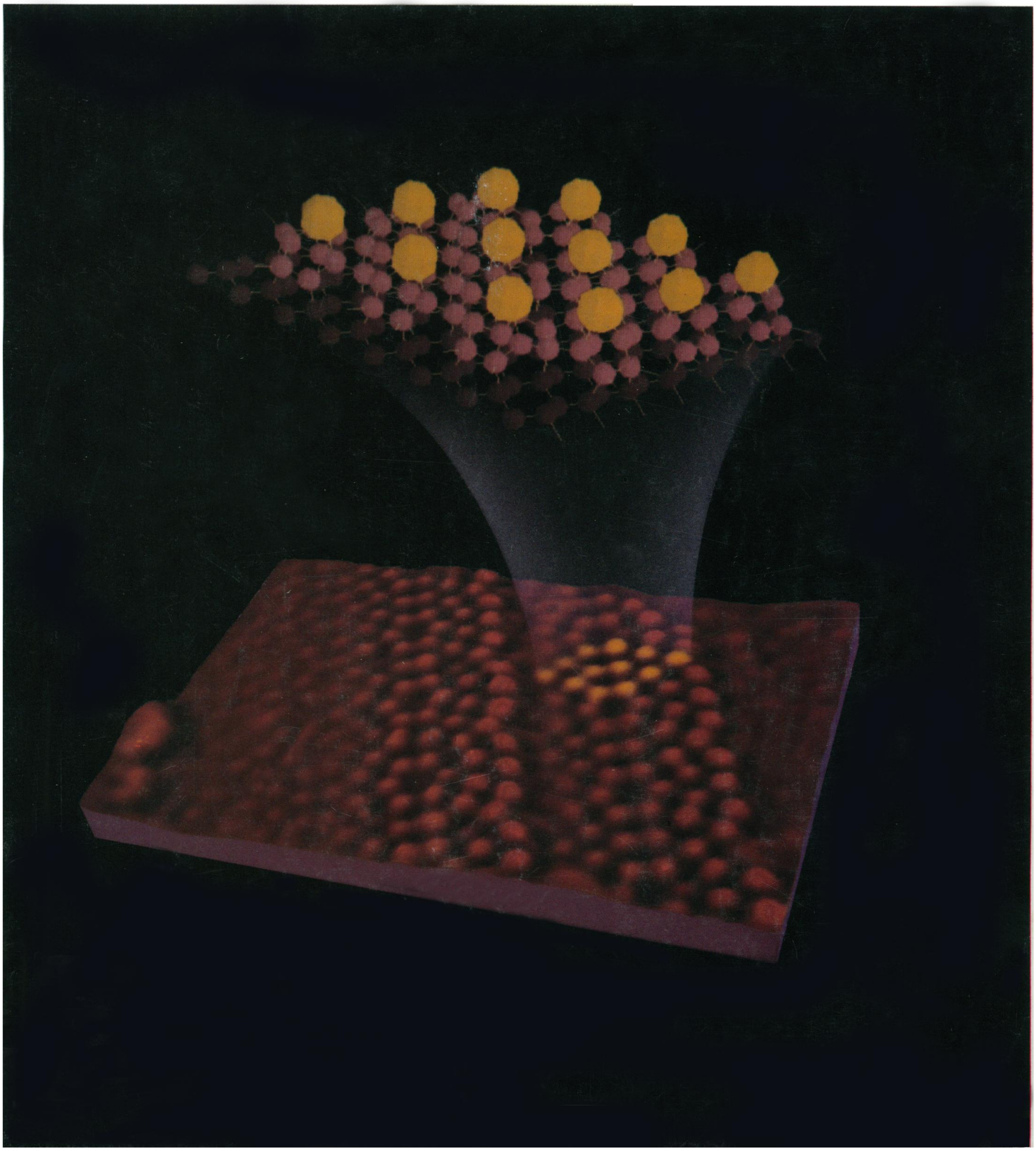
American Association for the Advancement of Science

