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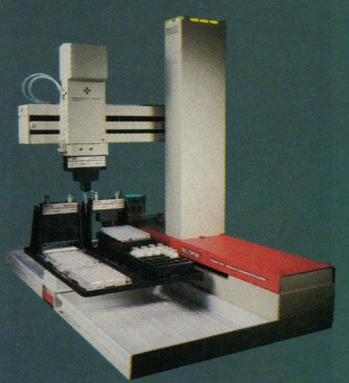
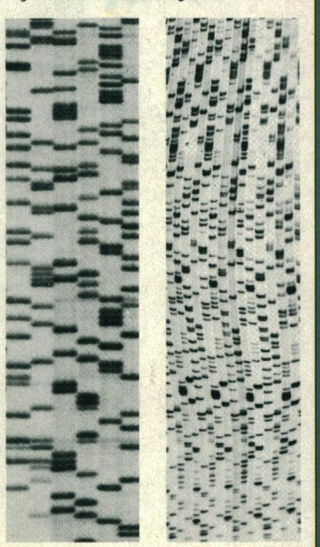


Figure 1 Figure 2



1 18

Figure 1. Autoradiogram of sequence analyses accomplished on the Biomek 1000 using GemSeq K/RT double-stranded DNA sequencing system and Riboprobe Gemini pGEM-3 vector, containing an insert of a known cDNA.

Figure 2. Autoradiogram of sequence analyses using M13mp18. Lanes 1-9 were performed manually, lanes 10-18 were performed on the Biomek 1000.

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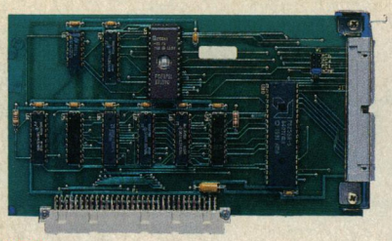

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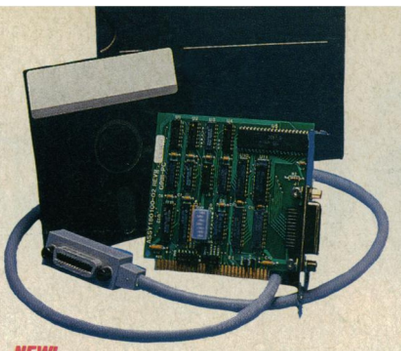

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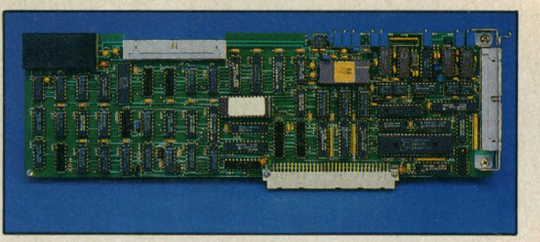

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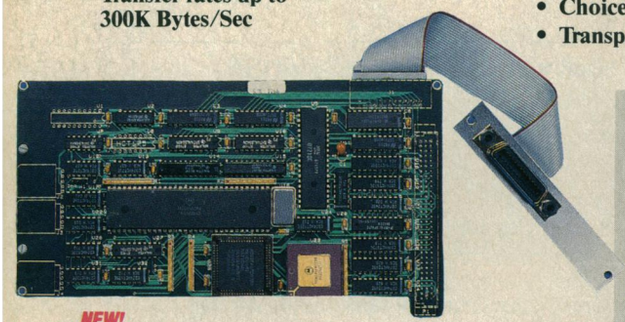

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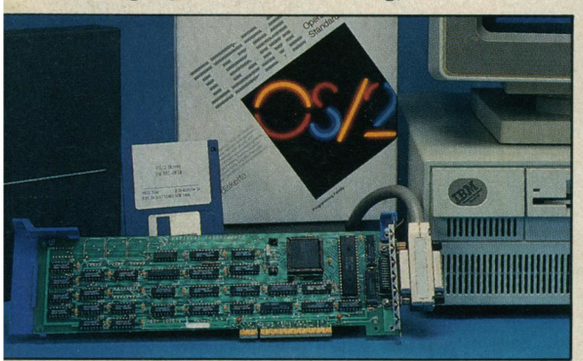

