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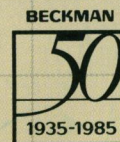
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**COVER** Praying mantis, *Tenodera aridifolia sinensis*. The prominent eyes of the mantis reflect its striking visually mediated behaviors, especially prey capture. While mantises, in general, are diurnally active, many are also active at night when hearing may play a dominant role in their natural history. See page 727. [David D. Yager, Division of Biological Sciences, Cornell University, Ithaca, NY 14853]

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## This Week in SCIENCE

### Metallothionein structure crystal clear

**R**at metallothionein, a member of a class of small, ubiquitous proteins, has three-dimensional features that account for its ability to bind metal ions (page 704). Furey *et al.* studied the three-dimensional structure of metallothionein from liver and interpreted the crystallographic results with reference to earlier biochemical and biophysical data. The protein of 61 amino acids, 20 of which are cysteines, folds into two globular domains (regions) of equal size. (The 20 cysteines are in invariant positions in metallothioneins from diverse sources, indicating their importance in the proper functioning of the molecules). The sulfurs of the cysteines can form chemical bonds linking either two metals or a single metal to the protein. In the  $\alpha$  domain there are four metal binding sites, and in the  $\beta$  domain there are three. Clusters of metals bound to cysteines form the cores of each domain, a single layer of protein wraps around each core, and water-soluble side chains extend outward. Metallothioneins seem to serve many functions: they are active during embryonic development, in normal cellular functioning (for such purposes as storing trace elements and inducing zinc-requiring enzymes), and in response to various types of stressful situations (such as detoxifying the body of heavy metals).

### Simulating a fault

**H**alite, common salt, has been used to study how materials along a fault may deform as strain builds up and the fault slips during an earthquake (page 711). Two features of halite make it an especially suitable substance: its consistent behavior illustrates how slow changes occur along a fault, and its ductility (it deforms by plastic flow) at room temperature is like that of rocks of the earth's deep crust which are ductile at high temperatures or confining pressures. Shimamoto studied responses of a thin

layer of halite on the cut surface of a sandstone cylinder as slip rate and pressure were varied. The halite showed a full range of deformations, from brittle to ductile. Measurements of halite deformations could help explain behavior of active faults at plate boundaries where strain accumulation is released by earthquakes. Until means are developed for directly studying rocks at depth, analog materials such as halite must substitute in analyses of fault-associated processes.

### Cyclopean ear of the praying mantis

**T**he praying mantis, *Mantis religiosa* (cover), which was thought not to have true ears for hearing, has been found to have a single ear in a groove in the middle of its body (page 727). In studies of nerve cell responses to sounds, responsiveness was particularly acute for sounds at ultrasonic frequencies, and an ultrasound-sensitive interneuron was identified by intracellular recording techniques. Neural studies localized the single ear to the general area of the groove region; further studies in which isolated body regions were coated with petroleum jelly pinpointed the ear to the groove, which was shown to be both necessary and sufficient for hearing. Yager and Hoy speculate that ultrasound responsiveness may be used during mating or may alert mantises to the approach of insectivorous bats that use echo-location for finding prey.

### Ivermectin treatment for "river blindness"

**A** chemotherapeutic drug, ivermectin, can reduce both the clinical severity of onchocerciasis or "river blindness" in infected individuals and the rate of spread of the disease (page 740). Blood-sucking black flies (*Simulium yabense*) transmit parasites (*Onchocerca volvulus*) from person to person in the savannas and tropical rain forests of West Africa; the disease agent is similarly transmitted in regions of

South and Central America and the Arabian peninsula. When a person is bitten by a fly, parasites are picked up or deposited; worms mature in the skin and produce microfilariae, the infective embryonic forms that cause both skin and eye lesions and, in the worst cases, blindness. Previous work had shown that a single dose of ivermectin caused no serious side effects but significantly reduced the skin population of microfilariae for up to 6 months after treatment. Cupp *et al.* found that, with fewer microfilariae available in skin, flies feeding on treated individuals effectively were unable to transmit the disease agent during that time. Ivermectin has been used in veterinary medicine and may prove an effective adjunct to or replacement for insecticide programs against human onchocerciasis, a disease that afflicts 20 to 40 million people worldwide.

### Todorokite synthesized

**E**conomically important metals, including cobalt, nickel, copper, zinc, and magnesium, may be traced to their sources in the ocean through analyses of the complex manganese mineral todorokite (page 717). Natural todorokite, which is often a major constituent of deep-sea manganese nodules, concentrates metals from ocean waters into crystals formed of tunnels, with manganese oxide octahedral structures aligned corner to corner and edge to edge. Golden *et al.* describe a two-step procedure for producing pure synthetic todorokite crystals from magnesium, manganese, sodium, and oxygen. Infrared spectra of synthetic and natural todorokites showed that the chemical compositions were similar, and electron diffraction patterns and high-resolution electron micrographs showed that the synthetic product had the tunnel structure characteristic of the natural mineral. If the size and composition of the tunnels of a crystal reflect the chemical environment in which it formed, todorokites could provide the clues required for locating metal resources deep in the sea.



