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LETTERS Plutonium Plant Safety: *D. E. Michels; L. H. Hempelmann* and *W. H. Langham*; Ecological Assessment: *M. H. Greenstone, R. K. Colwell, F. A. Pitelka*; Suffering Legions?: *D. A. Goodman* 208

EDITORIAL Science and Trans-Science: *A. M. Weinberg* 211

ARTICLES Orbiting Astronomical Observatory: Review of Scientific Results: *A. D. Code and B. D. Savage* 213

Locomotion: Energy Cost of Swimming, Flying, and Running: *K. Schmidt-Nielsen* 222

The Evolutionary Taxonomy of Culture: *A. Lomax* with *N. Berkowitz* 228

NEWS AND COMMENT Technology in Vietnam: Fire Storm Project Fizzled Out 239

Spain (III): Education Reform Draws on Outside Ideas, Support 241

Ehrlich versus Commoner: An Environmental Fallout 245

Ray Nominated to AEC 246

RESEARCH NEWS Report on Astronomy: A New Golden Age 247

Narcotic Antagonists: The Search Accelerates 249

BOOK REVIEWS Purposive Explanation in Psychology, *reviewed by W. P. Alston*; The Functional and Evolutionary Biology of Primates, *M. H. Day*; Invertebrate Tissue Culture, *I. Schneider*; Fertility of the Sea, *G. A. Riley*; Books Received 251

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REPORTS

Carbon Monoxide and Nitric Oxide Consumption in Polluted Air: The Carbon Monoxide-Hydroperoxyl Reaction: *A. A. Westenberg* 255

Apollo 16 Geochemical X-ray Fluorescence Experiment: Preliminary Report: *J. Adler* et al. 256

Kom Ombo: Preliminary Report on the Fauna of Late Paleolithic Sites in Upper Egypt: *C. S. Churcher* and *P. E. L. Smith* 259

Birch's Law: Why Is It So Good?: *D. H. Chung* 261

Rostroconchia: A New Class of Bivalved Mollusks: *J. Pojeta, Jr.*, et al. 264

Heat Capacity of Superconducting Ternary Molybdenum Sulfides: *R. Viswanathan* and *A. C. Lawson* 267

Electron Diffraction of Wet Proteins: Catalase: *V. R. Matricardi, R. C. Moretz, D. F. Parsons* 268

Coral Chronometers: Seasonal Growth Bands in Reef Corals: *O. W. Knutson, R. W. Buddemeier, S. V. Smith* 270

Oligothymidylates: Formation by Thermal Condensation of O^2,5′-Cyclothymidine 3′-Phosphate: *J. Nagyvary* and *K. L. Nagpal* 272

Anemic Stress as a Trigger of Myelogenous Leukemia in the Unirradiated RF Mouse: *J. K. Gong, P. G. Braunschweiger, C. A. Glomski* 274

