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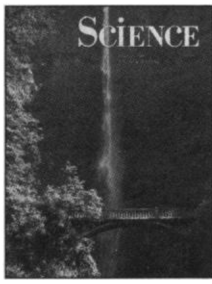

COVER Multnomah Falls, Oregon, on the Columbia River Plateau just below the Bonneville Dam. Seventeen million years ago, lava began to pour out of huge fissures across an area of 200,000 square kilometers (80,000 square miles) in the northwestern United States and eventually formed a basalt plateau with an average thickness of more than 1 kilometer (half a mile). The rock is now deeply cut by the Columbia River and its tributaries. See page 663. [Michael R. Rampino, New York University, New York, NY 10003]

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This Week in SCIENCE

Lunar atmosphere

THROUGH earth-based telescopes it has been possible to make high resolution spectroscopic measurements of the lunar exosphere (a part of the moon's atmosphere where gas-phase collisions are negligible). Sodium and potassium vapors above the moon scatter sunlight, and each of these elements produces resonance radiation at a characteristic wavelength. Potter and Morgan analyze the spectral profiles that were obtained from measurements made at both the McDonald Observatory and the Kitt Peak National Observatory; possible sources and sinks of the exospheric sodium and potassium are also discussed (page 675). Because the ratio (about 6:1) of sodium to potassium in the moon's exosphere is much like the ratio on the lunar surface, it is likely that the exosphere develops from the vaporization of surface minerals. The lunar ratio of sodium to potassium is much different from the ratio of the two in Mercury's exosphere, where it is about 100:1. If the exospheres of the moon and Mercury are generated by similar processes, then the surface of Mercury may be greatly depleted in potassium compared with sodium.

Nodal bending wave from Saturn's ring

THERE is a wave structure in one of Saturn's rings (ring C) that is unlike any seen before. Rosen and Lissauer interpret the radio occultation data that were collected by the Voyager 1 spacecraft in 1980 as evidence for the existence of a one-armed spiral bending wave (page 690). The distinctive signature of the unusual nodal wave includes outward propagation from the ring (the first bending wave that has been found to bend outward), winding in the direction that the ring particles move, but rotation in a direction opposite to that in which the ring particles rotate. Particles making up ring C are small compared with those in another one of Saturn's rings, ring A. The observations described fit with theory regarding how the wave is excited and propagated and what properties would characterize such a wave. The spiral bending wave appears to be caused by the gravitational potential of Saturn's largest satellite Titan.

Multidrug resistance

MULTIDRUG resistance is a phenomenon that compromises effective chemotherapy. Some tumors, for example, colorectal cancers and some lung and breast cancers, do not respond at all to chemotherapeutic drugs; other tumors are at first effectively inhibited by a chemotherapeutic agent but subsequently become refractory not only to the effects of this drug but also to drugs that they have never before encountered. Two previously known biochemical changes that take place in multidrug-resistant cells are overproduction of a membrane glycoprotein called P170, which facilitates the efflux of chemotherapeutic drugs from the cancer cells and, as a result of this effect, a decrease in the accumulation of the drug within the cell. A third change in multidrug-resistant cells has now been identified by Kramer *et al.*: when multidrug resistance was induced by the antitumor agent adriamycin there was an increase in the activity of the glutathione redox pathway, a metabolic pathway by which reactive oxygen species are detoxified within cells (page 694). These and perhaps other biochemical changes may be common to multidrug-resistant cells whether the resistance occurs de novo or is acquired.

Membrane attachments

TRANSPLANTATION antigens are stably integrated into the membranes of cells. In contrast, a surface glycoprotein called Qa-2, which is closely related to the transplantation antigens and is found associated with certain types of hematopoietic cells, is anchored in the lipid bilayer of the membrane by phosphatidylinositol (PI). Waneck *et al.* report that Qa-2 can be converted from a PI-anchored protein to a stably integrated protein if just one of its amino acids, residue 295, is changed (page 697). Through site-directed mutagenesis, the nucleic acid code for the negatively charged aspartate at position 295 was replaced with the nucleic acid code for a neutral valine residue. The altered Qa-2 could no longer be modified by PI and therefore could not be released from the membrane by those enzymes that typically release PI-anchored proteins from membranes. The simple substitution apparently removed from the protein its signal for modification; this signal is believed to be, at least in part, a weakly rather than strongly hydrophobic transmembrane segment in the protein.

Quinoxalinediones

ANTAGONISTS have now been found for a subtype of neurotransmitter receptors for which no antagonists had previously been available. The receptors are the non-NMDA (*N*-methyl-D-aspartate) subtype that experimentally mediate postsynaptic actions of quisqualate and kainate, two synthetic analogs of glutamate; the new class of antagonists, quinoxalinedione compounds, are known as DNQX and CNQX. Honoré *et al.* evaluated the binding characteristics of DNQX and CNQX and show that these compounds are potent competitors for the non-NMDA receptors on the cortical membranes in rat brain (page 701). In addition, DNQX and CNQX prevented quisqualate and kainate from exciting spinal neurons. Availability of the new antagonists will open the way to study physiologic functions and pharmacologic actions of quisqualate- and kainate-responsive receptors and may help explain how the receptors participate in neurotransmission.