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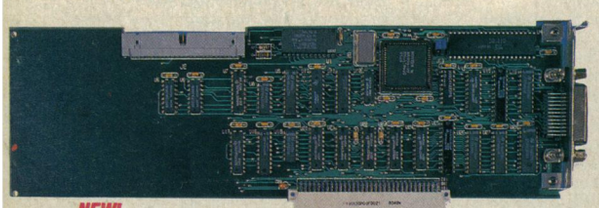

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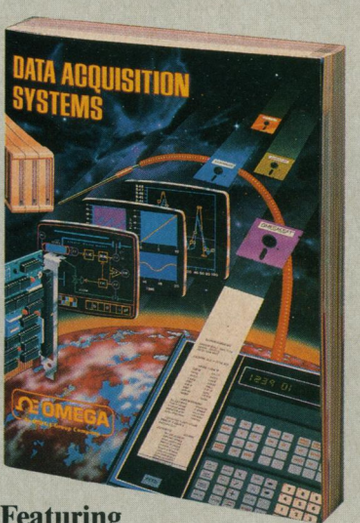

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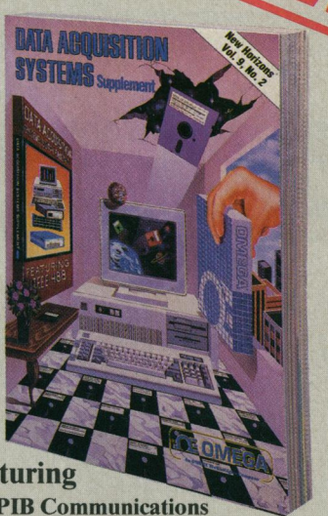

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COVER Scanning tunneling microscope images of an uncoated DNA fragment adsorbed on a single-crystal gold surface under water. The image, which has been repeated in a chevron pattern, is 700 Å by 700 Å and is viewed at an angle of about 45° with respect to the surface. The individual 36 Å twists of the helix backbone can be seen. See page 1063. [Photograph courtesy of S. M. Lindsay, Department of Physics, Arizona State University, Tempe, AZ 85287]

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This Week in
SCIENCE

Jury decision-making

WHAT goes on behind closed doors as juries make their decisions (page 1046)? Only limited insights into the deliberations of juries have been gained from archival information and from post-trial interviews with jurors, because trial records indicate only what decisions were made and not how or why they were made and individual jurors have been found to recall the same trial proceedings differently. Mock jury experiments, in which criminal trials are simulated, have provided more information; they serve as experimental forums in which the dynamics of jury deliberations can be observed and in which theories about how juries operate can be tested. MacCoun reviews some of the findings of these experiments, evaluates the extent to which they accurately reflect the dynamic processes that occur within real juries, and discusses models for how juries function that have been generated from these experiments. Lawyers and social scientists are attempting to develop "scientific" methods for selecting jurors who will favor their client in a trial and thus are keenly interested in determining what happens as juries deliberate.

Crocodylian mouths

THE fossil record indicates that there have been remarkably few changes in the structures of teeth and jaws of crocodylians throughout their history. Both modern and fossil teeth are generally sharp and conical (like canine teeth) and are well suited for capturing and holding prey. The jaws are hinged and can open wide and then shut down on prey, which is processed little if at all before it is swallowed. Thus, the discovery by Clark *et al.* of crocodylian jaws capable of back-to-front movement and of molar-like teeth (in addition to the canine-like teeth) in both upper and lower teeth rows is a striking departure from the norm (page 1064). The specimens were recovered from Lower Cretaceous deposits (about 100 to 140 million years ago) in Malawi. The addition of a sliding jaw and molar teeth (which are similar in appearance to teeth found in primitive mammals) would have made it possible for the Cretaceous crocodylians to process their food; they had a secondary palate, so they could have continued breathing while they were "chewing"; their jaw movements probably were controlled by adductor muscles that resembled those found in living crocodylians. The diets of these animals may have been very different from those of their relatives whose mouths were less versatile.