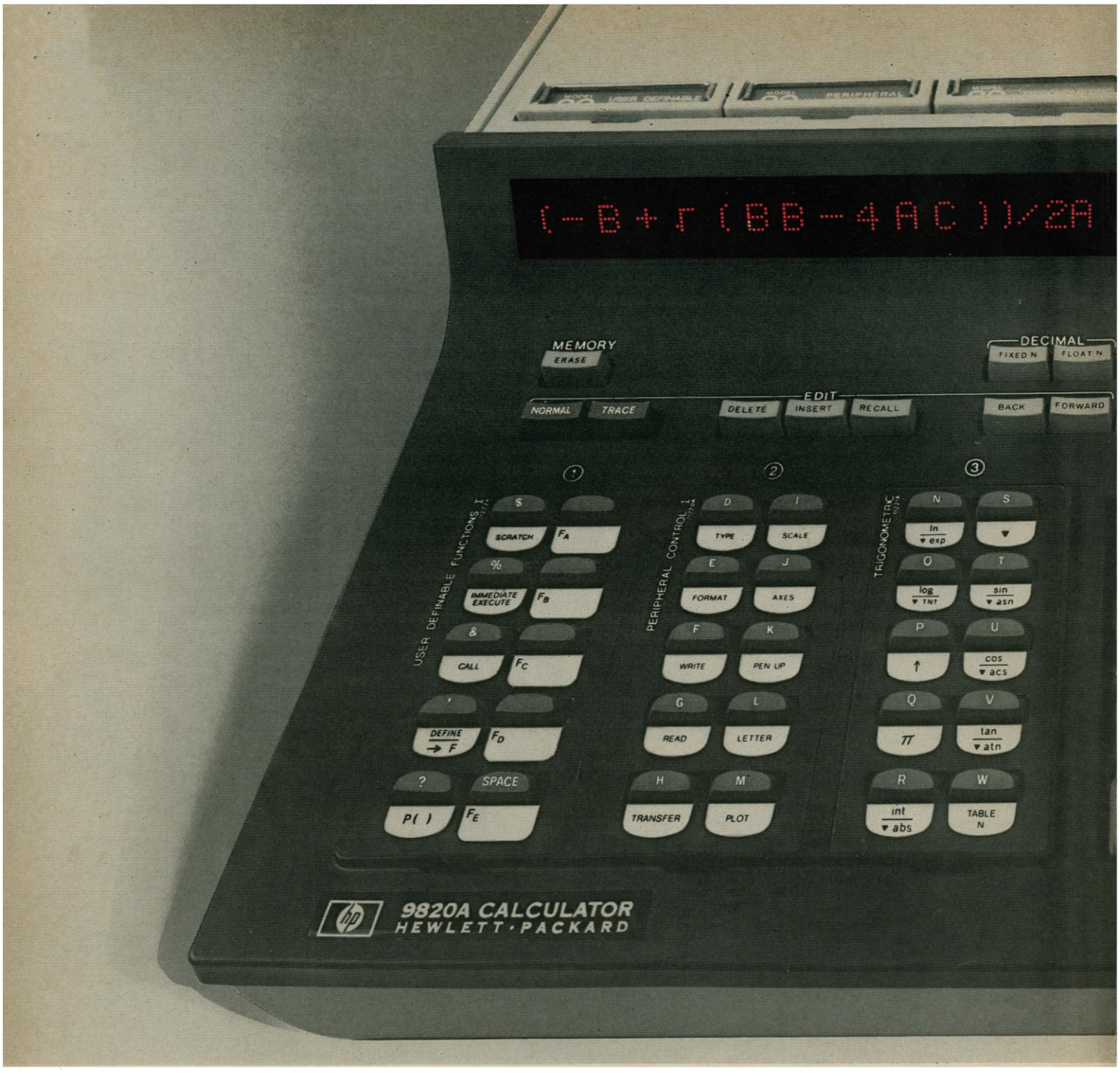
Terminal Saccharides on Sperm Plasma Membranes: Identification by Specific Agglutinins: *G. L. Nicolson* and *R. Yanagimachi* 276

Fluorescent Modification of Adenosine 3′,5′-Monophosphate: Spectroscopic Properties and Activity in Enzyme Systems: *J. A. Secrist III* et al. 279

Cytochalasin B Prevents Specific Sorting of Reaggregating Embryonic Cells: *D. E. Maslow* and *E. Mayhew* 281

COVER

Single specimen of *Favia* coral from lagoonward reef flat on southeastern portion of Eniwetok Atoll (actual size). See page 270. [David W. Knutson, Robert W. Buddemeier, and Stephen V. Smith, University of Hawaii, Honolulu]



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LETTERS

Plutonium Plant Safety

If the purpose of Deborah Shapley's report (News and Comment, 5 Nov., p. 569) on the Dow Chemical Co., Rocky Flats Division, in Colorado was to increase the gap between what the Atomic Energy Commission (AEC) and the Rocky Flats management say and what listeners will believe, then her piece was well done. If, on the other hand, a reader can imagine that plutonium handling has evolved somewhat during the last 25 years, he might also believe that certain things that were condoned in the past are now forbidden and would be forbidden even without the strong environmental considerations that abound today.

By today's standards, yesterday's actions were crude, but today's concern with human welfare and the environment is historically recent. How long, for example, have seat belts been generally available for automobiles, and how old is the Environmental Protection Agency? Whether events in the 1950's are examples of managerial ineptness or reflect the developmental style of industrial America is pertinent to criticisms of the AEC, since the legality of the spending of funds hinges partly on the nature of current practice. Machines are known to wear out, and improved safety practices tend to require redesigned equipment. What is safe today is predictably unsafe tomorrow, even if the safety standards were to remain constant. There is no inconsistency in saying we are safe, *and* we need more funds to maintain safeness, yet Shapley implies such an inconsistency.

Shapley's principal source on Rocky Flats contamination, E. A. Martell, suffers from his own credibility gap. For example, his original indictment (*1*) included soil analysis data for plutonium that failed to show a bimodal distribution of values, a prerequisite to establishing a Rocky Flats anomaly. His conclusion that off-site contamination was occurring was correct, but for the wrong reasons, since the 1968 barrel storage site was established as the source of contamination (*2*), not the 1969 fire suspected by Martell.

