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COVER

The 200-kilometer-long Hubbard Glacier, Alaska, terminates in Disenchantment Fjord, Gulf of Alaska. Recession and thinning of glaciers, bordering the Gulf of Alaska, in Alaska and British Columbia have made a larger contribution to the rise of sea level in the last century than that of the polar ice sheets or the glaciers in other areas on earth. See page 1418. [Photograph No. 74CN03-127 by Austin Post, U.S. Geological Survey, Tacoma, Washington]

LETTERS

Malaria Research

It is good to note that *Science* will be reporting on recent developments in parasitology. Gina Kolota's article "The search for a malaria vaccine" (Research News, 9 Nov., p. 679) does not, however, tell the full story of malaria research in recent years.

The seminal work of Cohen, McGregor, and Carrington in 1961 (*1*) demonstrated protective antibody to human malaria and provided a basis for believing an effective vaccine to malaria might be possible. But a vaccine cannot be made unless one has a source of antigenic material. Yellow fever and flu virus vaccines are grown in chick embryos, and polio vaccines are grown in tissue culture. In 1975, when the World Health Organization embarked on its Programme of Research on Tropical Diseases, there was no way of producing any amount of human malaria parasites. No stage of the parasite could be grown in culture, and there were no suitable experimental animals. Cultivation of the parasites was the first priority. This was achieved in 1976, when a relatively simple method for continuous culture of the erythrocytic stages of *Plasmodium falciparum* was reported (*2*). This work sparked the revival of hope for a malaria vaccine. For the first time a way was available to produce quantities of human malaria parasites in any reasonably equipped laboratory. This meant that antigens could be purified from such cultures and tested for immunization. At this time there was no way to produce sporozoites in adequate amounts. This was the real reason why a sporozoite vaccine did not seem feasible. Then came the methods for monoclonal antibodies and recombinant DNA, and these have been exploited very effectively by Ruth and Victor Nussenzweig.

The work on a merozoite vaccine discussed in Kolata's article depends on the culture method, yet cultures are not mentioned. Nor does Kolata mention one of the most significant results published so far—the report by Perrin *et al.* (*3*) showing effective immunization of laboratory-bred squirrel monkeys to *P. falciparum* with very small amounts of a highly purified surface component prepared from cultures of erythrocytic stages. It is important and encouraging that the protein was prepared from one isolate of *P. falciparum*, whereas the challenge infection was derived from an entirely different isolate highly adapted to the squirrel monkey.

The work on a gamete vaccine likewise rests squarely on cultivation of the erythrocytic stages. In these cultures we can produce gametocytes infective to mosquitoes, thus providing a source of sporozoites. The cultures are also being widely used to screen for new drugs and to study the mode of drug action and the remarkable physiological relationships between the parasite and its host erythrocyte.

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1. S. Cohen, I. A. McGregor, S. Carrington, *Nature (London)* **192**, 733 (1961).
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Reported Laboratory Frauds in Biomedical Sciences

In recent years, we appear to have been hit by a wave of accounts in journals and newspapers of fraudulent reporting of scientific data. Many factors may have contributed to this, including an increase in the number of persons devoting substantially full time to research; an increase in the competition for available support dollars; an increase in the pressure to publish abundantly; possible changes in the nature of the training process that leads to the Ph.D. degree; and possibly, just possibly, a deterioration in the morality of our scientists. Assignment of weights to each of these and other factors is, at this time, not possible. However, review of reported cases indicates that certain generalities may be noted.

The frauds appear to occur most frequently in our most prestigious research and teaching institutions. A young man enters the laboratory of a very successful investigator, one who has an unusually large bibliography and who has, therefore, secured generous grant support and abundant laboratory space. The young man (there is a paucity of cases in which women are involved in fraud) inspects his new environment to ascertain what it takes to succeed there, and he soon concludes that, since his preceptor, who is obviously successful, has published an unusually large number of papers, this is the route to success. He therefore tries to follow this example and may publish ten or more papers in a year. Those of us experienced in the production of bio-

medical research know that to generate novel research results sufficient to fill that number of papers in the allotted time is not easy. Our young candidate, therefore, is forced by circumstances to consider the routes he may follow to achieve his ambition. On the one hand he may choose to plagiarize from the results of others. On the other hand he may choose to fabricate results and experiments. By these means, he hopes to diminish the time normally consumed in honest research, which entails the planning and design of experiments, the acquisition of the necessary technical skills, consideration of the relevant literature, and finally the preparation of his own research report. All of these steps consume time and energy.

One of the consequences of the selection of a very successful investigator as preceptor is that he will have attracted the attention of other pre- and postdoctoral fellows. He is likely to have a large number of trainees at some level of training who are accountable to him. Sometimes this number exceeds 20, and this, together with the fact that successful preceptors are likely to spend much time on the road giving lectures and participating in various committees and editorial board functions, reduces the time the preceptor may spend with each trainee. There are cases in which the trainee meets with his preceptor for 1/2 hour every 6 weeks. This is simply not enough if the preceptor is to take his teaching responsibility seriously. He should review with each trainee experiments done yesterday, and he should outline with the trainee the experiments planned for tomorrow. He should guide the trainee through the maze of the literature, and he should assist the trainee in the acquisition of the necessary experimental skills.