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## Future Supplies of Energy and Minerals

**M**ost past estimates of long-term future demands for energy and mineral resources have been outmoded by events. The projections led to predictions of large unsustainable requirements for energy and to pessimism about the future. The estimates did not adequately take into account the impact of the oil crises of the 1970's in stimulating the use of human ingenuity to adjust to new circumstances.

A Dahlem Conference held in Berlin 12 to 17 January provided the basis for less pessimistic views. At the end of the meeting it was a widely held conclusion that during the next 50 years mineral supplies would probably be adequate for global demands. There was less confidence about energy. It was generally thought that the developed countries could obtain adequate supplies but that the future of the less-developed countries was uncertain.

In the past, one of the major uses of energy in developed countries has been in the winning and industrial processing of minerals. In these countries the manufacture of goods involving minerals now represents a decreasing percentage of the gross national product. Demand for many major consumer goods is near saturation. Requirements for primary materials are being decreased by enhanced efficiency of use, including recycling, better engineering, and advances in manufacturing techniques. Downsizing of automobiles by U.S. manufacturers has led to a decrease in materials consumption by that industry of more than 25 percent in the past decade. Current emphasis on quality control will result in longer lives for products such as automobiles.

Another factor that is decreasing the need for energy while increasing the flexibility of the economy is substitution of, for example, polymers and composites for more energy-intensive materials such as steel. This leads to lighter motor vehicles and further energy savings through less fuel consumption. Substitution is likely to have an important role in reducing dependence on imports of minerals. For example, ceramic matrix composites can replace superalloys that contain such elements as cobalt, chromium, and columbium.

A sufficient number of improvements in efficiency of energy use have occurred so that it seems feasible for the developed countries to raise their standard of living without increasing the use of energy. What will happen in the less-developed countries is not predictable. It is clear that availability of energy alone is not a magical answer. Korea, with practically no indigenous fossil fuel, has experienced a fast-growing economy. Most of the oil-rich less-developed countries have not provided for their future well-being. Some others will probably barely be able to obtain enough food for growing populations.

At the Dahlem Conference a group of leading earth scientists considered the matter of economic minerals from the standpoints of present reserves and probable future discoveries. By reason of improved techniques employing geophysics and geochemistry, explorationists have been able to maintain effectiveness in terms of ore found per unit of effort. In Canada, where massive copper-containing sulfide deposits are being mined, no appreciable decrease in grade has been noted. The often cited drop in grade of copper ore in the United States was attributed to a decision to mine low-grade porphyry ores because of lower costs.

Three frontiers for exploration were cited, including the continental shelves, the ocean deeps, and the continental crust. The probability is high that in the developed countries sizable deposits are present but under cover. As improved exploration techniques become available, future exploration for minerals may tend to occur in developed countries.

The Dahlem Conferences\* are conducted under a formula that makes for good transfer of information and positive interaction of participants, whose number is limited to 48. Before the conference, about half the participants are asked to provide background articles on the topics to be discussed. These articles are distributed well in advance of the meeting so that when participants meet, they can begin discussions on an informed common level. These discussions lead to opinions and conclusions that are brought together with the invited articles to form a book. In the present instance, a second, related conference will be held in late April on water and land. The results will be published either in a single book or as companion volumes.—PHILIP H. ABELSON

\*Dahlem Konferenzen, Wallotstrasse 19, D-1000 Berlin 33, Federal Republic of Germany.



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## Letters

### The Scientific Method

Some months ago (25 Oct., p. 391), editor Daniel E. Koshland, Jr., wrote an editorial voicing a view (identified in the philosophical literature as "scientism") that the success of science and high technology in improving life conditions demonstrated that the scientific method is a universal method applicable to social problems. In particular, he stated that any scientist (knowing scientific method) could formulate a null hypothesis about a social problem, such as the teaching of math or the treatment of prisoners, undertake an experiment in a real-world situation, and, by statistical testing, determine the best course of action.

Three letters were published (20 Dec., p. 1410) commenting on the editorial, two laudatory and, if anything, more extreme in viewpoint, and one critical. The last, by a statistician, correctly pointed out a flaw in the design of the experiment. It strains credulity to believe that there was but one mildly critical letter about a subject on which there is an immense literature in statistical theory, philosophy, and public policy, pointing out the hazards of experimenting in the real world.

Indeed, I hope the editors of *Science* are not unaware that there are epistemological, ontological, logical, and ethical aspects of the subject of science and the scientific method. Scientism, a populist version of logical positivism, has been largely abandoned by the philosophical community. In a sense, the Koshland position is not surprising: every natural scientist seems to harbor a secret belief that potentially he is a master of every social science and could find the answer to every social problem.

