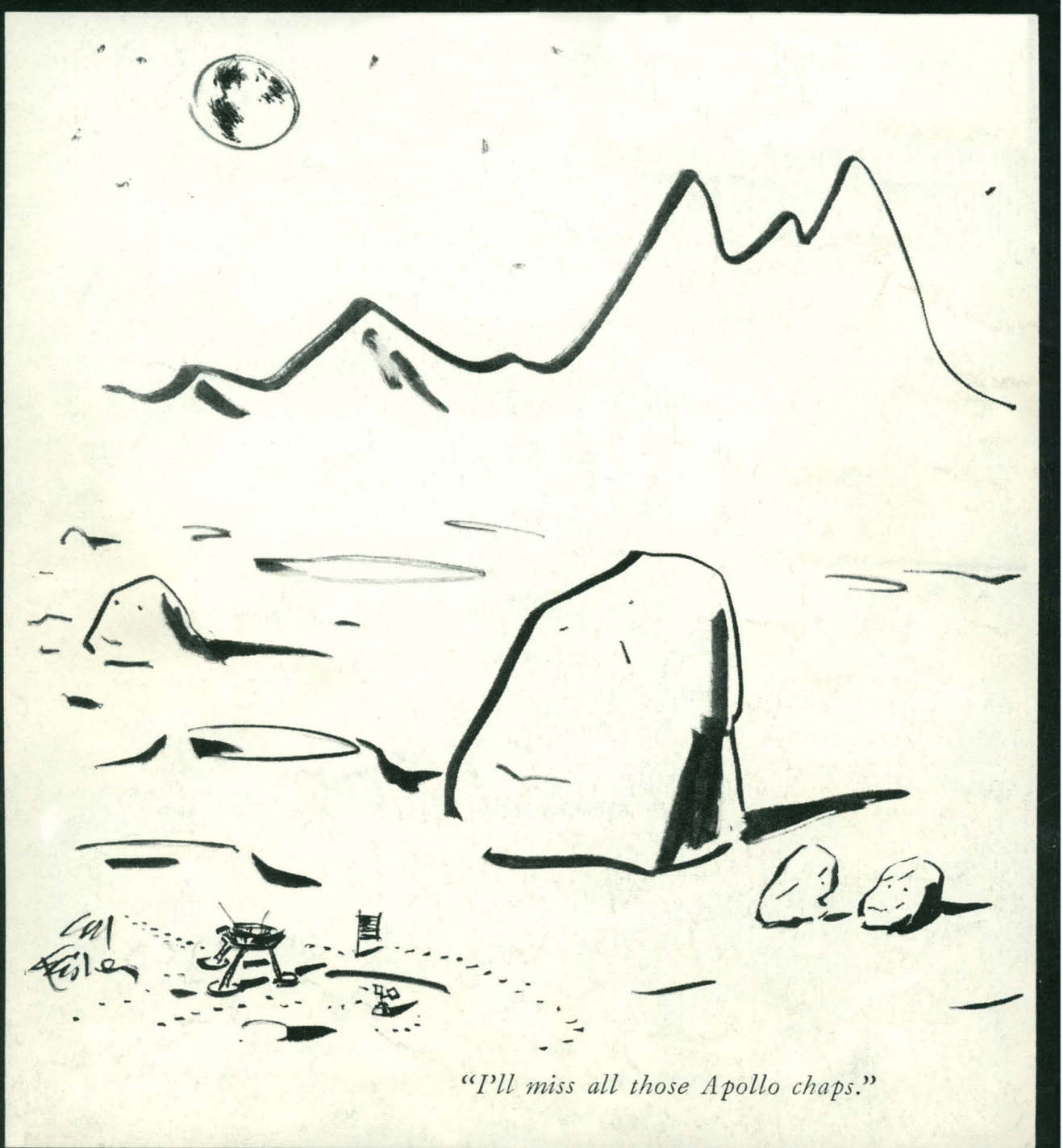
SCIENCE

17 August 1973

Vol. 181, No. 4100

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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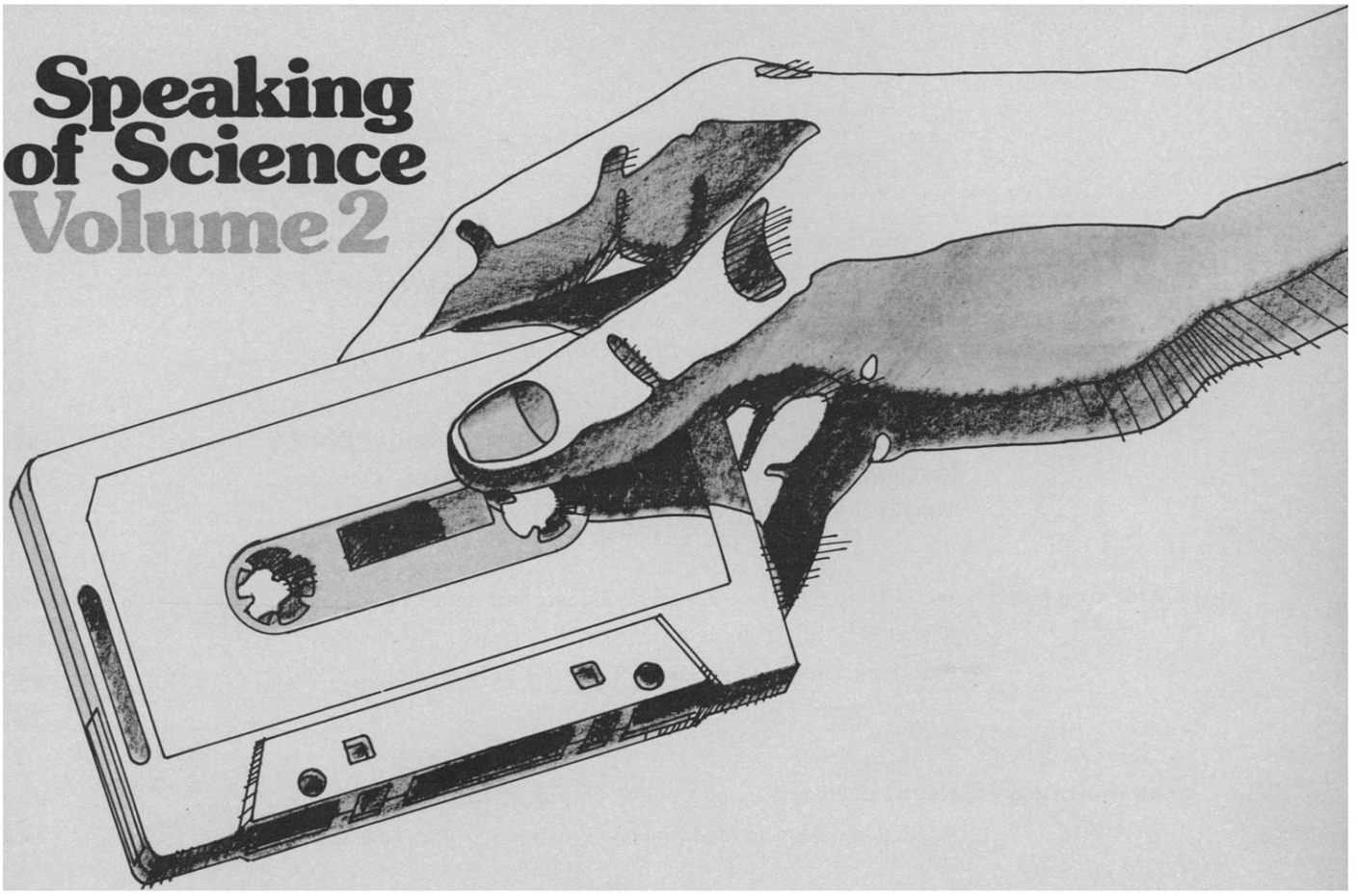

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Volume 181, No. 4100

SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Fourth Lunar Science Conference. See page 615. [Drawing by Ed Fisher; copyright © 1973 The New Yorker Magazine, Inc.]