In addition, both by example and by precept, he has an obligation to make certain that each of his trainees is fully sensitized to the absolute requirement of total honesty in the reporting of scientific results. Many professions recognize unacceptable deviations from strict honesty. The banker cannot tolerate the embezzler. The military person cannot tolerate the deserter. And the intelligence services cannot tolerate the mole. Science cannot tolerate the man who takes lightly his moral obligation to report strictly what is true.

In light of the foregoing, it is suggested that research training groups under a single preceptor be kept small in size, permitting abundant contact between preceptor and trainee. The preceptor, if he is to fulfill his moral obligation, will undertake to spend significant periods of time at frequent intervals with each of his trainees. The candidate trainee will be well advised to select a preceptor who is not excessively encumbered with large numbers of trainees. He should recognize that a preceptor with an excessively lengthy bibliography may set quantity of publication above quality of research and may thus be a poor role model. In several of the recently publicized instances of laboratory fraud, the trainee has been the prime target of criticism, while the preceptor has been treated sympathetically and with commiseration. There may be instances in which this distribution of blame is not appropriate. Frequently, when one member of a group produces many more publications than do his contemporaries, this is taken as an indication of unusual ability. It may be appropriate to view such exceptions as a basis for suspicion and an indication for scrutiny.

DEWITT STETTEN, JR.
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Dating the COHMAP Project

It is remarkable how many startling bits of news one finds hidden in the articles in *Science*. Before reading Richard Kerr's article "Climate since the ice began to melt" (Research News, 19 Oct., p. 326), I had no idea how long the Cooperative Holocene Mapping Project (COHMAP) had been constructing climatic maps on the basis of pollen distribution. Kerr tells us that

> Since the 1960's an increasing number of pollen studies have been dated using radiocarbon technique.

And he reports that

> Thompson Webb and his group at Brown University have plotted abundances of 30 pollen types in eastern North America every 2000 years since 18,000 years ago.

One might be a bit skeptical about this, but the secret comes out a few paragraphs later, where we learn that these workers had help.

> To complete the maps, including the oceans, COHMAP workers are drawing on studies by 20 collaborators that include marine plankton . . . .

This is the best trick on marine life since the walrus and the carpenter enticed the oysters to attend their seminar on the beach. Perhaps they did it by offering the little fellows coauthorship.

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Law, Science, and Technology

A recent News and Comment briefing by John Walsh (16 Nov., p. 815) quotes law school dean Benno C. Schmidt, Jr., as saying that Columbia Law School's chair in law, science and technology is "the first in this vital subject at any major law school."

While we are pleased to see that Columbia is embracing this important topic, we must point out that the Yale Law School's chair of law, science and technology (currently occupied by Steven Duke) will be celebrating its 20th birthday next year. In addition, the Yale Law School is home to Stephen Carter (a young, but noted, scholar in the field) and to the Yale Law and Technology Association, a student organization that supports speakers, research, and a clinical program in technology-related law.

This is not to understate the importance of what has happened at Columbia. It is high time that law schools everywhere begin paying attention to the pervasive influence of science and technology on the law. In the interest of accuracy, however, the Yale Law School's efforts in this area should not be ignored.

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Erratum: In the News and Comment article "EPA scraps radionuclide regulations" by Marjorie Sun (9 Nov., p. 672), the reduction of risk to cancer was incorrectly calculated. Individuals living near elemental phosphorus plants have an increased risk of dying from cancer of 1 in 1000. The Environmental Protection Agency is proposing to cut the cancer risk to 4 in 100,000. The plan would reduce the risk by just over one order of magnitude, not three orders of magnitude, as stated in the article.

Erratum. The price of *The General History of Astronomy*, volume 4, part A, was omitted from the heading of the review that appeared in the issue of 30 November (p. 1067). The price is $29.95.

Erratum: In the report "Growth inhibitor from BSC-1 cells closely related to platelet type β transforming growth factor" by Ronald F. Tucker *et al.* (9 Nov., p. 705), figures 1 and 2 on page 706 were incorrectly interchanged. The figure captions are correct.