Brefeldin A and antigen processing

THE antibiotic brefeldin A is proving of value in studies of how cells process foreign proteins for recognition by the immune system (page 1072). Cells display antigenic determinants—portions of foreign proteins—on their surfaces in association with membrane proteins called class I major histocompatibility complex (MHC) molecules. Cytotoxic T cells of the immune system recognize displayed antigenic determinants in MHC contexts and are able to kill "antigen-presenting cells." Yewdell and Bennink report that proteins are processed inside antigen-presenting cells and that antigenic determinants apparently bind to MHC molecules as the latter move from sites of synthesis to the cell surface for display; brefeldin A prevents MHC molecules from leaving the cell's interior and thus inhibits antigen presentation. In contrast, brefeldin A does not interfere with presentation of small peptides, which appear to bind directly to MHC molecules already displayed on the cell surface.

Malaria immunity

EXPERIMENTALLY, the best immunity to malaria has been achieved when irradiated sporozoites are used in vaccines, but this does not mean that the immune response is directed against the sporozoite stage of the parasite. The malaria parasite has a complex life cycle: sporozoites are introduced into mammalian hosts in the bite of a carrier mosquito; these soon enter and mature in the liver; subsequently merozoites are released and invade red blood cells. One target of the immune response appears to be the parasite-laden liver cell of an infected individual; this cell has now been found to display parasite antigens on its surface (page 1078). Hoffman *et al.* report that there are many inflammatory infiltrates in the livers of immunized animals and that among the infiltrating cells are cytotoxic T cells; this type of cell can recognize parasite antigens on liver cells in a genetically restricted fashion, probably in conjunction with specific major histocompatibility complex molecules on the liver cell surface (see previous story) and can kill the infected liver cells in an in vitro assay. These result suggest that all of the pre–red blood cell stages of the parasite, and not just the sporozoite, should be considered as candidate antigens for anti-malaria vaccines.

Von Recklinghausen neurofibromatosis

RESEARCHERS are getting closer to identifying and cloning the gene that causes one of the most common inherited conditions of humans, von Recklinghausen neurofibromatosis (pages 1085 and 1087). This disease affects 1 in 4000 people, and it is associated with a gene called NF1. The disease is characterized by diverse abnormalities of the nervous system (for example, learning disabilities), the bones, the eyes, and the skin; affected individuals are also predisposed to certain types of tumors. There are many mutations and translocations in NF1, suggesting that a rather large genetic region may be involved. The general location—band q11.2 of chromosome 17—of NF1 was determined in 1987 by genetic studies; now, using physical mapping techniques, Fountain *et al.* and O'Connell *et al.* have zeroed in more specifically—by an order of magnitude—on the probable location of NF1 on chromosome 17.

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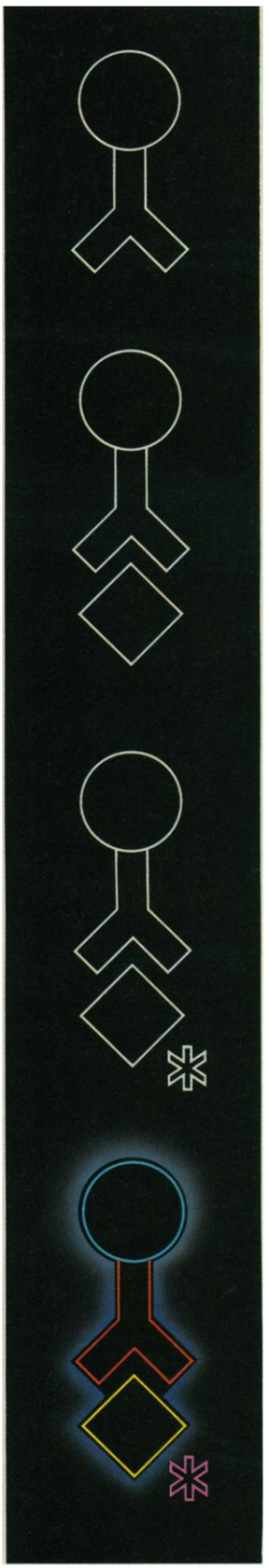