These calculators have such special significance for scientists and engineers that we devoted this space to describe them in some detail. Other new instruments and systems stemming from our measurement/computation technologies are being developed: look for them in the coming months.

Three alternatives (two of them brand new) to the drudgery of paper-and-pencil mathematics.

Almost 300 years ago, Gottfried Wilhelm Leibniz wrote, "It is unworthy of excellent men to lose hours like slaves in the labor of calculation." He was right, but how could anyone avoid it then?

Today, in any field of science or engineering, tedious manual calculation is neither wise nor necessary because things have changed significantly for the better, even in the last few months. We're convinced you should never again labor with slide rule, tables, scratch pads and adding machines . . . wasting your creative time getting answers that aren't as accurate as you'd like.

Any of the economical calculators that we describe in this month's message is as easy to operate as an adding machine but incomparably more powerful. All are pre-programmed to perform not only the basic arithmetic operations but also transcendental and statistical functions. All calculate positive and negative numbers throughout a 200-decade range. All automatically keep track of the decimal point and can display answers to the tenth significant digit.

One of the traits that sets them apart from the recent flood of electronic calculators is a four-register operational stack that is solidly based on computer theory. The stack automatically stores intermediate results obtained during your calculations — whether they be serial, chain or mixed chain — and brings them back to the working register when they are needed to complete the calculations. In plain English, the stack relieves you of the necessity to make scratch notes and re-enter intermediate values: it does it for you, automatically and without error.

HP-35.
The electronic slide rule

Small enough so that you can easily carry it around in your shirt pocket — it weighs only 9 ounces including rechargeable battery — the HP-35 is the original electronic slide rule introduced a little over a year ago. It has since become the constant companion of more than 75,000 scientists and engineers around the world.

Due to the economies realized in this long production run, the price of the popular HP-35 has been reduced to $295.*

HP-35

The HP-35 is easier to use, 10 times faster and significantly more accurate than the slide rule. With a single keystroke and in less than a second, it performs trigonometric (sin, cos, tan), logarithmic (log x, ln x, e^x) and other commonly used functions (x^y, $1/x$, $\sqrt{x}$, π) as well as the four arithmetic operations. It also calculates inverse trig functions.

In addition to its computer-like operational stack, the HP-35 has a constant storage register which lets you store any number and recall it as often as you want for repeat operations, without ever having to re-enter it.

The HP-35 comes with owner's handbook, battery pack, AC adapter/recharger, carrying case and travel case.

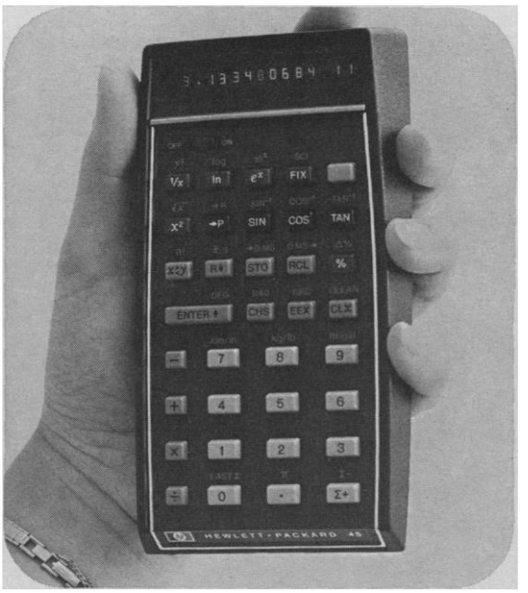
HP-45.
The scientific pocket calculator

A direct descendant of the "electronic slide rule," the new HP-45 packs nearly twice the computational power into the same package. The trick is that it has a unique gold-colored "shift" key that doubles the function of 24 of its 35 keys. Hence it does all that the HP-35 does . . . and then some.

