neurologic patterns

EUROLOGIC signals that affect body movements, emotions, and thinking—three very different processes—are all processed in the basal ganglia of the brain. The major component of the basal ganglia is the striatum, which consists of a mosaic of "patches" and "matrix" that differ anatomically and chemically. A direct link appears to exist between the compartments in the striatum at which nerve projections terminate and the layer of the cortex from which nerve outputs originate. Gerfen injected a tracer substance into nerve cells at various sites in the brain's cortex (page 385); weeks later, after the tracer had been transported to the striatum by projections of the nerves (the axons), the sites of deposition of tracers were identified. Inputs from each different part of the cortex terminated in both patches and matrix, but the relative proportions of patches and matrix differed: superficial areas of the cortex more commonly fed into the matrix compartments while deep areas fed into the patches.

■ RUTH LEVY GUYER



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On Being a Scientist

ow does a young person just entering a career in science learn the ethos and behavioral norms of the profession? For example, how does one know when it is okay to be secretive and when such behavior is unacceptable? At what point is one expected to share data and research materials with others, including competitors? What about sharing materials with those who have commercial interests? Whose name goes first on a publication? What are the "rules" for assigning credit, and how are the rules implemented?

Most of us learned answers to such questions through an informal process of on-the-job training or even at the school of hard knocks. For the majority of us, role models, especially our major professor, were a key factor. Of course, formal mechanisms also exist, including courses and scholarly books and papers. Moreover, professional organizations have made significant contributions, notable examples being the 1975 AAAS report Scientific Freedom and Responsibility, the 1984 Sigma Xi report Honor in Science, and the 1989 Institute of Medicine report The Responsible Conduct of Research in the Health Sciences. Unfortunately, most of these are unknown to the typical graduate student or postdoc.

Science today, like everything else, is undergoing rapid changes, some of which clearly affect the scientific ethos. Communication—the sine qua non of science—is rapidly evolving because of new technology. Moreover, the relation between science and society is increasingly one of interdependence, with society counting on science and technology for future competitiveness on the one hand, and science being heavily dependent on having the confidence and support of the public on the other. Both sides have a stake in nourishing and strengthening this relationship. Given these changes, it is fair to ask whether the informal mechanisms for preparing young scientists for their role in science and society will serve as well in the future as they have in the past.

In partial answer to this question, the National Academy of Sciences has just published a booklet entitled, On Being a Scientist. The booklet was prepared under the leadership of Academy President Frank Press and written by a very distinguished panel headed by Francisco Ayala.

On Being a Scientist covers topics such as the treatment of data (Is fabrication a more serious offense than "cooking" or "trimming" data?), values in science, the risk of selfdeception, and the priority of discovery. It concludes with a discussion on "the scientist in society." This 20-page booklet is a good read. With carefully selected examples, it brings life and meaning to the discussion of social and behavioral issues that will confront any young person embarking on a career in science.

In a section on human error in science, the authors note that the perceived pressure to have a large number of publications can create an atmosphere where quality is sacrificed. In that regard, the authors commend institutions that have adopted policies that make it clear that quality is more important than quantity in judging a scientist's performance. This movement, which is long overdue, should be enhanced by the recent decision of the National Science Foundation to limit the number of publications that it will consider in grant applications. Future applicants to NSF will be limited to listing only five publications relevant to the proposed research, plus not more than five additional publications the applicant considers to be significant. If other funding agencies were to follow NSF's lead, this movement would be accelerated appreciably.

How can publications such as On Being a Scientist be used most effectively? Many possibilities come to mind, but an obvious one is to use it as a basis for discussion and debate among graduate students and postdocs. Many major professors hold regular meetings with their research group to discuss progress on individual projects, new contributions in the literature, and the like. These meetings often play a key role in the socialization of young scientists, an effect that would be enhanced by having group members read and discuss the NAS booklet. The Academy deserves credit for taking the initiative in this area, but it will be the response of the scientific community as a whole that determines the impact.

—RICHARD S. NICHOLSON

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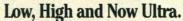
^{*}F. Ayala et al., On Being a Scientist (National Academy Press, Washington, DC, 1989).

