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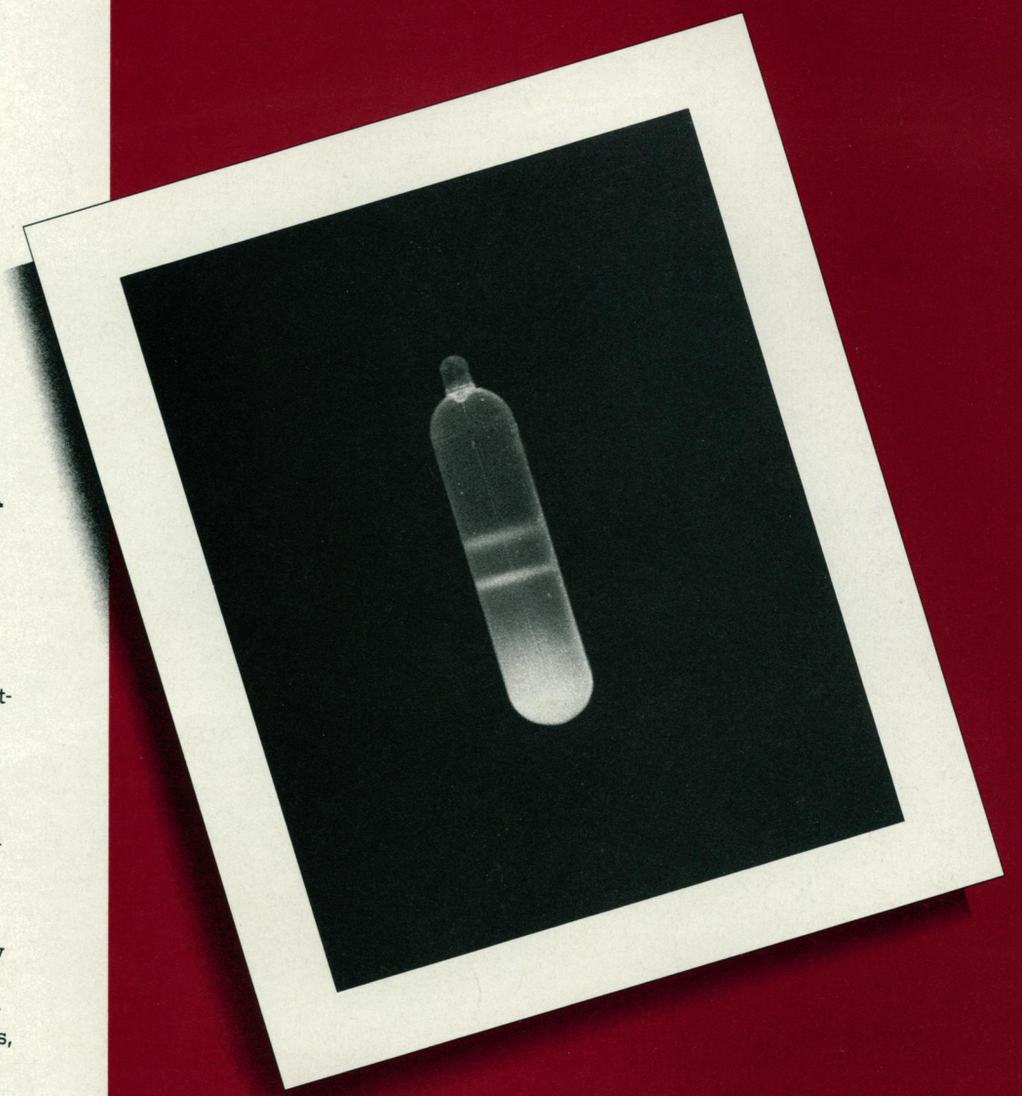

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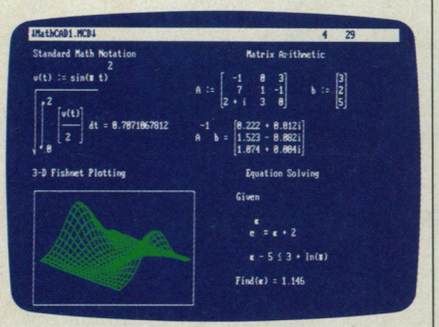

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■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

COVER An aggregation of crown-of-thorns starfish (*Acanthaster planci*) on a staghorn *Acropora* coral, Great Barrier Reef, Australia. The starfish feed on the coral polyps, leaving behind a bleached skeleton. The white branches were recently eaten; the overgrown basal branches have been dead for several months or more. In recent years, *A. planci* outbreaks have caused extensive damage to a large section of the Great Barrier Reef. See page 847. [Photograph by Len Zell; courtesy of The Great Barrier Reef Marine Park Authority, Townsville, Queensland, Australia]