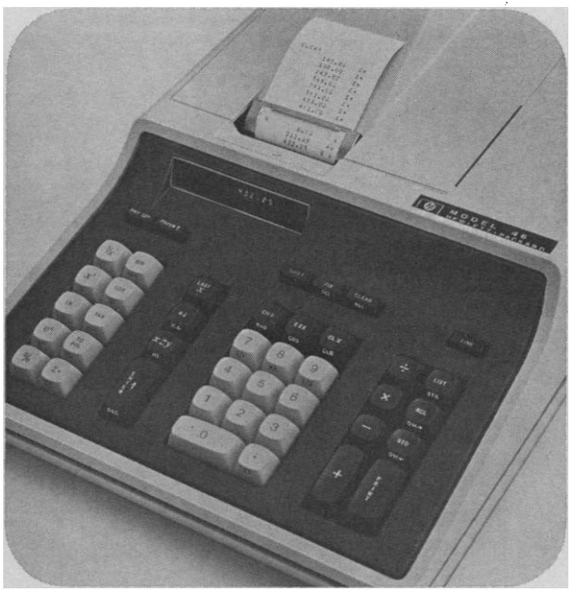
The HP-45 is the first pocket calculator with *nine* addressable memory registers besides its operational stack. You can store data in each one — any number that appears on the display — and recall it to the working register whenever you want. (Let your imagination picture the calculating horsepower of this feature for register arithmetic, conversions, continued products, payrolls . . .)

The HP-45 also has a 14th register, called "Last X" in which the last input argument is auto-

HP-45



HP-46



matically stored. You can recall this number by pushing the "Last X" key . . . then proceed to correct it or to perform calculations with it.

There's more. The HP-45 lets you do trig calculations in any of three angular modes (degrees, radians or grads) and converts angles in any mode to degrees/minutes/seconds instantly, and vice-versa. It lets you convert polar coordinates to rectangular and vice-versa, at a single keystroke. Add or subtract vector components in polar or rectangular coordinates. Perform two dimensional accumulations for vector calculations. And convert U.S. units of length, weight or volume to metric, and vice-versa . . . to 10-digit accuracy.

The HP-45 costs $395* including owner's handbook, quick reference guide, battery pack, AC adapter/recharger, carrying case and travel case.

HP-46.
The scientific printing calculator

If you need a permanent record of your calculations and don't insist on the size and portability of our two shirt-pocket wizards, the HP-46 was designed especially for you.

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For example, when you calculate the mean and standard deviation of a series of numbers, the printer lists each entry with a $\Sigma+$ symbol. Then, after you push the $\bar{x}$, s key, it prints the results, in order: the number of entries, the calculated standard deviation and the mean . . . each clearly labeled.

On command, the printer will also record the contents of the operational stack or the 9 addressable memory registers, each also clearly labeled. Should you make a logical error in data entry or call for an improper calculation, the printer will make an error note with a reference to an explanation contained in the operating manual.

A 15-digit LED display is available as an option.

The HP-46 costs $695* including owner's handbook, printer paper, and carrying case.

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LETTERS

Prophecy

In his editorial "The support of science" (1 June, p. 909), Arthur Kornberg quotes from the Book of Proverbs: "Where there is no vision, the people *perish*" (italics mine). This quotation is from a secondary source (Old Testament, King James Version) and is incorrect. The Hebrew text (Torah, Nevi'im, Ukhtuvim) reads: "Beain hazon ipara am," and the correct translation of this verse is, "Where there is no vision, the people become *unruly*" (italics mine). Thus, if Proverbs 29 : 18 applies to the consequences of limited support to biomedical research, the prophecy of the original text is not as catastrophic as that of the King James Version.