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Teaching Statistics to Engineers

The competitive position of industry in the United States demands that we greatly increase the knowledge of statistics among our engineering graduates. Too many of today's manufacturers still rely on antiquated "quality control" methods, but economic survival in today's world of complex technology cannot be ensured without access to modern productivity tools, notably application of statistical methods. The Accreditation Board for Engineering and Technology (ABET) is now considering a proposal to make statistics an integral part of accredited undergraduate engineering programs. This proposal needs to be adopted.

Consider the molding process in which an integrated circuit chip is encapsulated in its familiar block of black plastic. The resin must cover the chip quickly, completely, and permanently, without disturbing the delicate wires that connect the circuit to the exterior metal "legs" which provide electrical contact. Success depends on a host of factors—temperature, pressure, mold design, material composition, viscosity, wire size, bonding method, and type of machine.

Each of these factors must be optimized to ensure quality results. But how does one find these optimum values? By experimenting with each one in isolation, critical interactions might be missed—raising the temperature might yield better results on one mold model but poor results on another, for example. On the other hand, attempting to vary each factor in all possible combinations could easily drive the number of experimental trials into the millions. No wonder that many traditional manufacturers still address only the obvious possibilities and hope for the best. Clearly, that kind of "best" is no longer good enough. Modern technology demands a far higher level of quality than a seat-of-the-pants approach can produce.

What is needed in this example, and thousands of others like it, is an application of methods from the area that statisticians call experimental design. A carefully selected number of experimental trials is carried out. In this selection, the factor combinations are chosen to allow estimation of the main effects of factors and those interactions judged to be critical by the engineer. Then sophisticated statistical methods are used to analyze the data. Such experiments require knowledge of statistics and engineering knowledge of the process at hand. It is no accident that today's leaders in quality manufacture encourage the use of statistically designed experiments at all stages of their processes—and see to it that their engineers have the training needed to succeed in these endeavors.

What training in statistics do today's U.S. engineering graduates receive? At present, most electrical engineers limit their studies of statistical variability to the stochastic processes involved in signal processing. Most others, such as civil, chemical, and mechanical engineers, can usually get one course in probability and statistics. Industrial engineers are typically given more, something between one and three semesters of course work. Despite some recent trends toward improvement, courses tend to emphasize the theory of statistics, in isolation, without relating it sufficiently to engineering processes.

Since Japan's universities have similar shortcomings, that country's employers routinely provide their engineers with substantial training in statistics. For example, one experimental design course taught by a Japanese professional organization lasts 30 days. In contrast, U.S. industry generally provides less than one-tenth as much training in experimental design and to only a small fraction of its engineers.

In most respects, the superior training of U.S. university graduates remains a key pillar of our economic strength. Unlike the Japanese, whose industries have adapted to shortcomings in their system of higher education by providing extensive on-the-job training, U.S. companies have normally been able to rely on university-based training for needed expertise. While the private sector must enhance its own training programs, it is clearly incumbent upon our engineering schools to adapt to evolving needs as quickly and effectively as possible. Change is never easy. Each addition necessarily displaces some other portion of the curriculum. Nevertheless, the adoption of the accreditation proposal by ABET would be an important step in ensuring the industrial future of the United States.

