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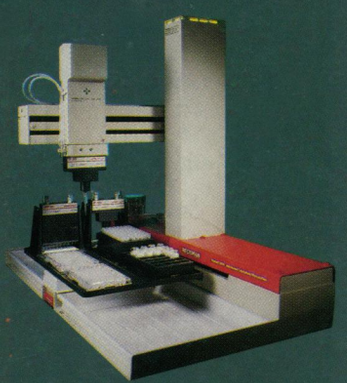
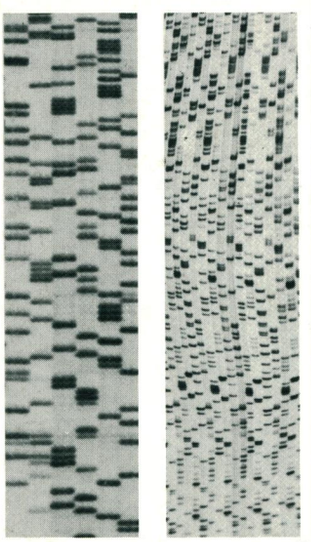


Figure 1 Figure 2



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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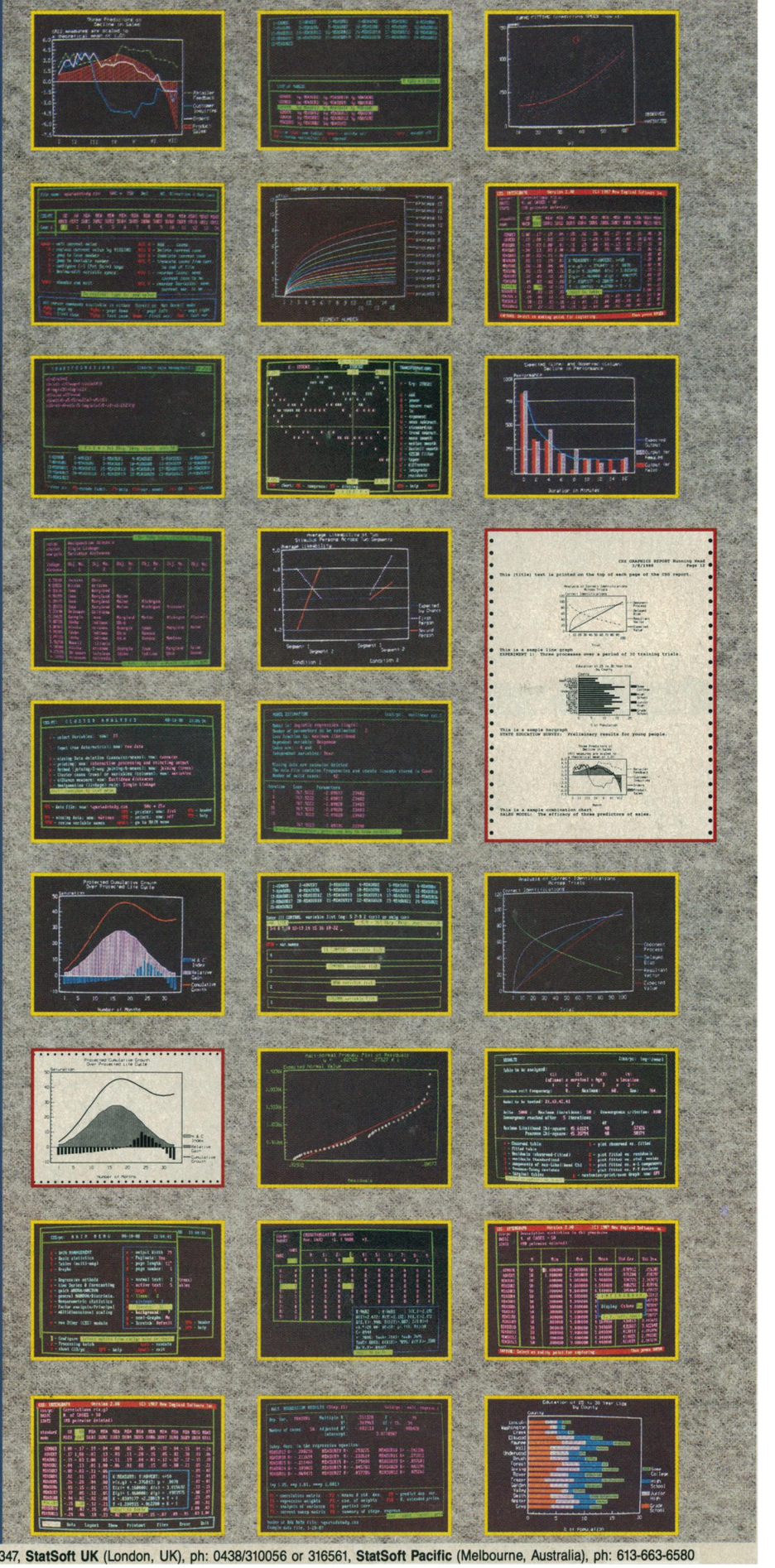