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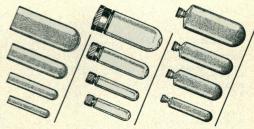
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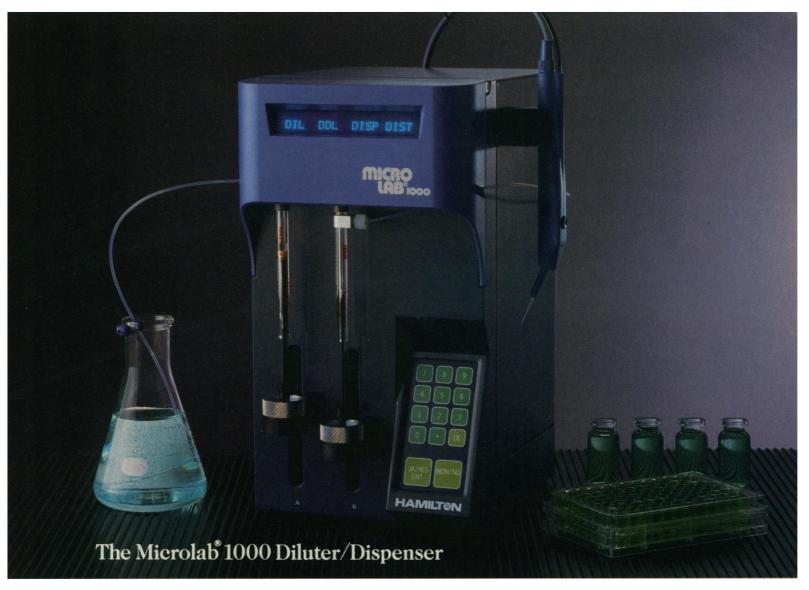
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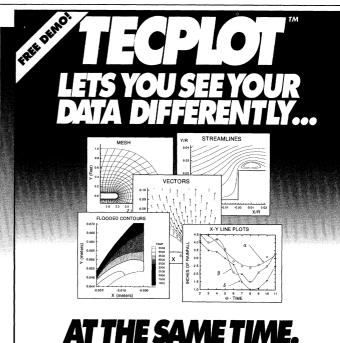
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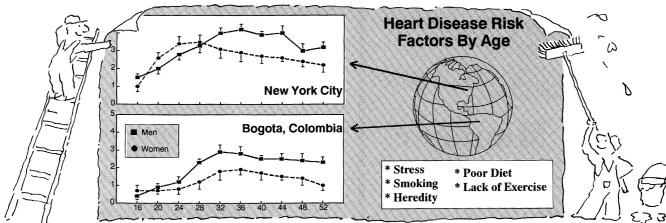
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Similar tales can be told of other renewable energy and conservation technologies. The United States has the opportunity to be a leader in the fight against global warming and atmospheric pollution and to gain economically from those efforts. To succeed, the federal government must reverse its policy of phasing out R&D and market support for energy conservation and renewable energy technologies.

JIM SWARTZ Department of Chemistry, Grinnell College, Post Office Box 805, Grinnell, IA 50112-0806

REFERENCES

 R. Pool, Science 241, 900 (1988); H. M. Hubbard, ibid. 244, 297 (1989); R. McCormack, Energy Daily, 11 August 1989, p. 2.

SSC Test Magnets

Mark Crawford's News & Comment article (25 Aug., p. 809) creates several misconceptions about the development of dipole magnets for the Superconducting Super Collider (SSC). Most serious is the implication that a report by an expert panel reviewing the magnet R&D program was somehow withheld from responsible officials. The fact is that at all stages, this review and its outcome have been discussed openly with Congress, the Department of Energy (DOE), and the scientific community.

In February 1989, I testified before both House and Senate subcommittees on energy research and development and reported on problems that had been seen in some SSC test magnets. At that time, I indicated my intention to appoint an SSC Collider Dipole Review Panel to study the magnet R&D program and to make recommendations to me. The panel was established, and I asked it

to provide a rigorous, critical review of the program. The panel met in April 1989 and provided a draft report in May. That month, I presented the main conclusions at a meeting of DOE's High Energy Physics Advisory Panel in public session. When the report was completed in June, a preface was added and the report was issued as SSC Laboratory Report SSC-SR-1040. The report is available to anyone who requests a copy; it has never been "closely held."