It should be obvious to any scientist, however, that science could not consist solely of testing hypotheses by statistical means. If that were true, ordinary knowledge about how to start a car or open a can would be science. To be worthy of respect, science must claim to assert a lawlike relationship. In order to do so, it must be able to assert that its variables are homogeneous, and to do that, it must have some standard of comparison or evaluation, a function served by theory. It is therefore impossible to have science without theory.

Although it sounds reasonable to recommend that school children be offered courses in scientific method, it turns out that the subject, in its generality, can be approached best through philosophy, and then only at an advanced level. Anything else turns out

to be history of science, introductory statistical methods or, sometimes, logic. What actually would be more to the point is to have people who have completed their scientific degrees take courses or do reading in the philosophy of science. The objective would not be to make scientists more socially conscious—although that would be a big plus—but to make them better scientists.

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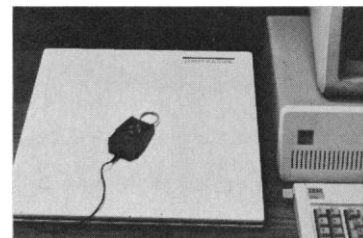
### Demography of China

A large-scale sample survey of the fertility of Chinese women, known as the 1/1000 Fertility Survey, was conducted in 1982. The survey, in which 311,000 women from 15 to 67 years of age supplied detailed lifetime histories of marriage and childbearing, has yielded an extraordinarily accurate record of changing nuptiality and fertility in China since 1940. The results at the national level were the basis of a 1984 analysis of population change in China (1).

The Chinese have also published a report on the survey (2). Although this report includes thorough documentation at the national level of changing age at marriage and rates of childbearing by age of women, the practice of different forms of contraception, and indications of differentials by rural-urban residence, education, occupation, and ethnicity, it could not fully utilize the enormous store of valuable information the survey contains.

This year computer tapes containing the individual responses of all women interviewed within each of the provinces in mainland China (except those in Tibet) were analyzed jointly by statisticians and demographers from China and staff members and consultants of the East-West Population Institute in Honolulu. These data are a demographic gold mine. The average number of respondents (11,000) per province is greater than in most national surveys; because of the precision with which Chinese respondents can report the date of birth and the extremely efficient organization of the survey, the data are complete and accurate. All eligible women were interviewed in each of 815 basic sampling units, which were production brigades in rural areas and neighborhoods in urban areas. It is therefore possible (by combining experience for several years) to compute fertility rates and other aggregate characteristics for each of these basic social units. Having, in effect, data for a probability sample of rural production brigades provides an unprecedented oppor-

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tunity to consider the large variations that exist among such units within and across provinces.

The data files also include the type of contraceptive being used at the time of the survey (including sterilization), reasons for nonuse, and the number of abortions for the 3½ years preceding the survey. Therefore, it is possible not only to relate these measures to the individual respondent's fertility but also to construct aggregate indices for each of these variables for the production brigades and urban neighborhoods and also for the rural and urban sectors of the provinces in which they are located.

Among the materials prepared for the conference was a set of tables providing age-specific and duration-specific fertility rates for the total, rural, and urban populations of each province for each year from 1940 through 1982. So far as we know, such data have never been available for any other country.

These data were fully available both to the U.S. investigators at the East-West Population Institute and to their Chinese colleagues. The preliminary results were freely discussed at a conference held recently in Beijing. Until 6 or 7 years ago, Chinese population data were held almost as a national secret. Data from the 1953 and 1964 censuses had not been published. It is clear that there has been a profound change in willingness to open Chinese demographic data to the world.

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#### REFERENCES

1. A. Coale, *Rapid Population Change in China, 1952-1982*, Committee on Population and Demography (National Academy Press, Washington, DC, 1984).
2. *Popul. Econ.*, special issue (July 1983).

**Erratum:** The cover caption for the issue of 31 January should have read as follows: COVER Branching colony of the flagellated chrysophyte *Dinobryon cylindricum* var. *palustre*. This phytoplanktonic algal genus is characteristic of nutritionally dilute lakes. Cells can supplement photosynthesis by ingesting bacteria and smaller algae. Note ingested yellow-green latex beads as well as the red fluorescence of cell chlorophyll (about  $\times 1100$ ). See page 493. [David F. Bird, Department of Biology, McGill University, Montreal, Quebec, Canada H3A 1B1]



**Erratum:** The title of the News & Comment article by Marjorie Sun on page 445 of the issue of 31 January should have been "The global fight over plant genes."