—ARNO PENZIAS, *Vice President for Research, AT&T Bell Laboratories, Murray Hill, NJ 07974*

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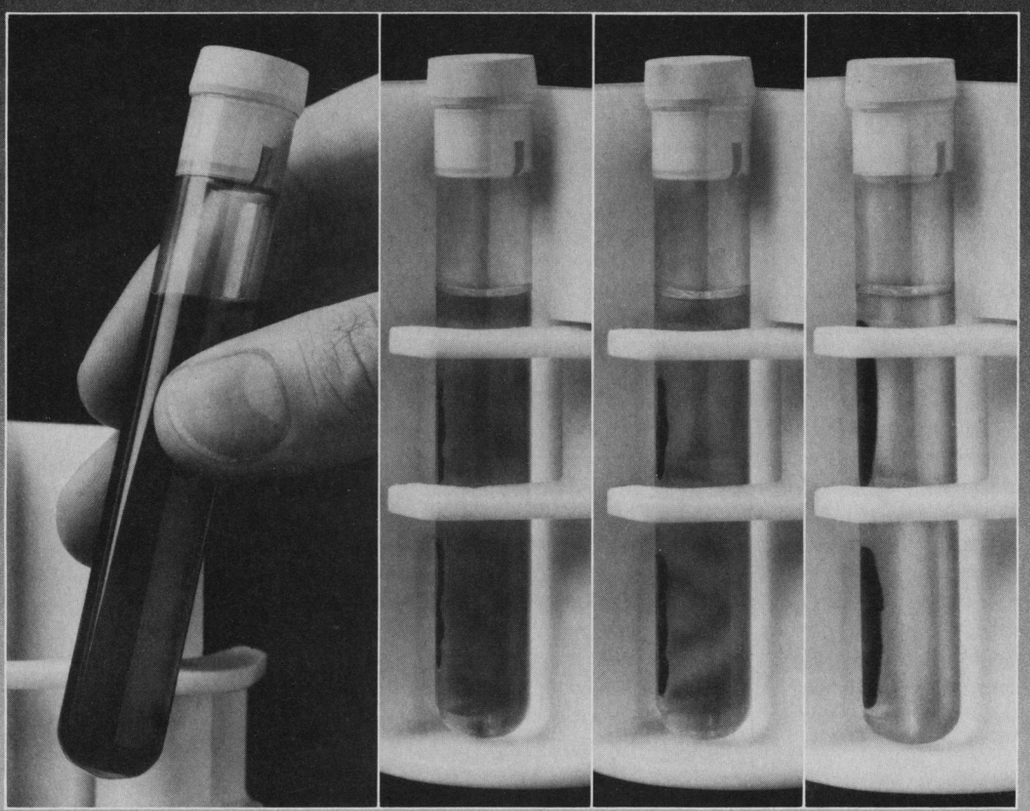

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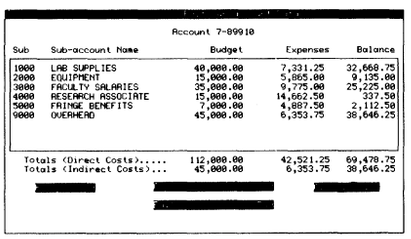

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2000	EQUIPMENT	15,000.00	5,865.00	9,135.00
3000	FACULTY SALARIES	35,000.00	9,775.00	25,225.00
4000	RESEARCH ASSOCIATE	15,000.00	14,662.50	337.50
5000	FRINGE BENEFITS	7,000.00	4,887.50	2,112.50
9000	OVERHEAD	45,000.00	6,353.75	38,646.25
	Totals (Direct Costs).....	112,000.00	42,521.25	69,478.75
	Totals (Indirect Costs)...	45,000.00	6,353.75	38,646.25

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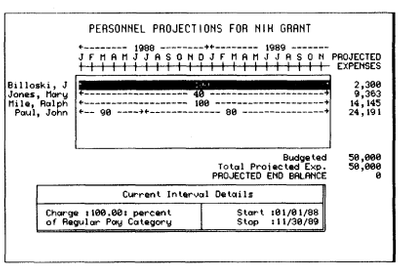

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Billoski, J	40	2,300
Jones, Mary	40	9,363
Mile, Ralph	100	14,145
Paul, John	90 / 80	24,191
	Budgeted	50,000
	Total Projected Exp.	50,000
	PROJECTED END BALANCE	0