Although Martell's criticisms were useful in that they focused attention on this matter, his data and interpretations should be looked at more closely. Where he took duplicate samples at single sites, the reported analytical values differed by a factor of 6 in one case and by a factor of 9 in another (*1*). His most recent contention (*3*) that off-site plutonium contamination is three times what has been determined by the Health and Safety Laboratory (HASL) is based, first, on his own interpretation of HASL data for the (compass) quadrant northeast of the plant, using a method which HASL people say abuses their data (*4*), and second, on the presumption that equal amounts of plutonium lie in the quadrants both southeast and west of the plant. Since only 17 percent of the winds blowing past Rocky Flats have an easterly component, and none of the strong winds do, it is difficult to understand how one-third of the effluent can end up west of the plant. Similarly, the quadrant southeast of the plant, which includes most of the Denver area, is protected by dominant northbound winds which take Denver air away via the Platte River valley; presumably Rocky Flats air goes the same route. I am disturbed that a scientist from the National Center for Atmospheric Research appears to ignore those two facts about local wind patterns.

Off-site contamination and exposure to workers inside the plant are transscientific problems, as described by Weinberg (Letters, 5 Nov. 1971, p. 546) and data are collected slowly. Studies of exposures to workers must naturally be restricted to those persons involved in incidents. If the 450 Rocky Flats workers (of 7700 total employees) in the Transuranium Registry seems a small number, one should realize that fewer than half of Rocky Flats employees work with plutonium in any way, and few of those collect significant exposures during their tenure. Perhaps the "smallness" of the 450 reflects the nature of the industrial safety record at Rocky Flats, which includes two disablement-free series of 24 million and 21 million man-hours, among the longest in American industry.

Shapley seems to imply that Dow is negligent in examining former (exposed) workers only on a voluntary basis, but on what grounds can we subpoena a reluctant nonemployee to submit to periodic examination? At best, these catch-as-catch-can experiments have minor scientific merit, in spite of their immense human interest. Their greatest value may lie in helping improve extrapolations from controlled experiments on animals.

Joseph Sykes, the Rocky Flats employee who refused to enter Building

776 after the 1969 fire, had received no significant exposure to plutonium. His concern about the risk apparently increased until he no longer felt compensated by the premium pay he had been receiving. To "just plain quit" for that sort of reason is a privilege that belongs to everyone, but no employer should have any after-the-fact obligations to a worker who makes such a decision.

It is easy, now, to see where past actions were inappropriate or worse, yet that same insight allows us to see better where our current ignorances lie and thus institute programs to improve our learning rate. The plutonium industry is really safer than it was 15 years ago, and in 5 years it will be safer still. The production of plutonium involves a multiplicity of dangers; the public should be made aware of them and demand that the industry invent and apply ever better safeguards. Public motivations in this matter are necessary, but many aspersions of the kind in Shapley's report will work to distort public judgment.

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1. E. A. Martell, letter to Glenn T. Seaborg, 13 January 1970, reported in St. Louis *Post-Dispatch*, 11 February 1970, p. 1.
2. P. Krey and E. P. Hardy, "Plutonium in soil around the Rocky Flats plant" (Report No. HASL-235, Health and Safety Laboratory, Atomic Energy Commission, New York, 1970).
3. E. A. Martell, "Plutonium-239 and americum-241 fallout in the Denver area" (paper presented at the 17th Annual Bio-assay and Analytical Chemistry Meeting, Boulder, Colorado, 1971).
4. H. L. Volchok and J. H. Harley, discussion of paper by E. A. Martell (*3*).

Shapley states that the AEC has not "rigorously" followed up its plutonium workers except by means of the recently established United States Transuranium Registry. A series of plutonium workers at the Los Alamos Scientific Laboratory with a body burden of more than 0.2 microgram of plutonium-239 (0.01 microcurie) has been followed up for the past 27 years at the AEC's expense. At about 5-year intervals, 25 workers have had physical examinations and laboratory tests, including blood tests, x-rays of the bones, and urine assays for plutonium. Now that it is possible to measure insoluble or fixed plutonium in the lungs, these men are being called back to Los Alamos for further study, including lung burden measurements and cytological examinations of the sputum. Of the 25 workers, 20 have been examined as of 7 June

1972, and 3 others will be studied in the near future. So far, no evidence has been detected of biological damage due to radioactivity in the body. These men, as well as other plutonium workers at the Los Alamos Scientific Laboratory, are being urged to join the U.S. Transuranium Registry.

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Ecological Assessment

Twin bills are pending in committees in both houses of Congress that would appropriate up to $10 million to the National Academy of Sciences for a study "to assess the extent of the damage done to the environment of South Vietnam, Laos, and Cambodia as the result of the operations of the Armed Forces of the United States in such countries, and to consider plans for effectively rectifying such damage." These bills will not pass without the active support of the scientific community.

Following is the text of a supporting letter to Senator J. W. Fulbright (D–Ark.), chairman of the Senate Foreign Relations Committee, signed by 78 members of the Department of Zoology of the University of California at Berkeley:

We, the undersigned, members of the Department of Zoology, University of California at Berkeley, wish to voice our strong support of S. 3084, The Vietnam War Ecological Assessment Act of 1972, and we urge you to lend your own support to its passage. We are professional biologists, representing a wide range of political opinion, acting collectively in response to our individual concern as United States citizens.