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COVER The rose sea anemone (*Tealia piscivora*) exemplifies the beauty of many cnidarians, the simplest animals having a nervous system. Tentacles of the cosmopolitan anemone (*Haliplanella luciae*) have mechanoreceptors on the surface that tune to the movements of prey identified by chemodetection. See page 1589. [Photograph by George Grall, National Aquarium, Baltimore, MD 21202]

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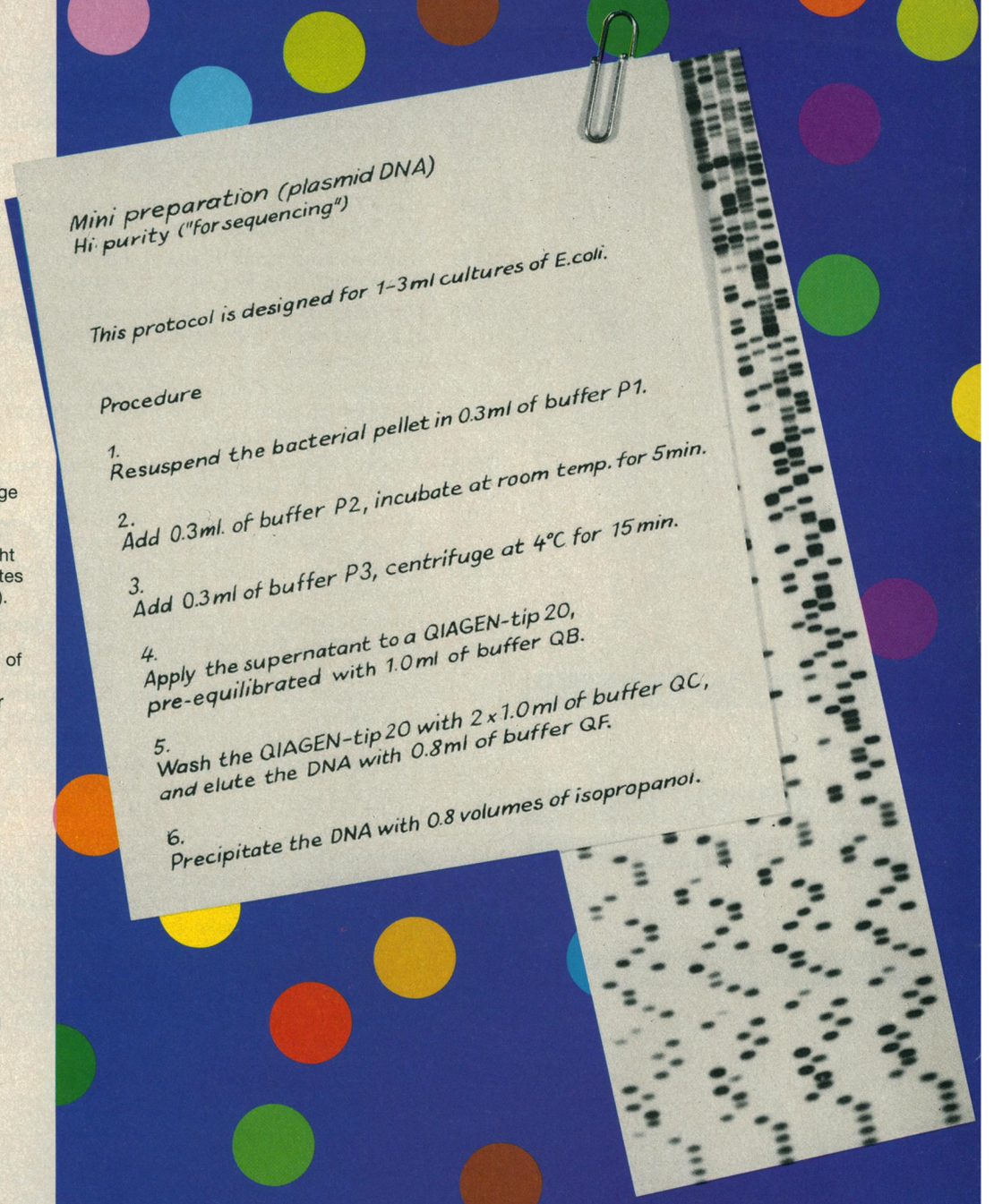