OVED SHIFRISS

21 Walter Avenue,
Highland Park, New Jersey 08904

Energy Efficiency

In his article "Energy conservation" (13 Apr., p. 155), G. A. Lincoln mentions only briefly the most energy efficient forms of urban transportation available—walking and bicycling. For an 84-kilogram person (about 185 pounds), walking requires about 264×10^3 joules per passenger-kilometer; with a 10-kilogram bicycle, bicycling requires only 59.4×10^3 joules per passenger-kilometer (*1*) compared to 450×10^3 joules per passenger-kilometer for the most efficient type of mass-transit reported by Lincoln (*2*). Of course these figures do not account for the low thermal efficiency of modern agriculture, which provides the human energy, but no doubt the figures for petroleum-powered vehicles do not include the energy needed for extraction or conversion to electricity.

Increasingly bicycles are becoming a viable and prominent commuting mode. In congested urban areas, bicycles provide door-to-door convenience with shorter trip times than those in automobiles (based on personal experience). Last year more bicycles than automobiles were sold (*3*), and at least two companies have developed enclosed pedal-powered vehicles designed for urban transit. In spite of the legal barriers and physical hazards of bicycling in an automobile-oriented urban transportation system, this efficient and pollution-free commuting mode continues to expand and should play a role in future urban planning.

CLARK BINKLEY

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1218 Massachusetts Avenue,
Cambridge, Massachusetts 02138

References and Notes

1. S. S. Wilson, *Sci. Amer.* **228**, 90 (March 1973). The figures were converted to the International System following B. B. Barrow [*Science* **179**, 1181 (1973)].
2. The efficiency of a suburban train is 200 passenger-miles per gallon of fuel. Approximate conversion factors are: 42 gallons = 1 barrel; 10^{15} British thermal units = 172×10^6 barrels; 1.609 kilometers = 1 mile; 1055 joules = 1 British thermal unit.
3. According to *Environ. News* (*Reg. 1*) X, No. 3 (March 1973), more than 11 million bicycles were sold in 1972, compared with 10.3 million automobiles. For the first time in the history of the industry, most of the bicycle sales were to adults.

Peer Review Appeal Mechanism

Rather than totally dismantling the peer review system (News and Comment, 25 May, p. 843; 8 June, p. 1035), the National Institutes of Health (NIH) might well consider reforming its procedures to allow for the establishment of an appeal panel. To me, the most serious problem with the existing study sections is the lack of effective means of appealing their unfavorable decisions. If a reconsideration is requested, it is made by the same group that made the rejection. Most areas in academia provide for appeals in cases of tenure, promotion, and other matters, and there would be great value in having the same safeguards for NIH grants. In spite of all efforts to keep personalities out of grants, there are cases, however rare, when something other than scholarly or scientific judgment intervenes.

VERN L. BULLOUGH

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Cost of Environmental Quality

Luther Carter (News and Comment, 30 Mar., p. 1310) hails the success of the Sierra Club and its allies in forcing the Columbia LNG Corporation to modify its plans for a receiving terminal for Algerian natural gas at Cove Point, Maryland.

Quite aside from the merits of the environmental arguments, I must protest the tactics of the Sierra Club, which can be viewed as little better than thinly disguised blackmail by the gas users of the Washington, D.C., area who ultimately will have to pay the additional costs of the modified plan. Let no one be deceived; it is the consumer who will pay the added bill, not Columbia LNG.

This decision was arrived at by attorneys for Columbia LNG and the Sierra Club without the benefit of consultation with responsible public officials of the area concerned, and certainly without the public hearings that usually precede such decisions.

In this brave new world of environmentalism, who speaks for the taxpayer and consumer? Certainly neither the Sierra Club or Columbia LNG can claim to in this matter. It is time that the public and their responsible officials had a voice in environmental matters of long-range concern to the area affected. Personally I don't want the Sierra Club deciding my gas bills for the next few decades, and I strongly protest the undemocratic, elitist flavor of this whole affair.