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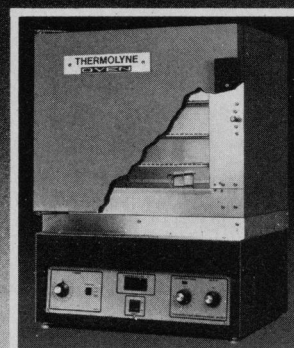
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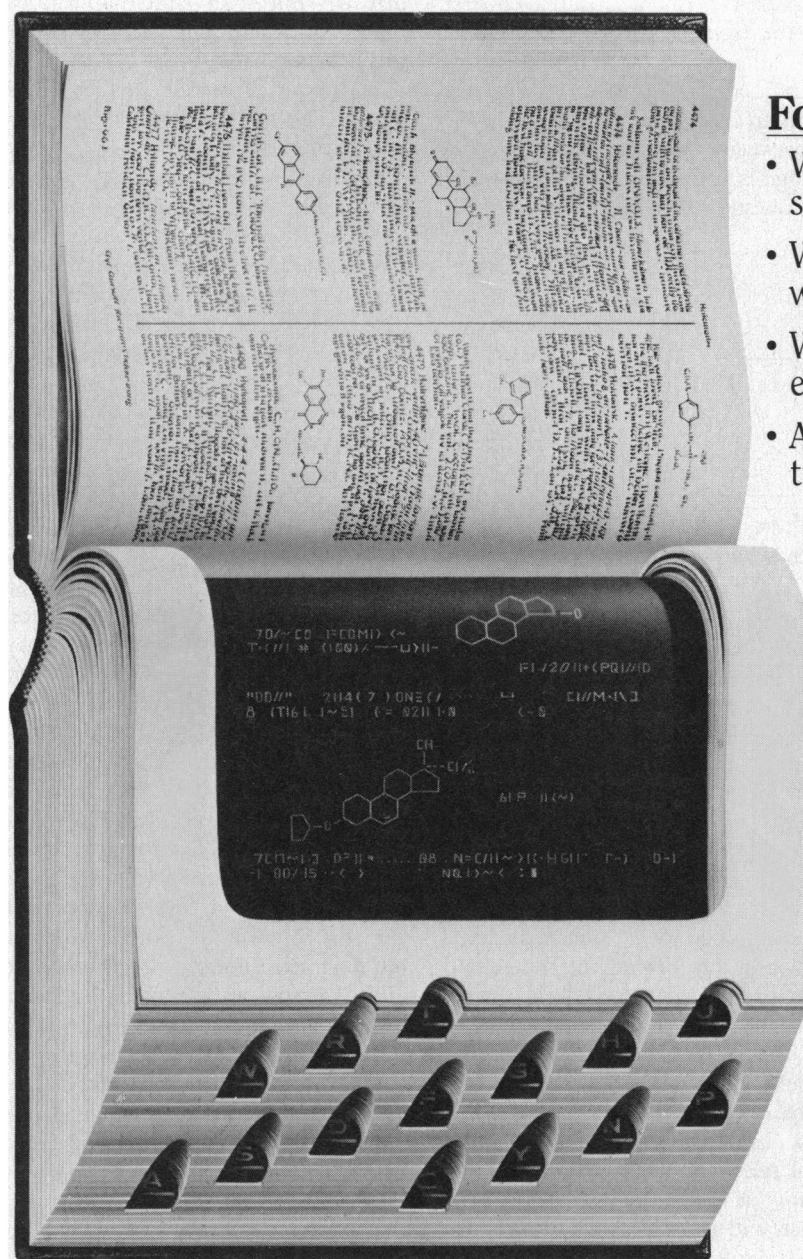
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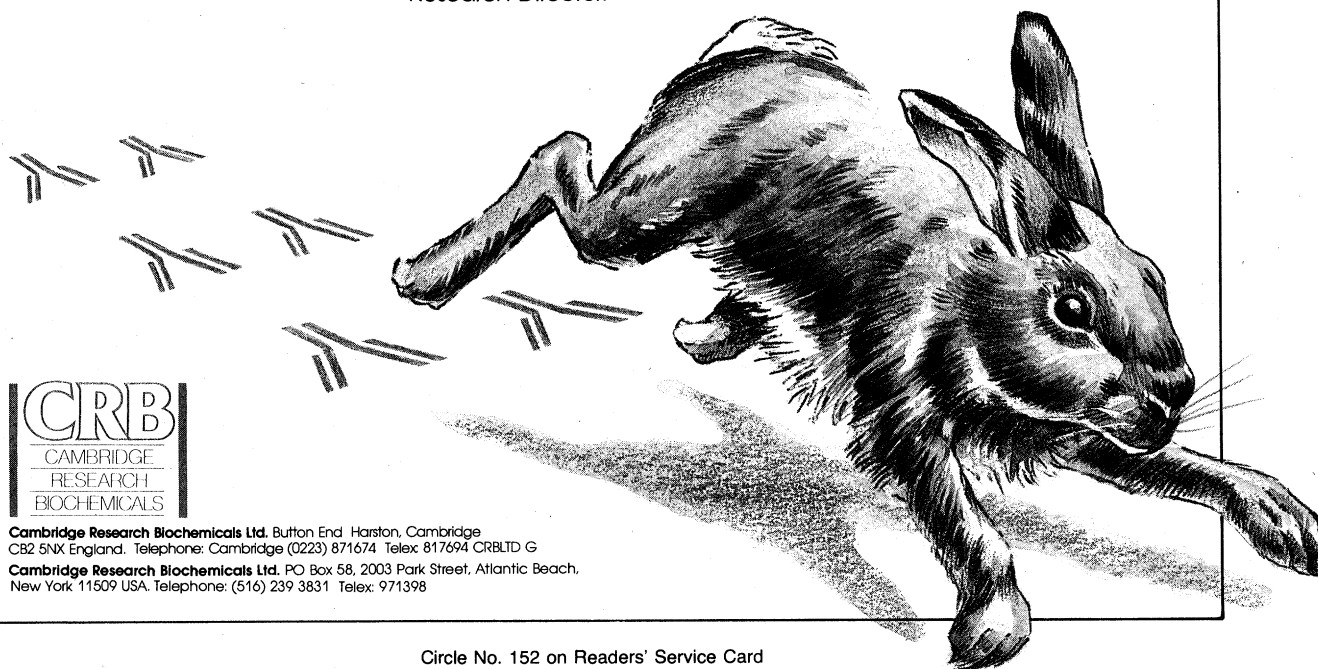
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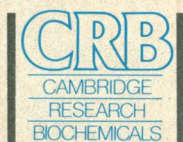
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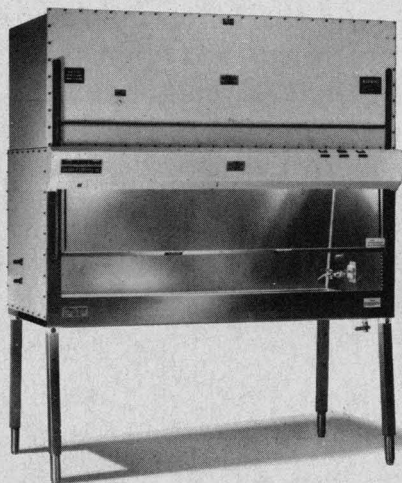
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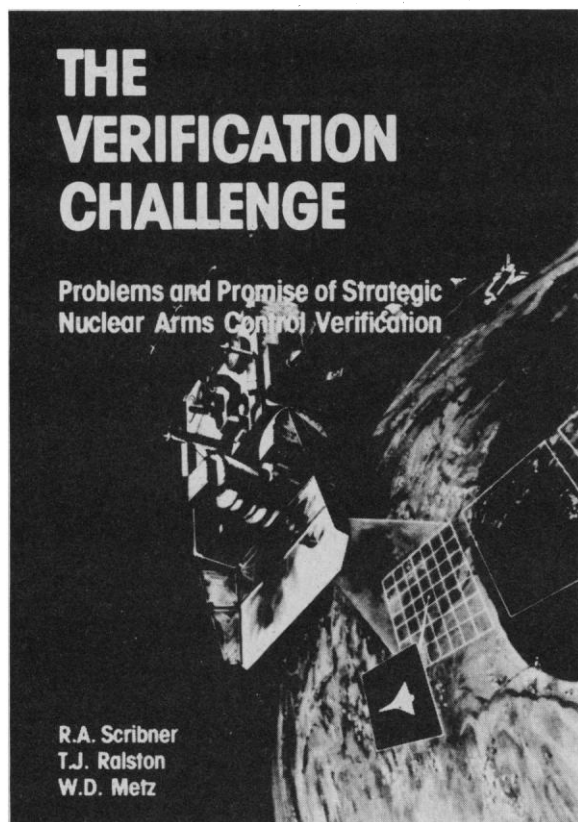