The bottom lines

Were ancient atmospheres the source of gases inside amber (fossilized tree resin)? Arguments are aired on page 717.

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The Price of Progress

Scientists are feeling beleaguered these days, and there is some danger that their problems may be exacerbated if they develop a siege mentality. Recent charges—that they are cruel to animals but kind to colleagues accused of misconduct, that they show excessive zeal in trying to cure disease but lack of interest in protecting the environment—cause many scientists to react by labeling all critics as modern Luddites. Actually, this situation only illustrates the fact that science, like everything else in the world, is changing, and rapidly. What is needed is a careful appraisal of new rules to cope with the evolution of science and new approaches to public relations with a society that is increasingly threatened by the mystique of science.

One mistake in the face of these criticisms would be to argue that scientists cannot improve their own procedures. Some will argue that any change is an admission of guilt, but change and some misunderstanding are always the price of progress. Increases in the rate of discoveries, in the number of investigators, and in interdisciplinary research are having their impact on the old procedures. The days of the gifted amateur working with pins and sealing wax are over. When many authors from more than one laboratory are collaborating, it is impossible to expect everyone to know all of the experimental intricacies of all the work—but there is no escaping the fact that an author's name on the paper implies responsibility for all the work in that paper. If senior investigators share the credit when the work of students and collaborators is good, they must expect to share the blame when the work is poor. Hence, prudence suggests limiting groups to a size that can be competently supervised.

Those who expect progress without mistakes do not understand progress. When mistakes do occur, whether by fraud, sloppiness, or honest error, it is essential that they be corrected as rapidly as possible, and retractions, however embarrassing, must be made. In a smaller and cozier world, deviations from high standards of scholarship were dealt with informally; today's scientists need to realize that errors must be handled more formally, and in full view of an anxious public. In complex problems of fraud, misconduct, or error, scientists will need to develop procedures that nonscientists will find thorough, objective, and fair. Otherwise, the case will be made that laypersons must themselves be the judges, a potential nightmare when complex science is involved.

A new area of concern relates to the publication of all essential data for the verification of a research paper. Although it is axiomatic in science that such data should be available to the reader, some of modern science is so voluminous—DNA sequences, coordinates for x-ray structures, computer programs—that it cannot take up valuable journal space. Data banks are now available, but some investigators, out of laziness or desire to maintain proprietary advantage, fail to deposit their data. This should not be allowed. *Science*, together with a number of journals, has developed procedures to help ensure that any individual who publishes in these journals will send the appropriate information to data banks. In the old days of the small, old-boy network, such conditions could be enforced by word of mouth. The need for more formal procedures, which will be explained to authors, arises because of the exponential growth in the numbers of scientists and journals.

A willingness to examine our own procedures should not be interpreted as a need to change good procedures into cosmetic ones. Preserving the good, however, will require explaining the goals and procedures of modern science to an uninformed public. Scientists should, when possible, convert their specialized terminology into understandable language, so that scientific jargon is not interpreted as a protective device. The implications of new discoveries and our judicial procedures, warts and all, will have to be clarified. This can be done, and in many cases has been done brilliantly. Most of the public, in fact, hold scientists in high regard, and few would like to stop progress in its tracks. However, scientists must deal with the issues honestly. We cannot say we have eliminated all fraud, all pain to animals, all radioactive spills. We can say that science, like all other forms of human endeavor, will never proceed flawlessly, but scientists accept the responsibility to minimize the unpleasant side effects as well as to maximize the advance of the frontier.—DANIEL E. KOSHLAND, JR.