Crawford's article also projects an excessively negative tone about the technical status of the magnet R&D program and the accomplishments of the national R&D effort that was led by the SSC Central Design Group. The tone is misleading. In fact, test magnets produced in the program verify the basic design concept. Nevertheless, when the panel was assembled, a number of issues remained for the magnet R&D program, among them the questions of operating margin, reliability, manufacturability, and reproducibility. These are the points that are emphasized in the review panel's report. They have long been recognized as critical and are basic to the next stage of the development program, which will involve major industrial participation in addition to national laboratory work.



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SCIENCE, VOL. 246

That there are problems and challenges in the development of the SSC dipole magnets comes as no surprise. Producing the dipole magnets is probably the single greatest technical challenge in building the collider. In any technically demanding program, the R&D phase is where problems are uncovered and solved. It would be unrealistic to expect every prototype to achieve all final design goals.

As part of our overall analysis and assessment of the SSC design, the Collider Dipole Review Panel produced a strong, critical report. The new SSC Laboratory is grateful for their fine effort. As their report shows, we do know how to build individual SSC magnets. The next step is to finish developing the methods for building all the magnets needed to achieve the great scientific promise of the SSC.

ROY F. SCHWITTERS Director. Superconducting Super Collider Laboratory, 2550 Beckleymeade Avenue, Suite 240, Dallas, TX 75237-3946

Response: Key aides to the House and Senate appropriations committees and the House Science, Space, and Technology Committee told Science just before the publication of the article that they did not recall receiving copies of the magnet report. Schwitters says the report was available to anyone who requested it. That may have been the case, but the SSC Laboratory made little effort to see that it was widely circulated to Congress before legislators had to decide how to vote on measures to double SSC's \$100-million budget and to start construction.

As for the magnets' operating margin, Department of Energy officials have previously maintained that an upper performance bound of 6.7 teslas at 4.35 K would be adequate. The report issued by the review panel was the first open acknowledgement that a higher operating field would be necessary, if the SSC is to operate as advertised.

—Mark Crawford

Asian-American Students

I write with reference to two News & Comment articles about Asian-American students, one by Constance Holden (18 Aug., p. 694) and another by Robert Buderi (18 Aug., p. 694).

Neither article clearly distinguishes be-

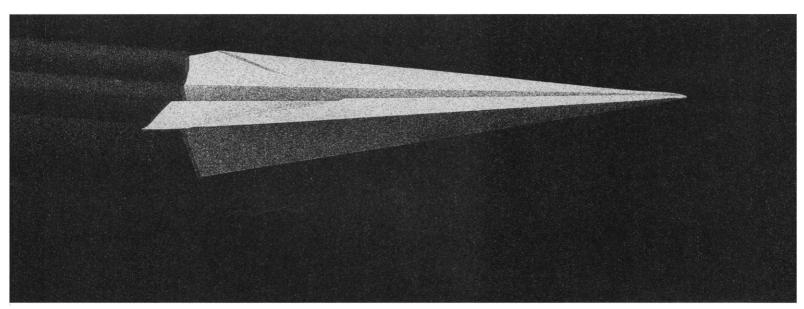
tween native-born and U.S.-born Asians. National Research Council data analyzed by Betty Vetter (1) demonstrate a vast difference in earned U.S. science and engineering degrees between these groups of Asians. Educational research focusing on cultural (including family) influences on learning, notably the studies of Harold Stevenson (2), also supports the conclusion that there are significant differences between oriental students schooled and nurtured in their native cultures and oriental students born, nurtured, and schooled in the United States.

Understanding such differences is essential to consideration of the issues Holden and Buderi discuss. If research data on these differences are ignored by admissions officers, then our educational systems and our students will get the wrong message.

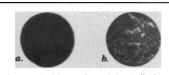
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- "Early release of summary statistics on science and engineering doctorates" (National Science Founda-tion, Washington, DC, 1988).
 H. W. Stevenson, Child Dev., in press.