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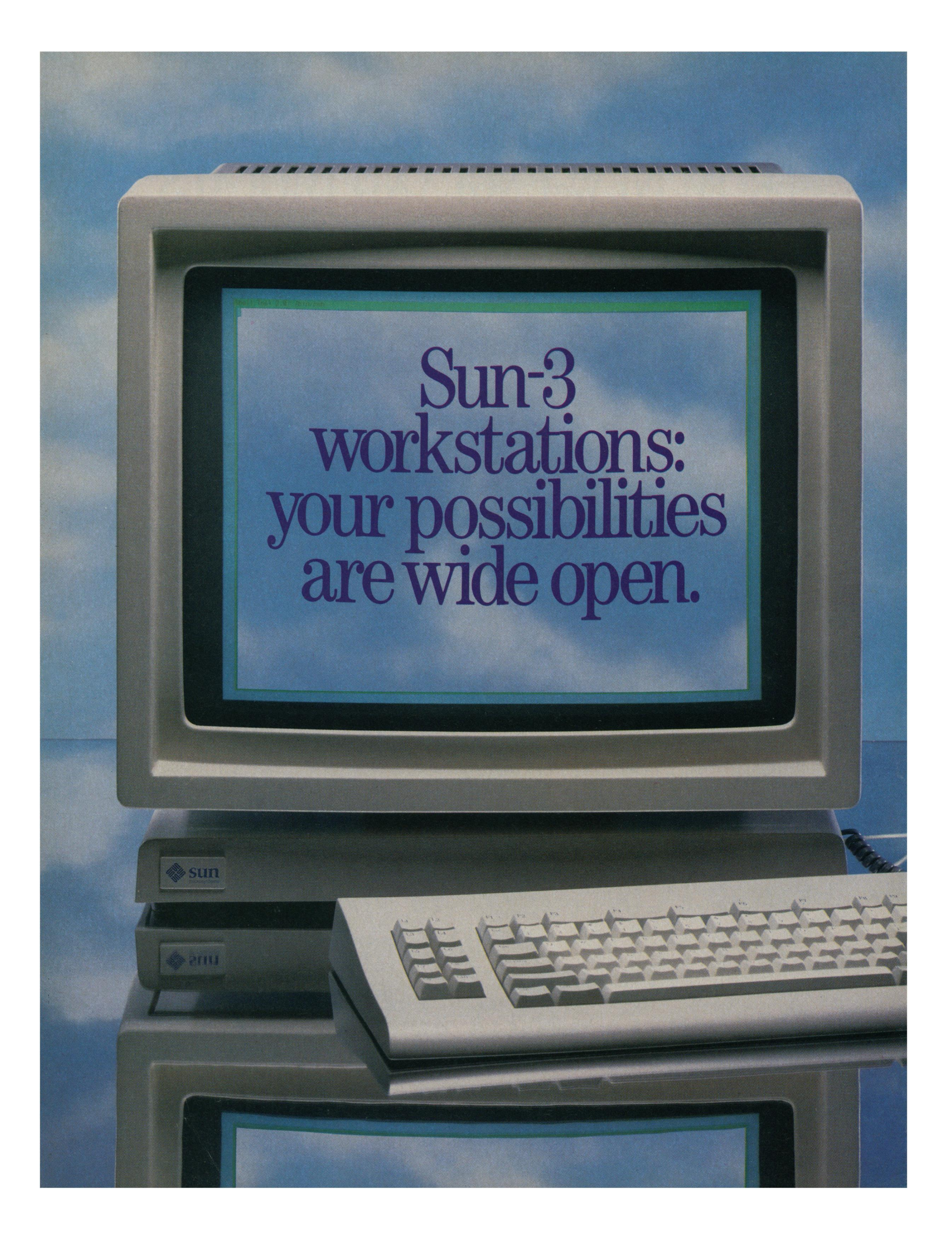