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Radar echoes from Phobos

MARS has two irregularly shaped and heavily cratered satellites, Phobos and Deimos—in mythology, the drivers "fear" and "terror" of Mars' chariot. Radar echoes from Phobos, obtained by Ostro *et al.* using the Jet Propulsion Laboratory's 70-meter Goldstone antenna as a radar telescope, indicate that the surface of Phobos is, at small scale, smoother than the surface of Earth's moon (page 1584). At radar wavelengths, Phobos most resembles the large C-class mainbelt asteroids whose mineralogy is thought to be representative of the primordial "stuff" of the solar system. (The dark-grey color of Phobos and its visual albedo also link it to C-class asteroids.) The Soviet Phobos II spacecraft, which has been orbiting Mars, is moving close to Phobos and will, within the month, place landers on the satellite; one of the landers will be collecting samples of this putative primordial material.

Underwater explorations

ATOMIC force microscopy has been transformed from an unwieldy, low-yield technique to what should soon become a quick, accurate, and robust method for exploring the topography of nonconducting materials in aqueous solutions; the range of potential applications is described by Drake *et al.* as extending from "mitochondria in cytoplasm to painted ships in seawater" (page 1586). The gently pressing probe that scans the surface consists of a diamond tip attached to a special cantilever system; the system works underwater where applied force can be accurately controlled and background vibrations minimized. An optical system amplifies and detects the deflection of the cantilever as the tip moves along bumps, grooves, and other irregularities. Three examples of the types of images that can be obtained are given. One is a close-up look at the surface of the biopolymer polyalanine. The second is resolution of the atomic lattice structure of crystalline mica. The third, perhaps the most intriguing, is a set of images of a biologic reaction as it is taking place—the polymerization of fibrin with thrombin to form fibrin nets that, in vivo, figure in such processes as the formation of blood clots and the healing of wounds.

Sea anemone sensors

SEA anemones (cover) and related organisms including jellyfish, hydra, and corals have two kinds of receptors for sensing prey—mechanoreceptors that can detect physical disturbances in the water and chemoreceptors that respond to certain sugars and amino compounds from the prey. The anemone's response to these stimuli is to discharge stinging organelles, called nematocysts, onto or into the prey; the prey becomes immobilized or entangled and subsequently may die. Watson and Hessinger have studied how the mechanoreceptors work and how the chemoreceptors affect their operation (page 1589). The fishing tentacles of anemones were touched with a vibrating probe, and the discharged nematocysts were counted; responses were compared in the presence and absence of chemical stimulation. If chemoreceptors had been stimulated, they "tuned" mechanoreceptors to frequencies corresponding to those of the rhythmically swimming prey—larval and adult forms of brine shrimp; then maximum release of nematocysts occurred at just those frequencies. The tuning may involve elongation or shortening of stereocilia in the mechanoreceptors. In the absence of chemosensitization and tuning, nematocysts were discharged at frequencies higher than those produced by swimming prey. The coordinated functioning of the two types of receptors thus maximizes detection of and responses to prey in the water.

How the beat goes on

PICTURES of the beating of the flagella of swimming sea urchin sperm confirm the proposal that paired microtubules in the flagella slide by other pairs, causing the flagella to bend and the sperm to swim (page 1593). Brokaw removed membranes from flagella so that the nine pairs of outer microtubules which surround a central pair were exposed. Gold beads were then adsorbed to the outer microtubules where they remained attached for hundreds of beats and served as markers for specific microtubule doublets. The relative movements of sets of beads were recorded in sequential pictures (dark-field photomicrographs), and, from the spatial information obtained, the diameters of the microtubule assemblages (which are called axonemes) could be calculated. The pictures confirmed that microtubule doublets slide rather than contract and elongate during flagellar beating and that each doublet slides independent of the others. Insights into the dynamics of flagellar beating in sea urchin sperm may be generally valid for explaining how other types of motile cells in which axonemes are "standard equipment" propel themselves through liquids.