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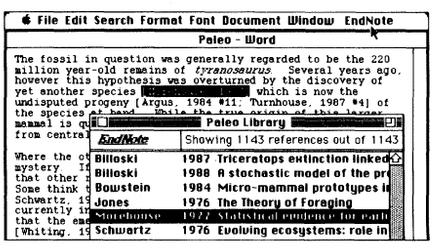

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The fossil in question was generally regarded to be the 220 million year-old remains of *tyrannosaurus*. Several years ago, however this hypothesis was overturned by the discovery of yet another species [redacted] which is now the undisputed progeny [Argus, 1984 #11; Turnhouse, 1987 #4] of the species at hand. While the true origin of this large mammal is qu[redacted]

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Jones	1976	The Theory of Foraging
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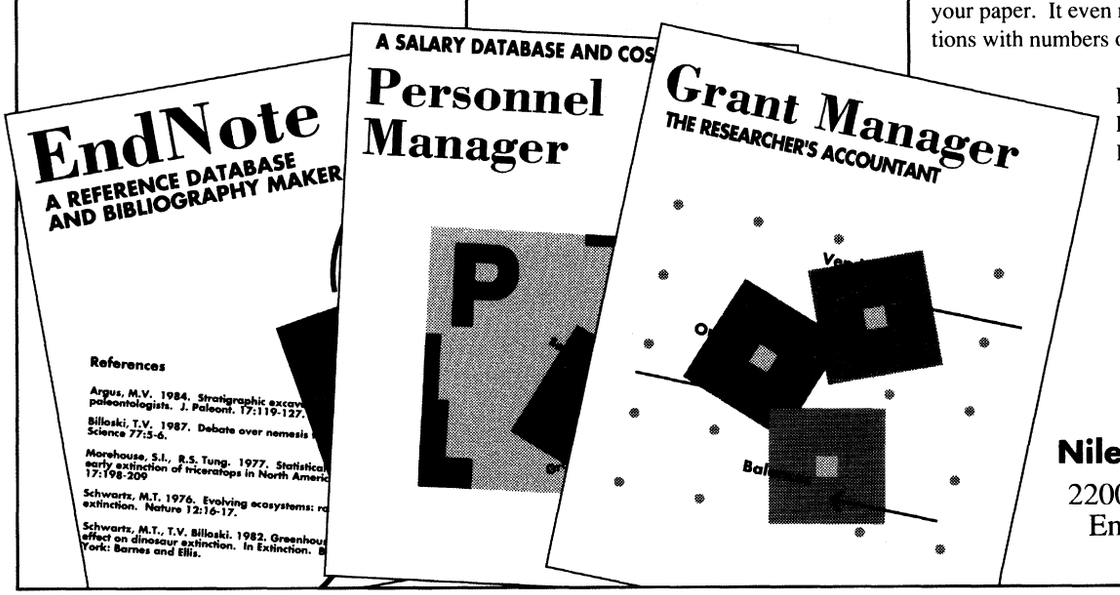

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fortuitously shifted to almost exactly the expected diamond diffraction angles.

Our present result—namely the absence of any (appreciably) crystalline diamond diffraction features—has also been verified in a preliminary synchroron study of ours at the National Synchrotron Light Source at Brookhaven. It thus remains for us to determine the detailed structure of these interesting films whose short-range bonding is clearly sp^3 and whose Raman spectrum shows evidence mainly of a broad peak at $\sim 1550\ cm^{-1}$ (*3*).

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REFERENCES AND NOTES

1. J. L. Robertson *et al.*, *Science* **243**, 1047 (1989).
2. J. L. Robertson *et al.*, in *Proceedings, MRS Symposium on "Optical Materials: Processing and Science,"* C. Ortiz and D. B. Poker, Eds. (Materials Research Society, Pittsburgh, PA, in press).
3. F. Adar, Y. Lifshitz, J. W. Rabalais, unpublished data.
4. We thank M. Geis for suggesting to us that some of our results could be observed on pure silicon.

Space Facility

We are reluctant to allow Eliot Marshall's 21 April article "National Academy panel rejects the case for a mini-space station" (News & Comment, p. 282) to stand as a record of what the study committee said.