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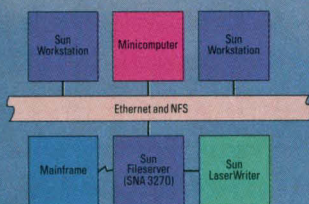
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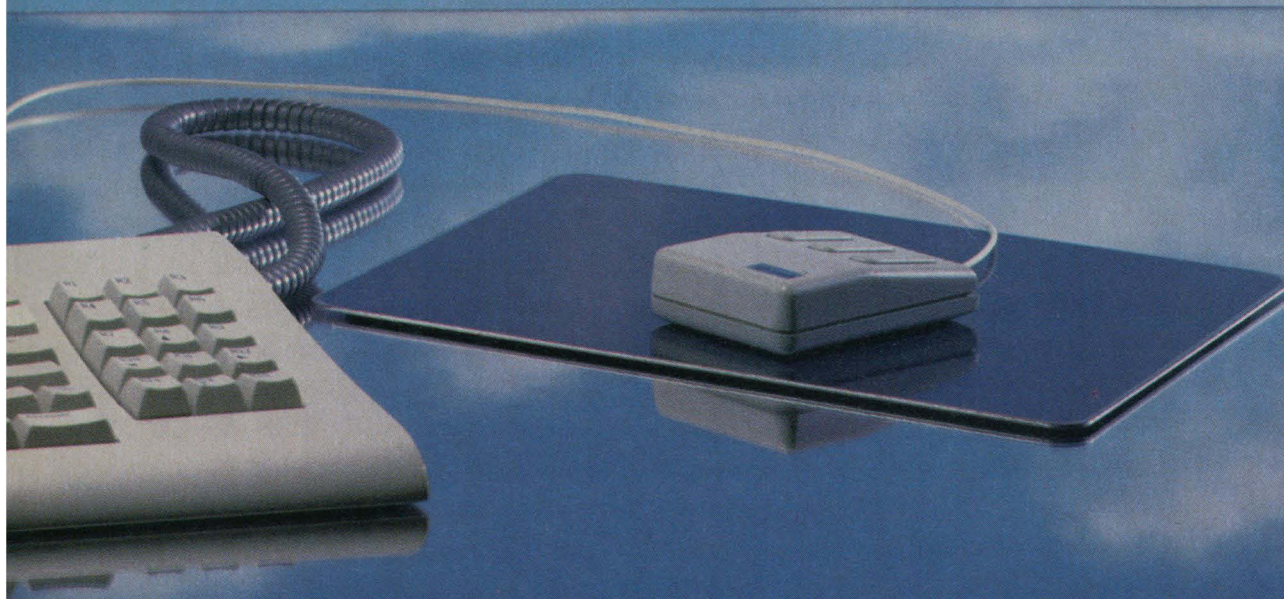
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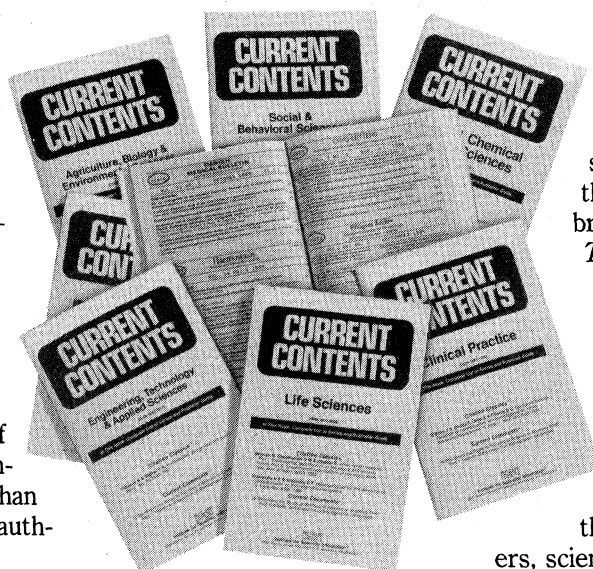