Pollination pathway

POLLEN sticks to the stigma of a plant; the male cells then move in a growing pollen tube through the long hollow style into the ovary. Sanders and Lord show that a matrix of secretions in the style plays an active, not just a nutritive, part in guiding pollen tube growth. Latex beads the sizes of pollen tube tips were observed to travel through the style on the same path—the "transmitting tract"—along which pollen tubes grow, and beads and pollen tubes moved at comparable rates (page 1606). The beads travel equally well in upright and horizontal plants, showing that the force of gravity is not responsible for bead movement. Bead migrations and pollen tube growth in three different types of flowering plants—one with an open style, one with a closed style, and one with an intermediate-type style—were all similarly matrix-driven. Matrix materials in animal systems may, in analogous fashion, regulate cell migrations during embryogenesis.

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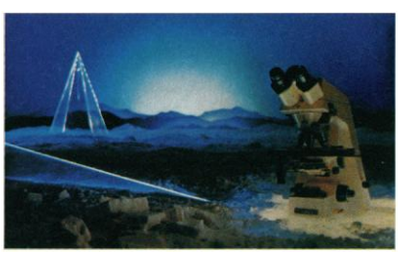

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A New Approach to Faculty Salaries

The situation of faculty salaries is becoming desperate. During the past 10 years salaries have not increased as much as the consumer price index, in distinct contrast to salaries of baseball players and to tuition for college.

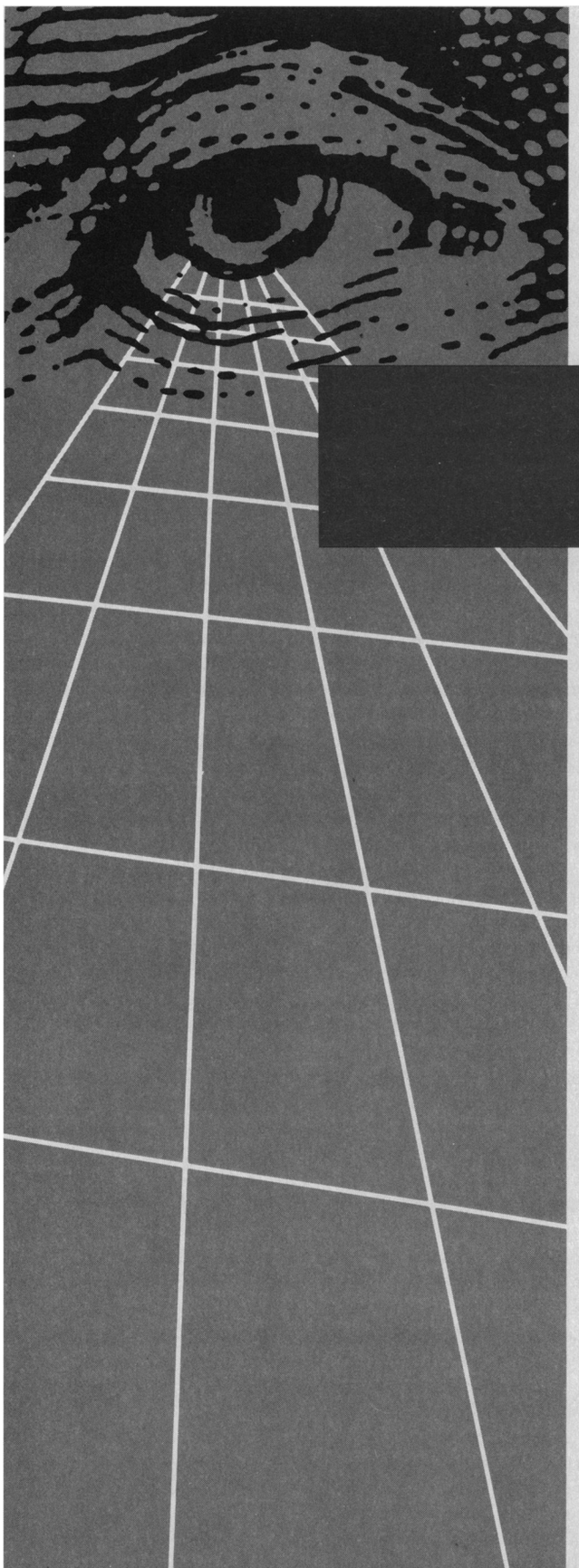
The traditional answer to such a problem is unionization, but unions have not worked in academia. Scientists, and other academics, tend to be individualists, and the enjoyment of doing basic research provides so many eager applicants that a university administration could in most cases replace a striking faculty in something less than a few milliseconds. At present, competition for star researchers raises salaries, but the process is too slow. Obviously, some different approach will be needed.