GEORGE H. DAVIS

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Silver Spring, Maryland 20902

Radiation Standards

Robert Gillette's review (News and Comment, 1 Dec. 1972, p. 966) of the National Academy of Sciences's report on "The effects on populations of exposure to low levels of ionizing radiation" was by and large accurate and helpful in emphasizing the implications for radiation protection. However, an impression of establishment influence was unfortunately created by the manner of reference to the fact that about a third of the parent academy committee of 20 are members of the National Council on Radiation Protection and Measurements (NCRP). Normally this would be trivial, but, because of previous controversy and especially because the value of the report will depend in large measure upon public confidence and acceptance, I should like to clarify this matter and reemphasize points of departure.

The academy report as a whole represents the thought and effort of some 50 members of the committee and its subcommittees, who were carefully selected to bring individual competence, judgment, and balance to the undertaking. They were exhorted to represent their personal views rather than those of any institution or organization with which they may have been affiliated. Naturally, careful study was made of the publications of various organizations, especially those of NCRP, because of its responsible role in radiation protection over the years. The interested scientist can read the report itself and make judgments as to varying points of view. However, for the benefit of those not familiar with radiation protection literature, I should like to generalize about the differences between the academy report and previous official documentation. These differences arise not so much from new data or new interpretations but rather from a philosophic approach to radiation protection generated by changing conditions and public attitudes.

The major differences I conceive to be as follows: (i) Numerical risk estimates for human populations exposed to low levels of ionizing radiation are presented together with the assumptions and compilations of the data on which they are based. (ii) Consideration is given to implications of possible effects of radiation on the environment—on organisms other than man. (iii) It is suggested that radiation protection standards not be set on an arbitrary basis, such as related to background levels (even though all agree that such levels will not produce observable effects), but rather should be established in terms of minimal exposures required to fill society's needs. Hopefully, it will be possible to make meaningful risk-benefit assessments, then to make cost-effectiveness assessments so that logical decisions can be made as to the worth of any given effort to reduce the risk, and finally to choose among the options by comparing the biological and environmental costs.

Ultimately, these techniques for dealing with radiation protection (actually estimating the risks and the worth of reducing them) may provide guidance in the case of other pollutants, since the time is coming when priority decisions will have to be made in the allocation of limited resources for the maintenance and improvement of the quality of life.

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17 August 1973, Volume 181, Number 4100 **SCIENCE**

Relevance—There and Here

Marxist philosophy holds that the most important problem does not lie in understanding the laws of the objective world and thus being able to explain it, but in applying the knowledge of these laws actively to change the world.—Excerpted from *Quotations from Chairman Mao Tse-Tung* (Foreign Language Press, Peking, 1972).

If one removes the first four words, the quotation from Chairman Mao takes on an oddly familiar ring. Any recent visitor to China has seen how the Cultural Revolution has reoriented China's scientists to the demands of social relevance. Any recent visitor to the United States must have noticed a similar reorientation—albeit accomplished through the persuasion of the research grant and the job market rather than self-criticism meetings and tours of duty in factories and communes.

The difference in means of persuasion is fundamental and should not be forgotten. But we also should not ignore the parallels between the demands that the two societies make upon their scientists. To lay claims to the resources of his society, a scientist must produce what the society wants. And what it wants is a little knowledge and a lot of relevance.

The myth prevails that during the Golden Age (that is, the last decade) American society supported basic science and now does not. The fact is that it never supported basic science on a large scale—as basic science. It supported science that it believed would solve health problems (National Institutes of Health) and would diminish the threats of Russian military superiority achieved through atomic technology (Atomic Energy Commission), space technology (National Aeronautics and Space Administration), and other high technology applied to military purposes (Advanced Research Projects Agency, Office of Naval Research). Even society's support of the National Science Foundation has been predicated mainly on the premise—which most of us accept—that the research will ultimately be relevant to society's needs.

Most scientists have a deep commitment to knowledge for its own sake, knowledge as intrinsically relevant to man's deepest need—his need to understand. On those occasions when we scientists talk with T. C. Mits (the common man in the street), we are reminded that he doesn't much share that value. He sometimes responds to our aspirations, but usually because he believes, with most of us, that basic science is the nutrient on which application feeds.