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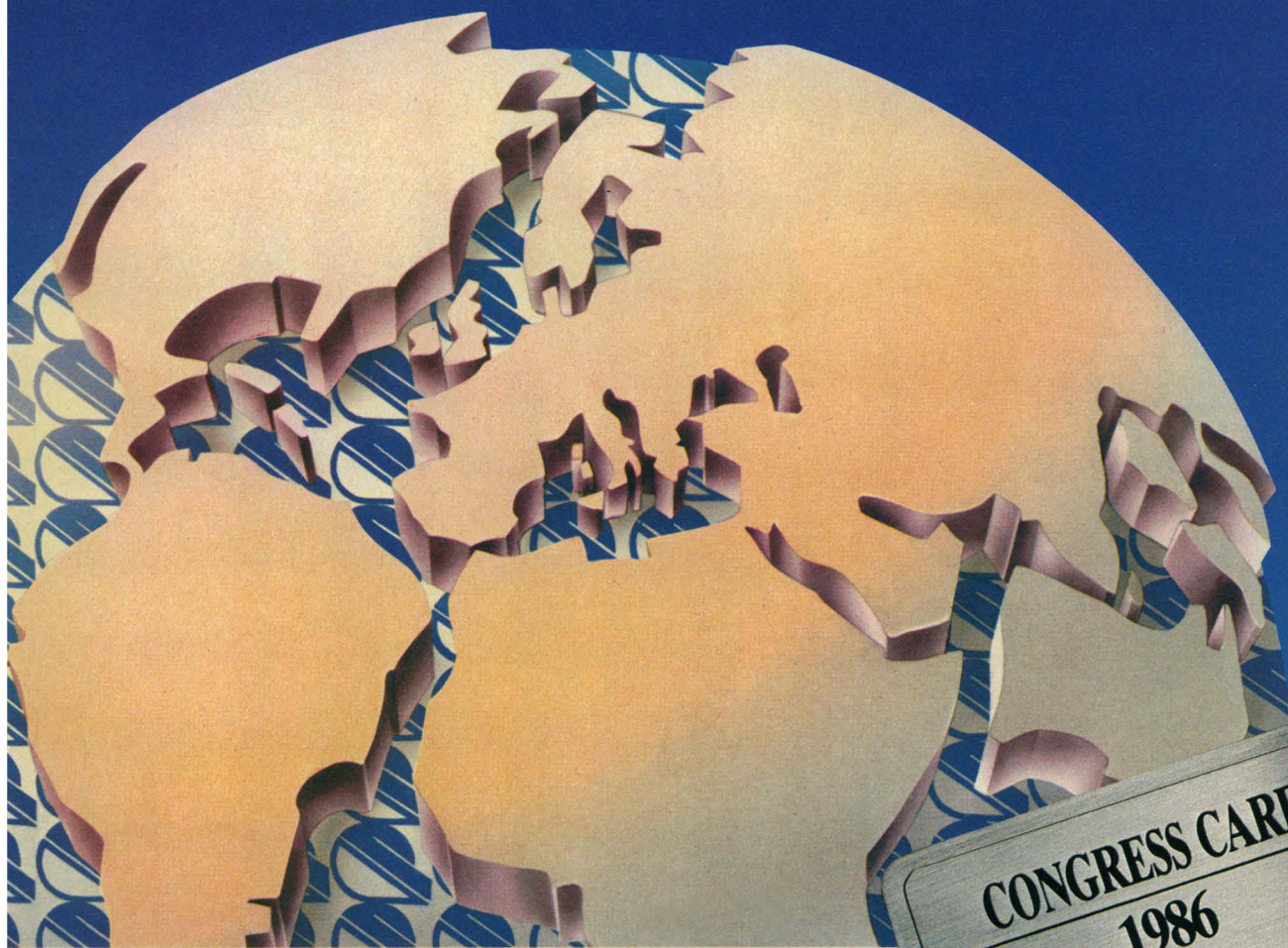
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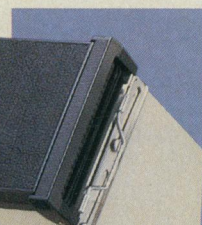
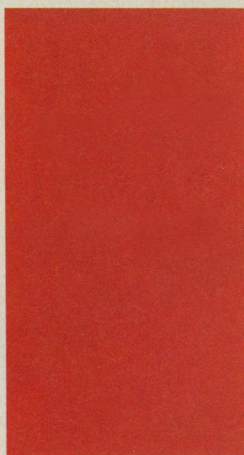
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Please type or print clearly