Although it will pain some souls dedicated to purity, one effective solution might be the creation of a phantom chair at each institution—one that is never filled but is used solely to raise salaries. Professor I. M. Pecunious at University X, with a clearly inadequate salary, will tell faculty friends at University Y that he is in distress. These friends at University Y will then offer the impoverished professor the Gaston P. Mirage Chair, which supplies a fantastic salary, laboratory space that is slightly smaller than Australia, and a reserved parking place with his name in large gold letters. Notice of the offer should then be leaked to generate a conditioned reflex in colleagues at University X, who will raise a large hue and cry, pointing out that the loss of Professor Pecunious will create irreparable damage to the university. Once Professor Pecunious has indeed been secured once again by University X at a price, other members of the faculty can rush in and claim that they are every bit as able as the professor and that he is being grossly overpaid. Only by giving other professors equivalent increases will the esprit de corps of the institution be maintained. Thus, faculties can receive raises without filling chairs or going through such painfully plebeian activities as strikes.

A similar principle can be used to increase the outside income of faculty members. At present, faculty members are invited to give speeches with the usual promise of a "modest honorarium." It is extremely poor form to ask for the actual dollar amount, but it is almost invariably discovered that the adjective is accurate. In the future, professors would be well advised to designate a colleague as their "scheduling agent." When an invitation is received, the faculty member should never negotiate directly, but should immediately say "Professor P. T. Barnum is in charge of my schedule, and you will have to speak to him." Such inquiries should be answered by Professor Barnum in terms such as, "What were you thinking of giving Professor Schmelzpunkt for an honorarium?" followed by satirical laughter, regardless of the figure mentioned. After the laughter, the professorial agent will state, "There is no possible way that I could book the distinguished Professor S. for such a modest honorarium." He will then explain that Professor S. is in such great demand that he could only consider visiting Pinnacle University for three times the amount offered; he also should be met at the airport with a chauffeured limousine and requires a guaranteed audience of at least 500 people. If each professor had such a designated colleague-agent, it would soon raise the prices for all and provide a basis for faculty total income approaching that of congressmen.

There is good reason to be concerned about faculty and graduate salaries. It is the conventional wisdom that the diminishing pool of scientists is the result of poor teaching, demographic shifts, and the growing reluctance of students to choose difficult courses. It is time to give serious consideration to the hypothesis that students may see science as a career of high competition and anxiety, with low pay compared to that of doctors or lawyers. Furthermore, even those devoted to science may lose heart when they enter graduate school and find that stipends put them below the poverty line. Moreover, postdoctoral work is becoming a requirement as science becomes more complex, and that only extends the period of asceticism into the early family-raising years.

Although this problem may solve itself in the distant future, as projections indicate severe shortages in a number of professions in the late 1990s, it would be prudent to start adjusting salaries now so that more young people will be attracted to scientific and engineering careers. In that way the faculty will have, as the saying goes, a salary level the football coach can be proud of.—DANIEL E. KOSHLAND, JR.



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part of the "missing carbon problem" (*4*) and balance the global carbon budget for 1980.

Such issues should be studied in detail, but we do not think our study lends support to Sedjo's argument. In response to a climatic warming, the boreal zone can act as a source of carbon dioxide rather than as a sink. Soil organic carbon in active exchange with the atmosphere constitutes approximately two-thirds of the carbon in terrestrial ecosystems (*5*). Increased release of carbon from soil in response to climatic warming may more than compensate for the effect of growth stimulation.

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*Formerly at the International Institute for Applied Systems Analysis (IIASA), A-2361 Laxenburg, Austria.