Color blindness

HUMAN blue cone monochromacy is a form of color blindness in which all colored light looks like gray. The condition is inherited as an X-linked trait. Affected males have functioning rods and blue cones, which are photoreceptors that respond to light at 500 and 440 nanometers, respectively; they lack functioning red cones and green cones, which normally respond to light at 565 and 535 nanometers. The genetic defects that underlie this condition have been studied by Nathans *et al.* (page 831). The X chromosomes of affected individuals in 12 families all had alterations in the gene cluster responsible for the production of red and green visual pigments. Two categories of mutations were noted. In some, DNA adjacent to the red and green visual pigment genes was deleted; both pigment genes were then nonfunctional, suggesting that the deleted material included information crucial to the control of transcription of pigment genes. In the second group, only one of the tandem array of visual pigment genes remained and this gene had been rendered nonfunctional by a point mutation. These mutations rarely affect longevity or fecundity, and so it is anticipated that this is one of the forms of color blindness that is on the increase in the population.

Superhard solids

Is it possible to prepare materials that are harder than diamonds? Liu and Cohen predict that it is and that C_3N_4 covalently assembled much like β-Si_3N_4 might be a candidate material for such a superhard solid (page 841). Their prediction is based on an empirical model of the bonding patterns and other structural and electronic features that a superhard covalent solid should have and on first principles calculations of the bulk modulus (a measure of hardness for an ideal crystal) and related structural properties of C_3N_4. C_3N_4 is only a hypothetical compound, but it might form from amorphous carbon nitride under extreme conditions of pressure and temperature; the transition to C_3N_4 could be similar to that which accompanies the formation of diamond from graphite. The creation of new types of materials that are superhard or have other extreme physical properties or unusual combinations of properties is one of the major goals of materials science.

Monolayer technology

DEVICE manufacturers search for novel methods by which to put complex patterns onto surfaces. A promising chemical derivatization procedure is described by Laibinis *et al.* that results in the formation of two different self-assembling monolayers on exposed surfaces of a gold–aluminum oxide substrate (page 845). After the substrate was immersed in an isooctane solution, a relatively pure monolayer of alkanethiol formed on the exposed gold surfaces and a similarly pure monolayer of alkane carboxylic acid formed in association with the aluminum oxide. Each orthogonal monolayer developed along the plane of the surface. A similar pair of independent monolayers formed when a microelectrode array of gold and aluminum wires was used as substrate. This remarkable selectivity of precursor molecules for one metal or one metal oxide may add new flexibility to device-pattern technology.

Crown-of-thorns starfish

AT the Great Barrier Reef, there have been two population explosions of crown-of-thorns starfish (cover) since 1962. These starfish devour living coral and have caused massive reef destruction. Are the outbreaks natural and recurring events or do they represent a new, anthropogenic phenomenon? Walbran *et al.* argue that outbreaks of crown-of-thorns starfish have been part of local reef ecology for thousands of years, perhaps since Holocene reef growth began some 9000 year ago (page 847). Skeletal elements from crown-of-thorns starfish, which are distinctive in color, shape, and microtexture, were counted in surface (contemporary) and subsurface (ancient) sediments from three areas of the reef. John Brewer and Green Island reefs, both of which were heavily hit in the recent outbreaks, had many surface and many subsurface skeletal elements; in contrast, few skeletal elements of these starfish were recovered from surface and subsurface sediments of Heron Island Reef, where the density of crown-of-thorns starfish has been low for at least 35 years. If they have been enduring reef inhabitants, the crown-of-thorns starfish may have contributed both to the infrastructure of the reef and to its species richness.

Cocaine pharmacotherapy

THE drug buprenorphine suppresses the self-administration of cocaine by rhesus monkeys (page 859). Mello *et al.* report that monkeys that had been self-administering cocaine for 6 months to a year stopped working for cocaine—but not for food—upon receiving buprenorphine. Thus the drug did not have a blanket suppressing effect on behavior but altered specifically the drive for cocaine. Might buprenorphine prove to be an effective treatment for cocaine addiction in humans? Buprenorphine is not chemically similar to cocaine and exactly why it suppresses cocaine effects is unclear. It is an opioid with both agonist (like morphine, heroin, and methadone) and antagonist (like naltrexone) effects. Cocaine, in contrast, is considered to act through the dopaminergic neural system. The observation that buprenorphine counters cocaine effects strengthens the hypothesis that the opioid and dopaminergic systems interact in the brain. In clinical trials, buprenorphine has suppressed heroin use by heroin addicts; its clinical value might therefore extend to double abusers of cocaine and heroin. There appear to be no serious withdrawal problems associated with buprenorphine use.