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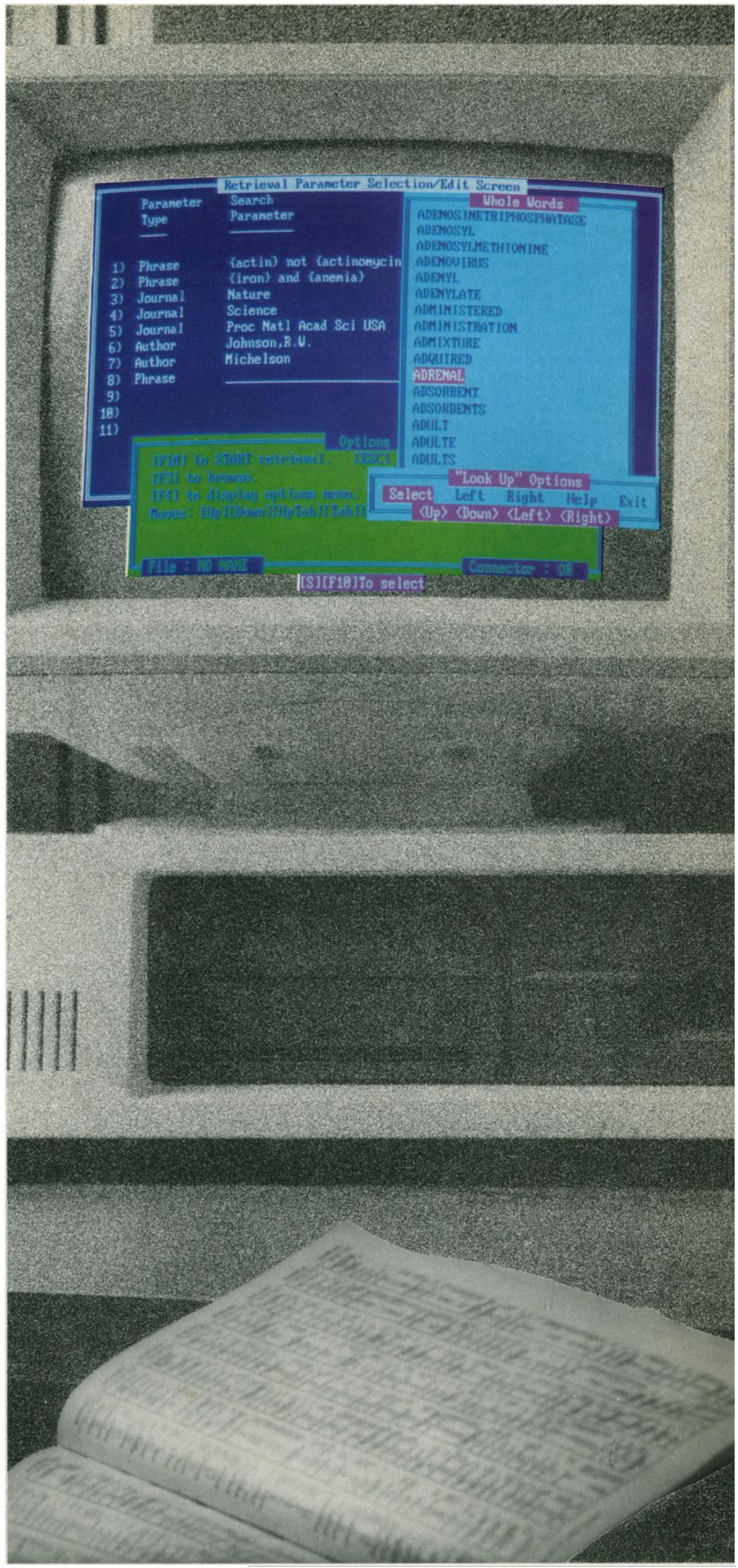

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hire scientists who have backgrounds predominantly in research. I would hope that the support of the Hughes Institute, along with the increasing recognition that undergraduates should be able to receive first-class scientific training without attending Ivy League schools, will encourage liberal arts colleges to recruit faculty interested both in teaching and active research.

AARON M. ELLISON
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Koshland's editorial on the new Hughes Institute initiative to support undergraduate education in the sciences struck exactly the right note. The Institute is indeed to be commended for growing both wiser and bolder as it has grown older, and one hopes there is more good to come. High-quality science education of the sort that attracts the ablest students depends on whether faculty members can sustain a simultaneous and serious commitment to both research and teaching. That, in turn, depends on a supportive academic and scientific environment. In decades past, value was placed on the idea that research and teaching are complementary activities, each enhancing the other; considerable respect was accorded to those scientists who developed the kind of broad perspectives and ability to synthesize that permitted evaluation and communication of a wide range of scientific observations. In recent years, however, the lives of those who aspire to the scientist-teacher ideal have become increasingly difficult. Correspondingly, career choices along those lines have been discouraged.

The core of the problem is a combination of financial and sociological forces which have made it appear that teaching and research are in conflict. Over the short run, teaching returns to institutions both less money and less prestige than does research. The upshot is that at the larger institutions, with their heavier dependence on outside money, time spent on teaching and on other activities necessary over the long run for both good teaching and good research, is widely regarded as time lost from more productive effort. Scientists at the smaller institutions are made to feel that their sustained concern for teaching has compromised their right to claim support as research scientists. Without anyone's intending it, the award of large sums of money based on short-term research productivity has created a mind-set within the scientific and academic community that seriously compromises its own longer range values and the likelihood of success in achieving them.

The problem is not an easy one to solve, particularly for federal agencies that are under pressure from their constituents to show rapid gains from money expended. It is, however, the sort of problem that the Hughes Institute, having displayed a willingness to invest for longer term payoffs, could undertake to address. To meet the immediate need, the institute might consider a program of research grants targeted specifically to those who still aspire to the scientist-teacher ideal. Of equal importance would be a special postdoctoral program, one which gives young scientists at an early stage of their careers the freedom to explore the advantages of combining research and teaching activities. If we are not careful, we will find ourselves in a situation in which the availability of support for scientist-teachers becomes irrelevant because there are not any people with the kind of background necessary to take advantage of it.

PAUL GROBSTEIN
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