Science

4 April 1986 $2.50
Vol. 232 ▪ Pages 1–132



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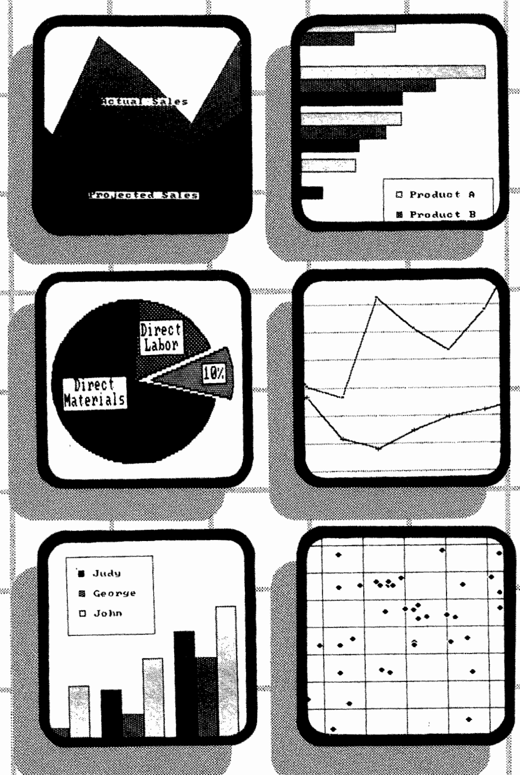

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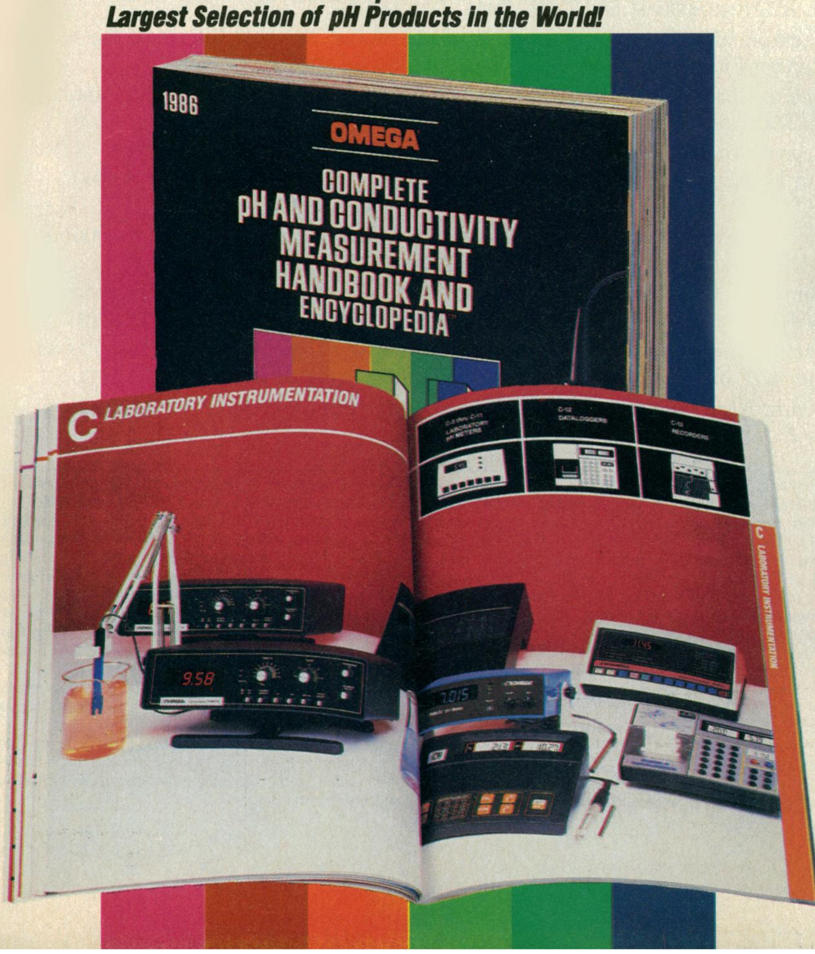

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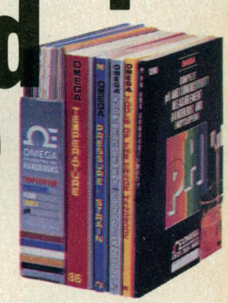

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AMERICAN
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SCIENCE

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NUMBER 4746

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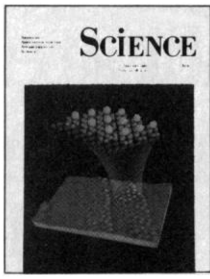
■ **SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005.** Second-class postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Now combined with **The Scientific Monthly®** Domestic individual membership and subscription (51 issues): $60. Domestic institutional subscription (51 issues): $98. Foreign postage extra: Canada $24, other (surface mail) $27, air-surface via Amsterdam $65. First class, airmail, school-year, and student rates on request. Single copies $2.50 ($3 by mail); back issues $4 ($4.50 by mail); Biotechnology issue, $5.50 ($6 by mail); classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. **Postmaster:** Send Form 3579 to *Science*, 1333 H Street, NW, Washington, DC 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