La Différence

Donald S. McLaren (Letters, 22 July 1988, p. 399) contends that the sex difference in the relation between resting oxygen consumption and surface area that I have postulated to prevail (Letters, 8 Apr. 1988, p. 130) disappears when expressed in terms of lean body mass. McLaren's contention is supported by experiments "carried out by medical students on themselves" (*1*). However, extensive studies by others, particularly those of Novak (*2*), clearly show in 215 healthy men and 305 women that fat-free mass and cellular mass are significantly lower ($P < 0.001$) in women than in men *at all adult age levels*. Fat-free, that is, lean body mass, was determined with ^{40}K gamma-ray spectrometry (fat does not contain potassium), and it was found that relative (fat-free) body cell mass is 18.5, 13.4, 17.21, 19.4, and 13.4% lower in women in the age brackets 18–25, 25–35, 35–45, 45–55, 55–65, and 65–85 years, respectively. The data on the 18- to 25-year-old group, that is, the age group of the medical students (*1*) cited by McLaren, display a large standard deviation.

My contention that women live longer than men because of their more efficient use of energy is expressed in terms of resting oxygen consumption. That a constant proportion of the difference in longevity is based on the relation between body mass and energy expenditure is, however, also manifest in the differential response to performance on a variety of tasks, including standing, walking, household work, football, and mining. On all tasks men expend more energy than women (*3*). I reiterate, therefore: "Vive la Différence!"

ROLAND FISCHER
07190 Esporles, Mallorca, Spain

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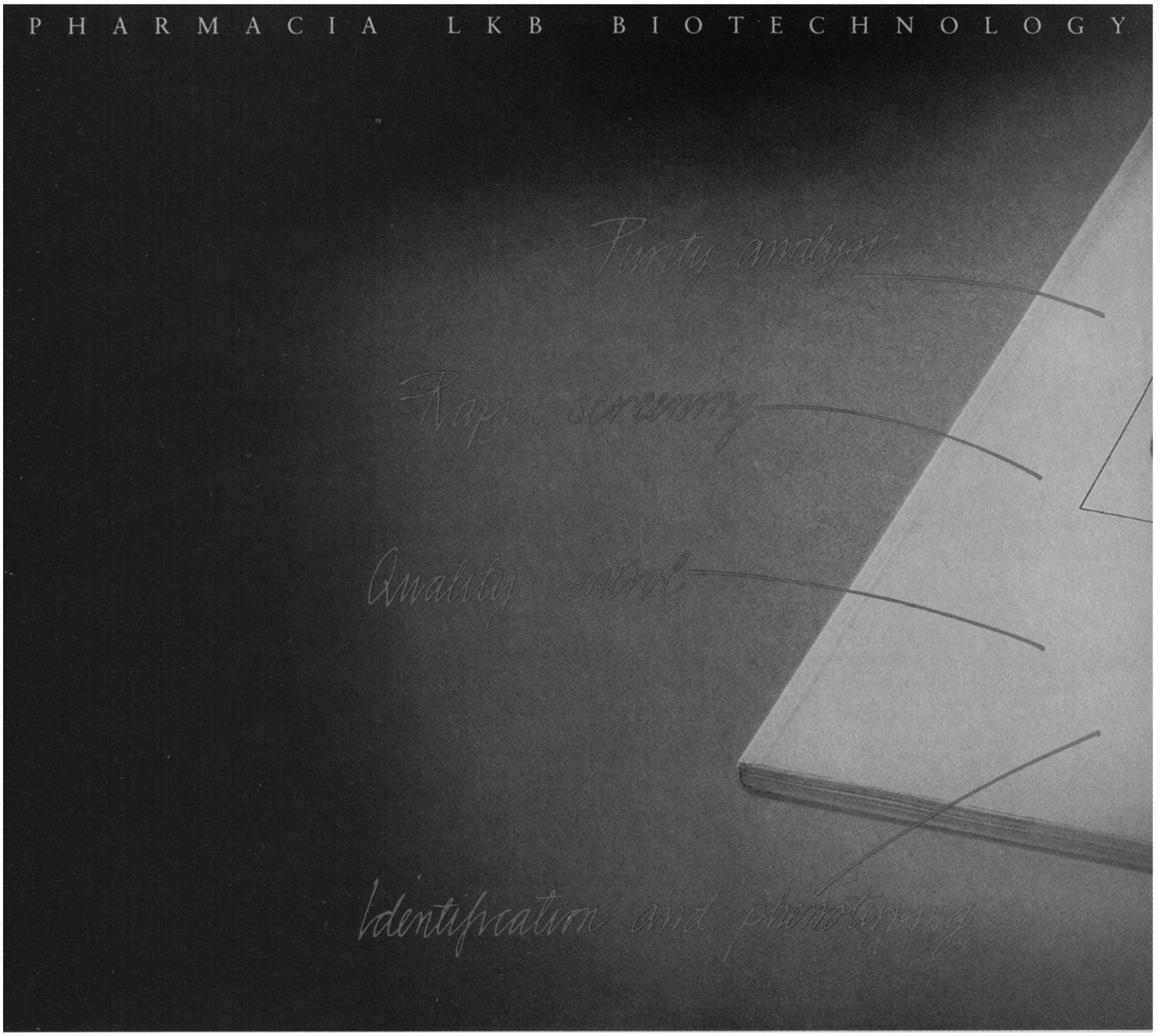