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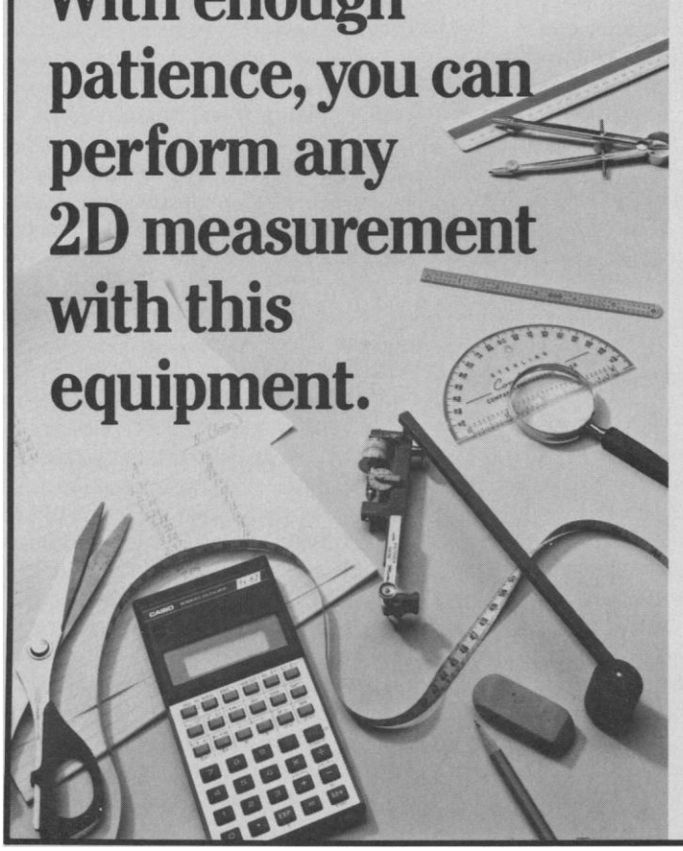

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Solar Power and Priorities

A short while ago *Science* published a cartoon of a desert scene with a lone billboard proclaiming, "Invest now! Greenhouse Estates coming soon: the best in ocean front living!" It would indeed be ironic if the cartoonists and the real estate agents were more thoughtful planners than the governments of the world. As serious as the problems of acid rain, toxic waste, and depletion of the ozone layer are, the greenhouse effect looms over all of them because it poses such great potential damage to the environment and is by far the most difficult to solve (see "Issues in atmospheric science," *Science*, 10 February 1989). The consensus prediction for a doubling of the CO_2 concentration, for example, is the year 2050—extremely close for a solution requiring scientific innovation, political courage, and international cooperation.

In developed countries the standard of living has been correlated with energy consumption per capita, with a steady rise in consumption occurring in the countries already consuming the most energy. In developing countries the consumption of energy is much lower, but the rate of increase is high. That mixture is explosive because developed countries argue that there is no point in conserving energy if developing countries keep using up the margin, whereas developing countries argue that they deserve to reach the consumption level of their rich peers. One might argue that we should delay action until the data on the current global warming are conclusive were it not for the fact that the energy industry is so massive. Even after a course of action is agreed upon, years will be required to implement it. Damaging environmental effects may be irreversible by then. A further argument against delay is that the remedies for the energy problem will help solve other environmental and economic problems.

The first and most important decision is the inauguration of a massive effort to use solar power. Solar power is not now cost-effective compared to oil. When the temporary energy crisis in 1973 and 1974 was over, the pressure for immediate alternative sources of energy disappeared. The long-range problems were forgotten. To develop solar energy technology to supply large amounts of power (not just for satellites and specialized missions, important as they are) should be a major priority of our civilization. It will be more and more cost-effective as oil becomes more and more expensive.

The energy crisis requires both technological fixes, such as solar energy, and societal restraint fixes, such as limits on the sizes and number of automobiles. The list of actions could go on to include major conservation efforts, better urban planning, encouragement of mass transit, tax laws to save our high-rise central cities, and zoning to decrease urban sprawl. If those measures, which will take much political courage, are to have a chance, they must be accompanied by some tough dealing on international issues. The developed countries can hardly say to the developing ones that the globe is at its limit of producing greenhouse gases and newcomers must stick to using bicycles. The developing countries, on the other hand, can hardly tell the developed countries that they must subsidize the continuing population explosion. Some international trade-offs can obviously take place: developed countries can concentrate on conservation plans and the funding for technological solutions; developing countries can concentrate on solving the overpopulation problem and preserving their forests and greenlands. The Montreal protocol on phasing out chlorofluorocarbons is a good first step in international cooperation.

Clichés about world peace roll readily off the tongue, but there is perhaps no more dramatic form of aggression of developed countries against developing ones than a gradual global warming. Developed countries are largely in temperate zones and can survive increases in temperature. Many developing nations lie in the tropics, and greenhouse climate changes could make life marginal and desperate. Fortunately, this is not a case of "them against us," for we are all in this environment together. The problem is one that will require politicians to think beyond the next election and citizens to think beyond the next generation. It will require the combined and dedicated attention of physicists, chemists, biologists, engineers, city planners, economists, efficiency experts, and politicians.

There is, of course, an alternative. We could pick an appropriate mountain and build on it a gigantic space vehicle designed to allow a male and a female of each species to be blasted off to live happily ever after on a distant but more livable planet, such as Venus.

—DANIEL E. KOSHLAND, JR.