■ 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 Atomic structure of a silicon crystal surface obtained from a tunneling microscope. The atomic reorganization at the surface of both flat atomic (111) planes and the atomic steps are seen in a 100 by 100 angstrom region. A unit cell of the 7×7 surface reconstruction is highlighted with an expanded computer-generated model above, which accounts for the observed structure. See page 48. [R. S. Becker, J. A. Golovchenko, and B. S. Swartzentruber; artistic assistance provided by J. Drobny and C. Jernstedt, AT&T Bell Laboratories, Murray Hill, NJ 07974]

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Visual skills not acquired in fly-by-night fashion

A fly's ability to make visual discriminations is not hard-wired in its nervous system but is learned during the first days after emergence from the pupal stage (page 83). Dewinged flies living in normal light-dark environments readily discriminate among visual patterns: they prefer and walk toward a star-shaped pattern and like least a pattern of equal luminosity consisting of oblique bars. Mimura found that flies cannot make visual distinctions if they have been growing in either a dark environment or in a light environment lacking visual stimuli. Only if they have been exposed to a lighted, patterned environment during the first days after emergence from the pupa do they learn to distinguish among the patterns, and 4 to 6 days are needed for complete pattern learning. Since pattern recognition and visual discrimination appear to be learned early in the life of flies, much as they are in vertebrates, this model may be useful for determining how neurologic networks develop in both vertebrates and invertebrates and what molecular mechanisms contribute to the establishment of visual-discrimination behavior.

Big DNA molecules lurch through gels

HUGE molecules of DNA can be separated from others of similar size by field inversion gel electrophoresis (FIGE) (page 65). Periodic inversions of the applied electric field cause the molecules to make, on an alternating basis, large movements forward and small ones backward as they migrate in agarose gels. Carle *et al.* show that, with FIGE, resolution by size is achieved for mixtures of large DNA molecules that, on standard gels, all migrate at the same rate. In an electric field, large molecules are thought to move through a gel as a wedge with a leading edge. When the direction of the field is switched, the wedge must readjust through conformation changes in the molecule. Backward movement can begin only when a new reverse wedge has formed, because molecules in intermediate (nonwedge-shaped) conformations have low mobility. By empirically matching the switching interval to the wedge-readjustment period, a high-resolution separation based on size can be achieved. Molecules of DNA that are two orders of magnitude larger than those separable by conventional gel electrophoresis can be resolved by FIGE.

Atomic topography from tunneling microscope

SURFACE features of matter can be mapped at the atomic level from data obtained with a tunneling microscope (page 48). This microscope, so-named because it relies on the quantum-mechanical property of tunneling (movement of electrons into "forbidden" areas after imposition of an electric field), has an ultrafine probe that terminates in a single atom. The probe scans a surface, resolving atomic features 2 to 3 angstroms apart. As electrons jump from the probe to the surface, the probe is maintained at a constant distance above the surface, and, in the image obtained, all atomic "bumps" and valleys are highlighted (cover). Golovchenko reviews the state of art and science of this technique. Its use is on the increase to provide detailed information about the geometric and electronic properties of conducting and semiconducting materials.

Recombinant colony-stimulating factor

MATURATION of blood cells is under the influence of growth factors (page 61). One such factor, the human granulocyte colony-stimulating factor (hG-CSF), is being produced in large amounts by a genetically engineered *Escherichia coli* bacterium and soon may be available for clinical trials. The hG-CSF gene was cloned by Souza *et al.*, sequences were deduced for both the gene and the growth factor it produces, and the carbohydrate constituent and the molecular mass of the factor were determined. The purified factor causes bone marrow cells to differentiate into granulocytes and monocytes and induces some leukemic cells to differentiate into more mature cell types. Thus, potential uses of hG-CSF for the regeneration of blood cells include treatment of immunologically compromised patients, those with infections, or those with blood cell disorders like anemia. In addition, hG-CSF may inhibit growth of leukemic cells (such as the myeloid leukemia cells that have surface receptors for this growth factor) by driving the cells to differentiate and die so that they cannot continue unchecked proliferation and self-renewal.