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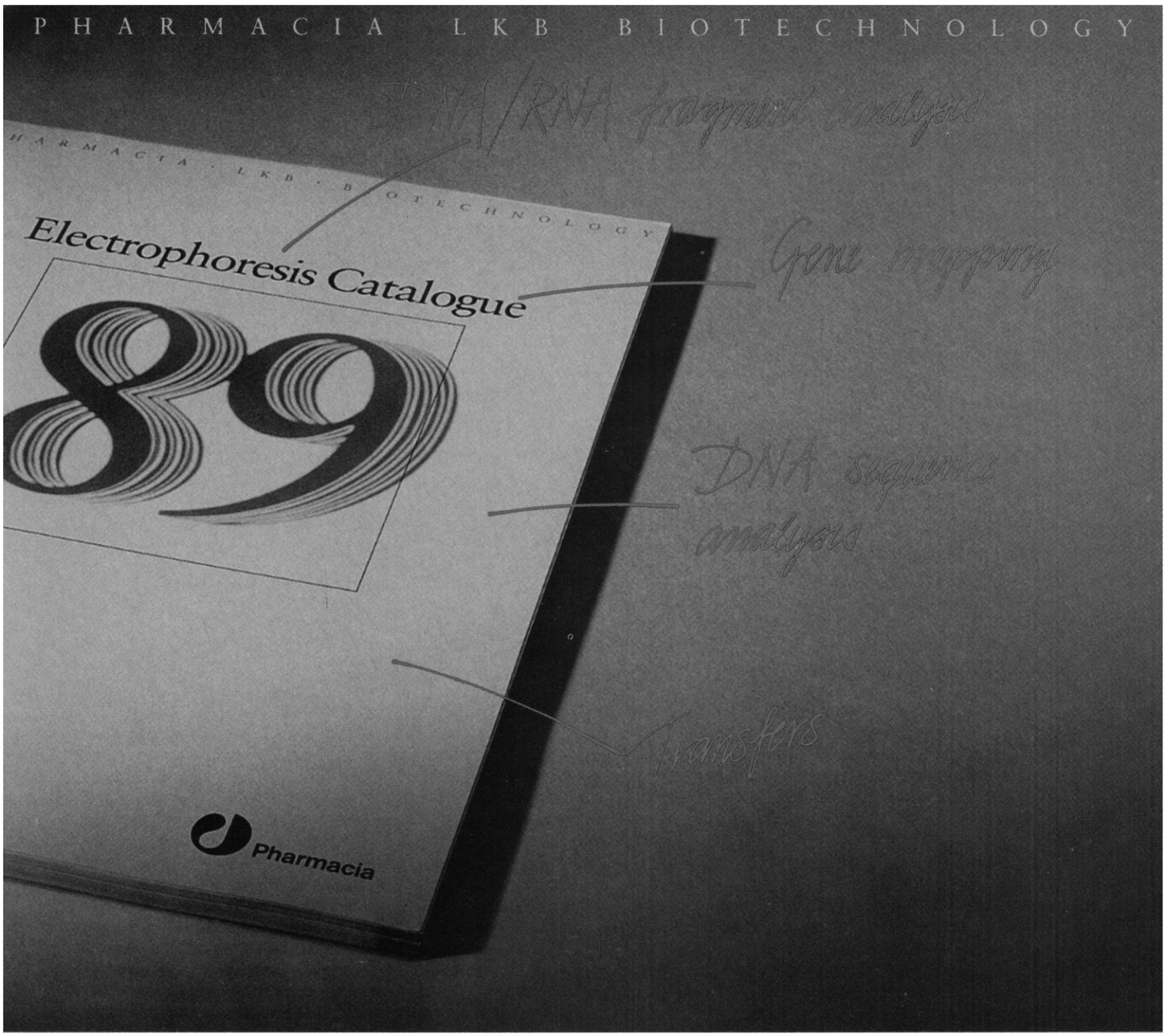

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