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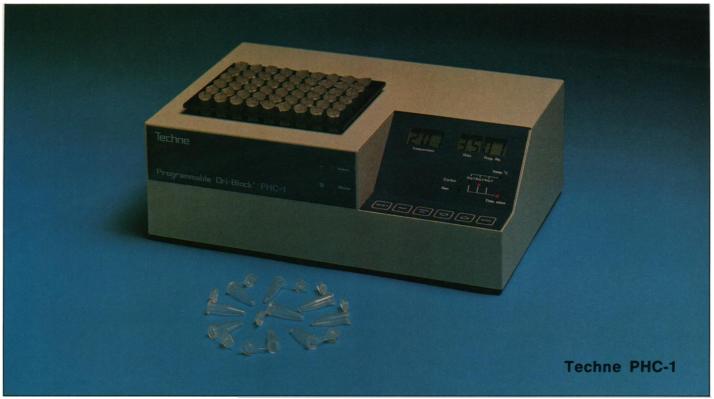
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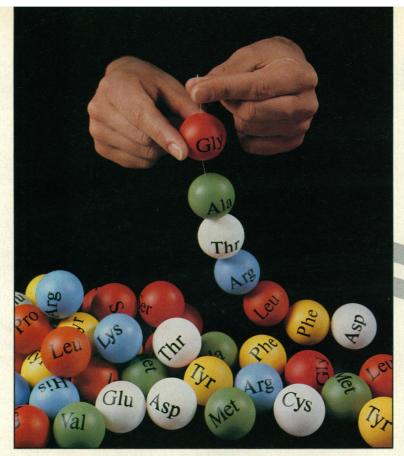
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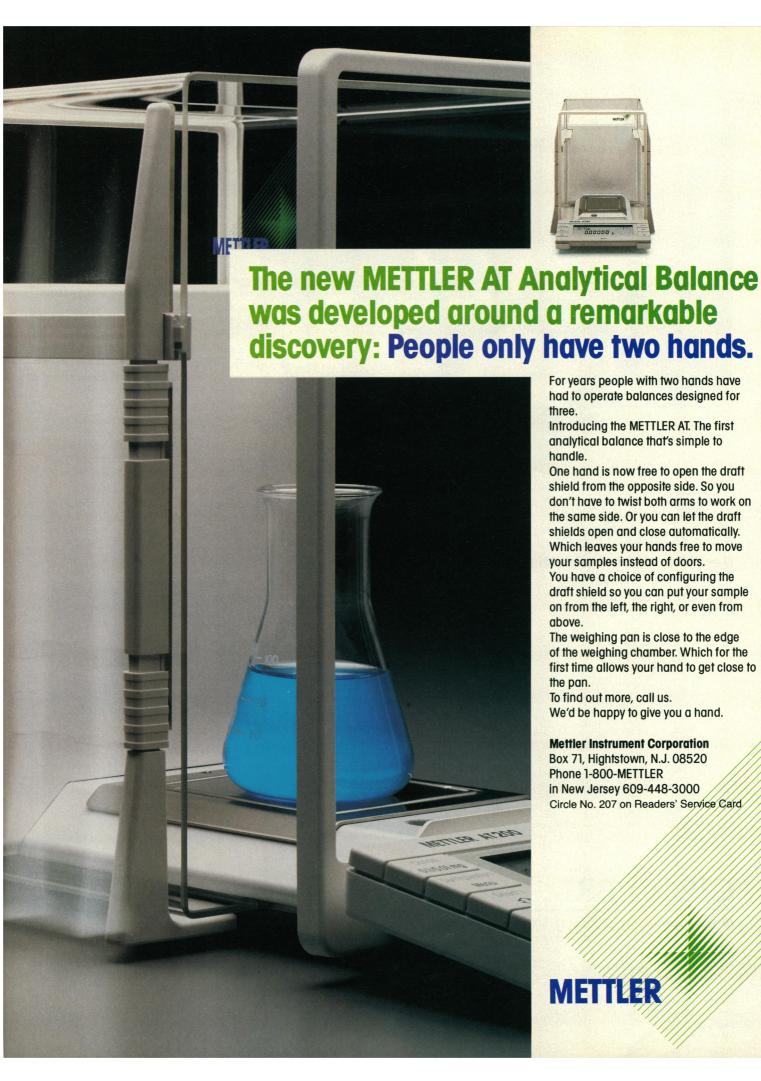
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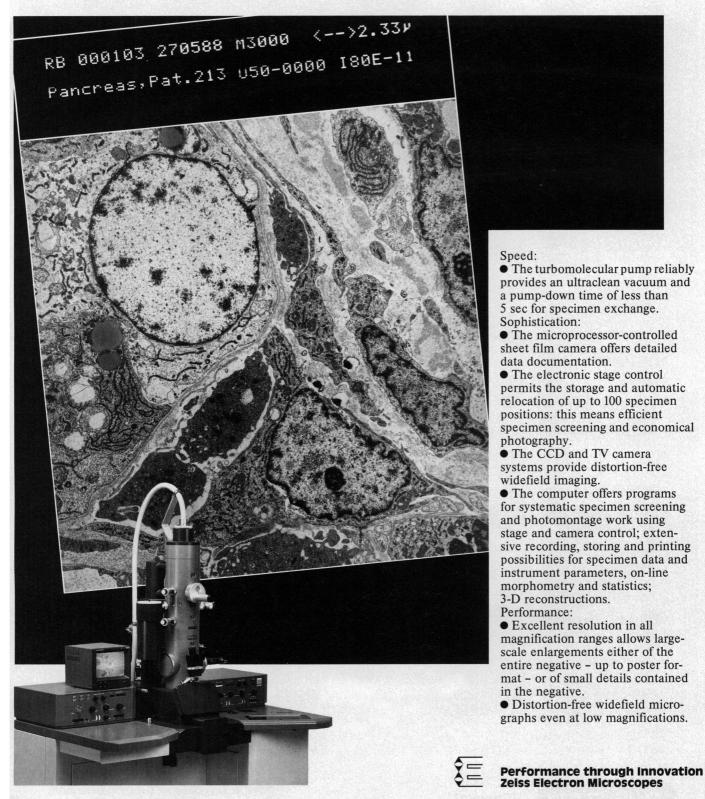
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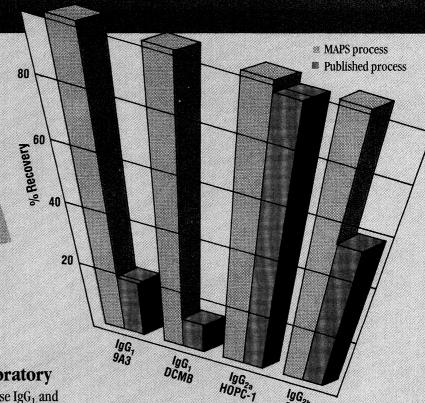