Hiker's diarrhea induces unusual gut reaction

COLONIZATION of the human gut by the protozoan parasite *Giardia lamblia* may be promoted by a host enzyme that activates a binding molecule on the parasite's surface (page 71). The cysts of *G. lamblia* are found in sewage-contaminated waters and even in pristine mountain streams. When ingested with water, the protozoan attaches to the proximal portion of the human duodenum and then causes diarrhea, malabsorption, and other symptoms of giardiasis. Binding may entail interaction between a lectin (a protein) on the parasite's surface and specific sugars on the mucous membrane of the host's gut. Lev *et al.* found that lectin activity was induced in *G. lamblia* extracts after only brief exposure to the enzyme trypsin, an enzyme that is normally produced in the small intestine, where it aids digestion. Lectin activity was not promoted by many other enzymes, some of which may completely destroy the lectin just as they digest other large molecules. There appear to be only a small number of prolectin molecules (from which lectin is activated) on the parasite's surface, but this quantity may be sufficient for implementing gut attachment.

SCIENCE

4 APRIL 1986
VOLUME 232
NUMBER 4746

Let Us Meander

When this column is finished, the saying, "When Demosthenes spoke, men commented on his eloquence; when Pericles spoke, they said, 'Let us march,' " will be amended to include, "When Koshland spoke, they said, 'Let us meander.' " Science policy is in need of more than eloquence these days. Marching would be appropriate if the enemy were identified and the battle lines were clear. If, however, a highly diverse constituency is faced with a new set of conditions, some purposeful meandering may be appropriate.

The era of the balanced federal budget is at hand regardless of the constitutional questions raised about parts or all of Gramm-Rudman. The soundness of science policy and the persuasiveness with which it can be presented may be crucial to the continued health of science.

How, then, should we act? Do we send a battalion marching north to the trumpet call, "Science will save the economy"? Dangerous. Scientific research will certainly help the economy, but do we wish to attach our banner to the promise of a foreseeable practicality? The greatest discoveries often come from the unplanned. The transistor, the laser, and recombinant DNA were not foreseen by either bureaucrats in Washington or scientific seers.

Do we march west to the banner, "Research for its own sake, pure and basic"? Even more dangerous. Farmers, city governments, and transportation systems, to name a few, are also needed for their own sake. Perhaps we should meander in the general direction of north-northwest, explaining as we go that basic researches are always ultimately relevant, but some are more relevant than others.

Should other heroic scientists march south to stirring choruses of "Don't rock the boat"? In times of crises (some will say) we must stick to the procedures of the past. Funding allocations for disciplines, the spheres of influence of universities and government agencies, and the methods of peer review that have brought us this far cannot be changed, because changes will generate divisiveness.

Should we march east, singing from the hymnals of reform? A willingness to criticize ourselves, to discard the fetters of the past, are the kinds of born-again policies likely to melt legislative hearts and lead to the promised land. A compromise, meandering south-southwest, exploring the advantages of the tried and true while adjusting to new realities may be the best approach to this destination.

Meandering must have a goal, or we may get lost in the wilderness. How can policy be formed in this new era? Committees of peers, manifestos from learned societies, and decisions of program managers are valuable and conventional procedures, but it may be rewarding to examine other ways to define our goals.

One might be to advance science policy the same way that we advance scientific discovery: by publication of novel ideas. The genetic code was not solved by assembling all the best geneticists in the world and agreeing on the next experiment. Rather, individuals devised their own experiments, and those that were good provided a basis for further advances; those that were less good were forgotten without damage to the system. Eventually, to have political clout, the best ideas will have to earn the consensus of larger groups who must march, but the seeking of consensus too early can lead to the stifling of truly original ideas. Ideas should be considered the basic research of science policy, the generation of consensus as its applied research.

To aid in the process, *Science* has invited various individuals to make suggestions in the science policy area. Frank Press, president of the National Academy of Sciences, courageously presented an idea in the 21 March issue that is both innovative and controversial. Others have been invited to contribute ideas on subjects ranging from evaluation of big science and little science, levels of indirect costs, amounts of salaries on grants, and the hazards of conformism in peer review. Volunteer contributions also are welcome and will be evaluated for originality, succinctness, and scholarship—comparable to the evaluation of scientific articles. In a sense, we are embarked on a social experiment the hypothesis of which is that science policy can proceed by incremental steps in ideas similar to the process of science itself.

Scientists of the world, unite! The battle of the budget looms. Let us meander!

—DANIEL E. KOSHLAND, JR.