Name of registrant \_\_\_\_\_  
(Last) (First & initial)

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Institution/Company \_\_\_\_\_  
(To be printed on badge) (Registrant)  
\_\_\_\_\_  
(Spouse registrant)

Mailing address \_\_\_\_\_  
(Street)

\_\_\_\_\_  
(City/State) (Zip code) (Telephone number)

Convention address \_\_\_\_\_  
(Where you can be reached) (Hotel and/or telephone number)

Check days on which you will attend meeting: Sun ☐ Mon ☐ Tue ☐ Wed ☐ Thu ☐ Fri ☐

☐ Check here if you need special services due to a handicap; we will contact you before the meeting.

Name(s) of new member(s): \_\_\_\_\_

■ Your registration badge, receipt, and voucher for full Program and Abstracts will be mailed to you in mid-April. ■ Registrations received after 9 May will be held at the Advance Registrants' Desk at the Franklin Plaza Hotel. ■ Refund requests must be made by letter or telegram to the above address before 16 May 1986 and will be honored after the Meeting. No refunds are made on cancellations received after this date. ■ Student registration fees apply to full-time undergraduate or graduate students only.

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Send confirmation to:

Name \_\_\_\_\_  
(Last) (First & initial)

Mailing Address \_\_\_\_\_  
(Street)

\_\_\_\_\_  
(City/State) (Zip code) (Telephone number)

Other occupant(s) of room: \_\_\_\_\_  
(Name) (Name)

Indicate special housing needs due to a handicap: ☐ wheelchair accessible

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Charge my major credit card (card type): \_\_\_\_\_

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Signature \_\_\_\_\_

**Hotel Rates** (Add 9%: 6% sales and 3% occupancy tax). Indicate 1st, 2nd, and 3rd choice of hotel; check appropriate box for type of room desired.

| Choice | Hotel                     | Single                        | Double or Twin                | Parlor + 1 Bedrm.                   | Parlor + 2 Bedrms.                  |
|--------|---------------------------|-------------------------------|-------------------------------|-------------------------------------|-------------------------------------|
| _____  | Franklin Plaza            | <input type="checkbox"/> \$69 | <input type="checkbox"/> \$79 | <input type="checkbox"/> \$140 & up | <input type="checkbox"/> \$365 & up |
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Arrival date \_\_\_\_\_

Time \_\_\_\_\_ ☐ a.m. ☐ p.m.

Departure date \_\_\_\_\_

Time \_\_\_\_\_ ☐ a.m. ☐ p.m.

Be sure to list definite arrival and departure dates and times. Reservations will be held only until 6 p.m. unless accompanied by 1 night's deposit or major credit card guarantee.

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■ Rollaway beds or extra person in room: Franklin Plaza, \$10; Hershey, \$10; Holiday Inn, \$7.

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