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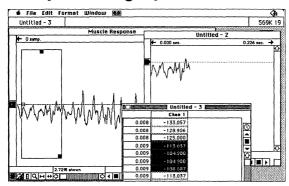
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A complex carbohydrate structural database (CCSD), with over 2,000 entries of structures and associated text files, and CarbBank, the computer program that enables investigators to search and manipulate the database, can be purchased as of October 1, 1989. CarbBank and the CCSD were developed under the auspices of a 14-nation Board of Directors. The entries have been provided by some 26 curators expert in such areas as N-and O-linked carbohydrated chains of glycoproteins, glycolipids, and bacterial and plant polysaccharides. It is anticipated that the database will contain over 4,000 entries by the end of 1991 and all published oligosaccharide structures soon thereafter.

CarbBank and the CCSD can be operated on IBM-compatible PCs with 540 Kb of free RAM, and will be supplied on either 5.25 or 3.5 inch disks. An operator's manual is provided, and technical assistance is available by telephone, mail, Bitnet, or FAX.

The purchase price of the CarbBank program includes updates through September 1991; the annual purchase price of the CCSD includes one free six-month update. Academic and government employees can purchase the CarbBank program for \$250 and the CCSD annually for \$250. This price allows the program and database to be used by one research team (a maximum of 15 individuals). The price for corporations for each of their research or business sites is \$1,000 for the CarbBank program and \$500 annually for the CCSD. A demonstration program containing a few structures and the search routine can be obtained for \$25. (This project has been sponsored by DOE/NIH grant #DE-FG09-88ER13970.)