As scientists and experts, we hope to choose the agenda of science with a minimum of interference from T. C. Mits. We share his values, we say to ourselves, our hearts are pure, and we are best qualified to judge. T. C. Mits is not so sure. Of course he recognizes our expertise and defers to it—up to a point. But he also detects in us our unusual thirst for knowledge and he understands that no man is a thoroughly trustworthy custodian of the public interest when it does not coincide completely with his own private interest.

The "contradiction," as Mao would phrase it, between expertise and social relevance is real. It is as real in the United States as in China. In our society, that contradiction is resolved through a political process that allocates resources to science in competition with many other activities. Necessarily, relevance will be the primary basis for successful claims to such resources. We who have a thirst for knowledge can be thankful that basic knowledge usually does prove relevant to social needs. That's why we're tolerated and sometimes nurtured.—HERBERT A. SIMON, *Department of Psychology, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213*

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BOOKS RECEIVED

(*Continued from page 650*)

lected Contributions to Theoretical and Experimental Studies of Polyatomic Molecules by Spectroscopic Methods and Gas Electron Diffraction. S. J. Cyvin, Ed. Elsevier, New York, 1972. 534 pp., illus. $26.

Must the Seas Die? Colin Moorcraft. Gambit, Boston, 1972. x, 194 pp. $6.95.

Nobel Lectures, Including Presentation Speeches and Laureates' Biographies. Physics, 1963–1970. Published for the Nobel Foundation by Elsevier, New York, 1973. xii, 352 pp., illus. $38.40.

Organic Polymer Chemistry. An Introduction to the Organic Chemistry of Adhesives, Fibers, Paints, Plastics, and Rubbers. K. J. Saunders. Chapman and Hall, London, and Halsted (Wiley), New York, 1973. x, 474 pp., illus. $18.

Organic Quantum Chemistry Problems. Rudolf Zahradnik and Petr Čársky. Plenum, New York, 1973. x, 222 pp., illus. $14.50.

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Physiology. Laboratory Manual. Byron A. Schottelius, John D. Thomas, and Dorothy D. Schottelius. Mosby, Saint Louis, ed. 3, 1973. viii, 282 pp., illus. + table. Paper, $5.95.

Physiology, Emotion, and Psychosomatic Illness. Proceedings of a symposium, London, Apr. 1972. Associated Scientific Publishers (Elsevier, Excerpta Medica, North-Holland), New York, 1972. viii, 422 pp., illus. $18.75. Ciba Foundation Symposium 8.

Phytochemistry. Vol. 1, The Process and Products of Photosynthesis. Lawrence P. Miller, Ed. Van Nostrand Reinhold, New York, 1973. xiv, 410 pp., illus. $22.50.

Practical Fluorescence. Theory, Methods, and Techniques. George G. Guilbault. Dekker, New York, 1973. xvi, 664 pp., illus. $29.50.

Psychology and Contemporary Problems. Norman W. Heimstra and Arthur L. McDonald. Brooks/Cole (Wadsworth), Monterey, Calif., 1973. x, 396 pp., illus. Paper, $6.50.

Readings in Ethology and Comparative Psychology. Michael W. Fox, Ed. Brooks/Cole (Wadsworth), Monterey, Calif., 1973. xii, 654 pp., illus. Paper, $6.95. Core Books in Psychology Series.

The Restoration of the Earth. Theodore B. Taylor and Charles C. Humpstone. Harper and Row, New York, 1973. viii, 166 pp. $7.95.

RNA Viruses: Replication and Structure. Ribosomes: Structure, Function and Biogenesis. Proceedings of a meeting, Amsterdam, Aug. 1972. H. Bloemendal, E. M. J. Jaspars, A. van Kammen, and R. J. Planta, organizers. North-Holland, Amsterdam, and Elsevier, New York, 1973. x, 312 pp., illus. $18.75. Federation of European Biochemical Societies Eighth Meeting, vol. 27.

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