First, the Commercially Developed Space Facility (CDSF) has rarely been considered a "mini-space station." In the recent National Research Council (NRC) White Paper on Space Policy, the National Academies go on record as believing "a station is essential to establish the feasibility of human exploration beyond the Earth's orbit." Clearly, a man-tended CDSF would not meet this criterion. It is misleading to continuously refer to the CDSF as a mini-station; certainly none of its supporters made that claim before the study committee.

The Academy report is faulted several times for "not examining the big station with the same rigor" with which it examined the CDSF. Indeed, the Academies were charged by the Office of Management and Budget and the National Security Council with an examination of the space station program in the summer of 1987, and a report was issued later that year. The present committee's charge was to assess the need for a CDSF *prior* to the station!

While the article observes the CDSF had support from "budget cutters in Congress," a quick reading of the introduction of the report would have revealed that the study originated at the request of both houses of Congress, rather than NASA, in an effort to secure an objective assessment of whether anticipated national needs for microgravity processing would exceed likely facilities in the period preceding the station.

The article states that NASA converted CDSF high-level endorsements to "a standard procurement request." The procurement process that NASA undertook last spring was far from standard, for example, no preliminary early phase studies were conducted or sought. Other erroneous details include reference to a private Spacelab (which should have read Spacehab), and two references to 11 March as the release date for the report (which should have read 10 April).

ROBERT H. KORKEGI
Aeronautics and Space Engineering Board Commission on Engineering and Technical Systems, National Research Council, Washington, DC 20418

Response: Former Senator William Proxmire (D–WI), who backed CDSF when he was chairman of the appropriations subcommittee for space, certainly saw it as a "mini" alternative to NASA's space station, which he called the "space palace." However, unlike the big station, CDSF would not permit astronauts to stay aboard indefinitely, but only for 3-week visits. Advocates said that CDSF could be used as a developmental outpost until the $16-billion big station arrived, especially if the big station were delayed beyond the 1996 due date. The Academy report assumes that the big station will be in place by 1998 and finds no useful role for CDSF before then.

—ELIOT MARSHALL

Erratum: On page 1556 of Robert Pool's Research News article "New equipment roundup dazzles scientists" (24 Mar., p. 1554), the photographs of the automated purification system and the low-level light detector were inadvertently interchanged.

Erratum: In the Research Article "Hydrogen tunneling in enzyme reactions" by Y. Cha *et al.* (10 Mar., p. 1325), the first equation in reference 28 on page 1329 was incorrectly printed. It should have read

$$k_L/k_T = \ln\{1 - f[\frac{(^3H/^{14}C)f}{(^3H/^{14}C)_z}]\} \quad (L = H,D)$$

Erratum: In the the caption of figure 2 on page 59 of the Research Article "Purification and characterization of mouse hematopoietic stem cells" by G. J. Spangrude *et al.* (1 July 1988, p. 58), the last sentence should have begun, "By linear regression analysis, one splenic colony was formed per ten hematopoietic stem cells transferred [frequency = 0.095 ± 0.08 (SD)]."... In the same article, the fourth sentence of the last paragraph on page 60 should have read, "In contrast, transfer of as many as 900 Thy-1^{lo} Lin$^-$ Sca-1$^-$ cells did not save the mice."

Erratum: In William Booth's short article on women in science, "Oh, I thought you were a man" (News & Comment, 27 Jan., p. 475), Sallie Watkins' affiliation was incorrectly given as the University of Southern California. Her correct affiliation is the University of Southern Colorado.

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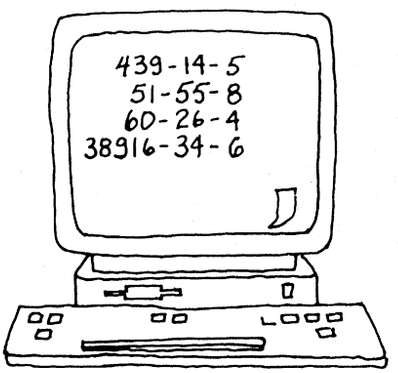

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