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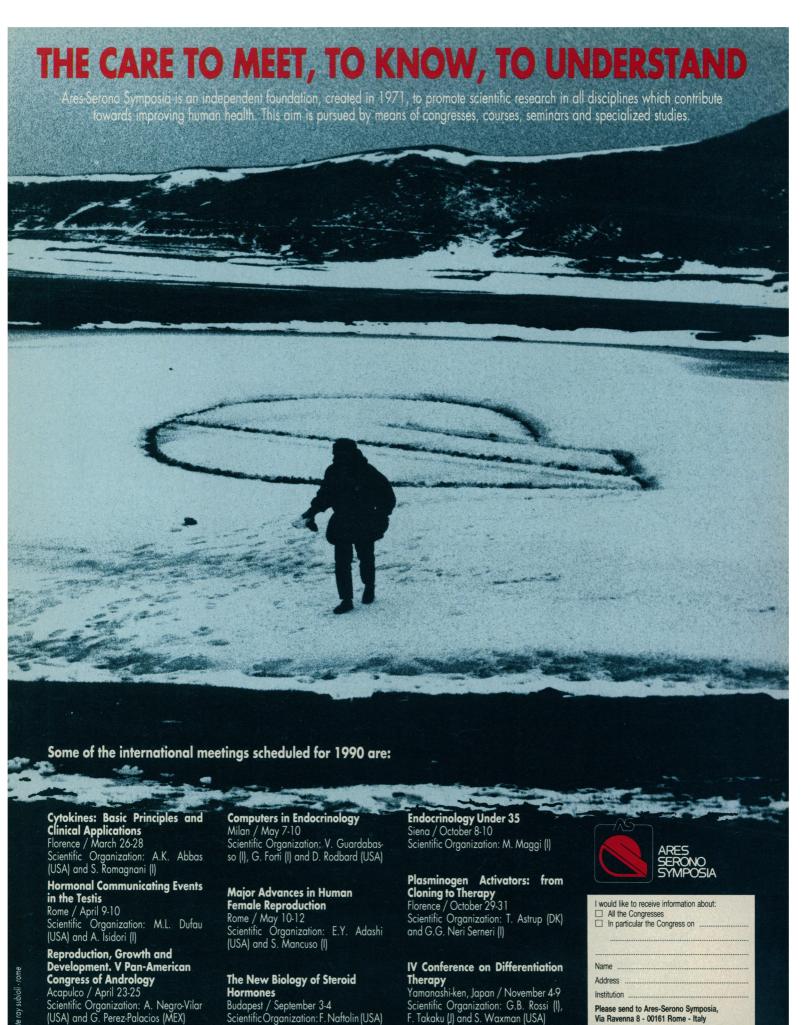
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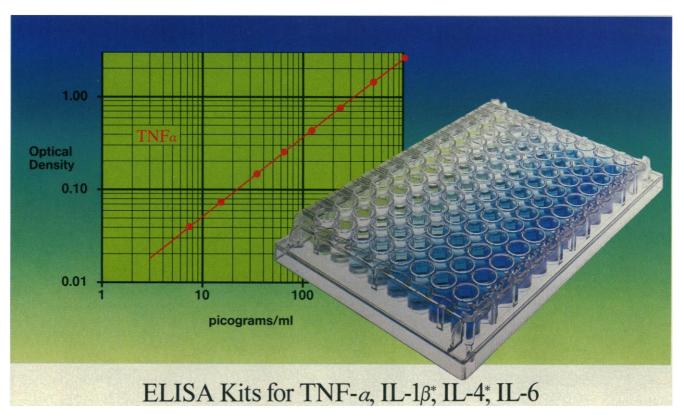
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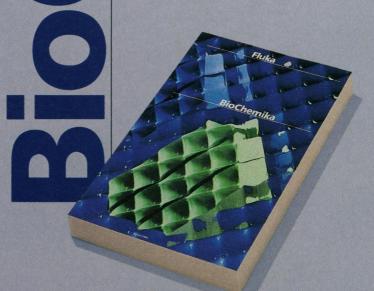
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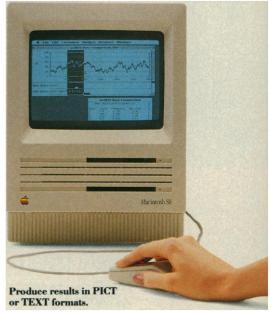
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