Many of us are teachers or researchers in ecology, who have devoted our professional lives to furthering basic knowledge of the structure and function of ecosystems. One overwhelming result has emerged from our work and from that of others: ecosystems are enormously complex. This complexity makes it almost impossible to predict the subtle, indirect, and delayed consequences of even the most simple and seemingly minor changes made by human beings. The widespread disturbances of local ecosystems by our armed forces in Southeast Asia are neither simple nor minor, and the force of their indirect and delayed effects may far outweigh their immediate and obvious consequences.

For this reason we feel that it is imperative that appropriate broad-scale, in-depth studies be initiated as soon as possible to determine both the short and long term ecological and human consequences of defoliation, deforestation, bombing, and chemical residues in the battlegrounds of Southeast Asia. Unlike the expense of reconstructing a building or a highway, the cost of ecological reconstruction rises sharply with every month's delay. A million dollars now may save hundreds of millions five years hence.

For all these reasons, and for the sake of future generations in Vietnam, Laos, and Cambodia, we implore you to support the Vietnam War Ecological Assessment Act.

We urge other concerned individuals and groups to support this legislation. Letters regarding the House bill (H.R. 13010) should be addressed to Representative Thomas E. Morgan (D–Pa.), chairman of the House Committee on Foreign Affairs.

MATTHEW H. GREENSTONE
ROBERT K. COLWELL
FRANK A. PITELKA
Department of Zoology, University of California, Berkeley 94720

Suffering Legions?

When exposed almost continuously to colonies of white rats and mice, I noted the gradual onset of some personally very upsetting symptoms: puffing of the eyelids; watering of the eyes; nasal congestion; sneezing; and extreme respiratory discomfort, including wheezing and bronchial coughing. Continued research with rodents became difficult.

As a probable result of my experience with rodents, I am now allergic to most furry creatures, as well as to pollens and molds. Such an allergy limits my ability to work at pharmaceutical research, where the white rat is the animal of choice.

At first I thought my experience was unique and I had best suffer in silence, but I have recently met other biologists who suffer the same symptoms. Have I had the bad (or, hopefully, the good) fortune of meeting most of the world's supply of fellow sufferers, or might there be silently suffering legions?

DAVID A. GOODMAN
Newport Neuroscience Center, Postal Service Box 4045, Irvine, California 92664

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Science and Trans-Science

Many of the issues that lie at the interface between science and politics involve questions that can be stated in scientific terms but that are in principle beyond the proficiency of science to answer. In a recent paper in *Minerva* [**10**, 209 (April 1972)], I proposed the term "trans-scientific" for such questions. For example, the biological effect on humans of very low level radiation (or of other physical insult, for that matter) will probably never be fully ascertained, simply because of the huge number of animals required to demonstrate an unequivocal effect. Estimates of extremely unlikely events (such as a serious reactor accident) can never be made with anything like the scientific validity that one can apply to estimates of events for which there are abundant statistics.

In the current attempts to weigh the benefits of technology against its risks, the protagonists often ask for the impossible: scientific answers to questions that are trans-scientific. What the scientist can do in clarifying matters of trans-science differs from what he can do in clarifying matters of science. In the latter case, he can bring to bear his scientific expertise to help establish scientific truth; in the former case, he can, at most, help delineate where science ends and trans-science begins. We scientists sometimes refuse to concede that science has limits. The debate on risks versus benefits would be more fruitful if we recognized these limits.

Scientific truth is established by the traditional methods of peer review: only what has value in the intellectual marketplace survives. By contrast, where trans-science is involved, wisdom (rather than truth) must be arrived at by some other mechanism. Our society is experimenting with procedures, either adjudicative or political, for making the delicate judgments of value that underlie the resolution of trans-scientific questions. These procedures are much in vogue now as a consequence of the National Environmental Policy Act. Although these procedures are often marred by their lack of discipline, even unruliness, such untidiness is, I suspect, inevitable in a democratic society.

We scientists value our republic of science with its rigorous peer group review. The uninformed public is excluded from participation in the affairs of the republic of science rather as a matter of course. But when what we do transcends science and impinges on the public, we have no choice but to welcome public participation. Such participation by the uninitiated in matters that have both scientific and trans-scientific elements may pose some threat to the integrity of the republic of science. To my mind, however, this is a lesser threat than is the threat to our democratic processes that would be posed by excluding the public from participation in trans-scientific debate.

We must strive to improve our procedures for conducting this debate in such a way that the issues can be aired fully and yet the procedures themselves cannot be easily abused. That this is easier said than done does not absolve us as scientists from contributing to the development of better institutions for conducting trans-scientific debate.—ALVIN M. WEINBERG, *Director, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37830*