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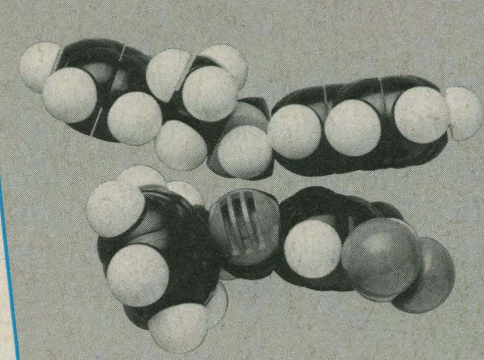

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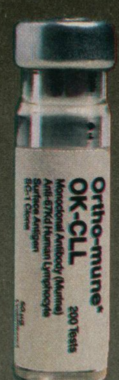

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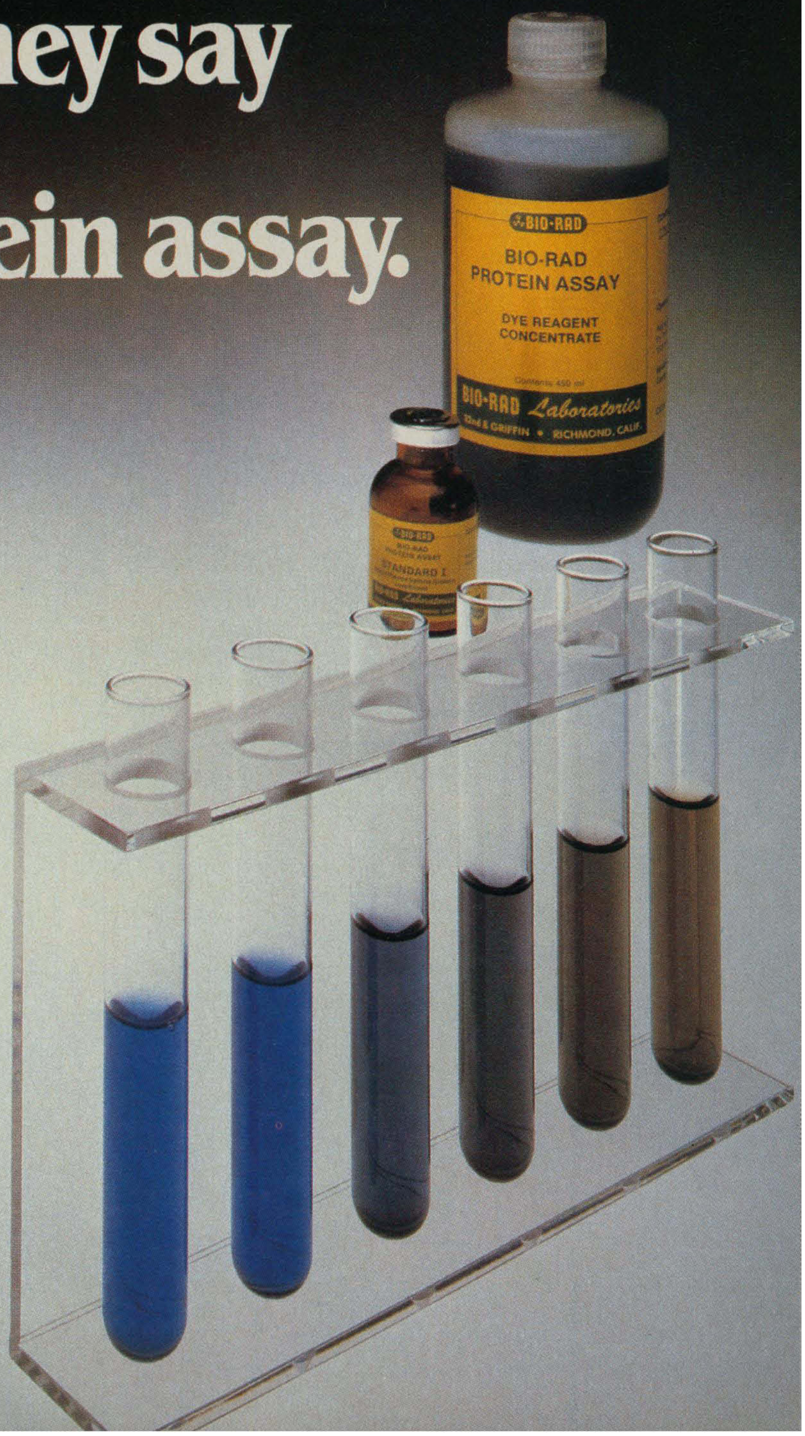

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SCIENCE

The Elegance of Choosing

A Soviet Embassy official, winding up an extended tour of duty in a reflective mood, remarked to his luncheon host that, all things considered, Americans and Russians are not all that different except for one thing; Americans have infinitely more choices. He did not add, though he might have, that the quantity of choices matters less than their quality.

In closed political systems most of the significant choices are made by the state through a structured planning process. Resources are mobilized to attain prescribed ends. In the Soviet Union the course of science and technology is directed through 170 comprehensive programs, 41 of which are targeted for accomplishment within the current 5-year plan, and the rest await the next planning round. It is an awesome way of doing the business of science and, if there is a flaw, it lies in the assumption that the research-production infrastructure has both the creativity and the efficiency to deliver planned objectives. Soviet science is not short on creativity. but there is many a fumble in handing off knowledge at the various stages of application, and Soviet officialdom does not conceal its frustration.

Comparatively speaking, the United States has the better of it despite the vagaries induced by the absence of straight-line planning and the unevenness of the roadbed on which science and technology travel. Ours is a system of interconnectedness rather than cohesion, but it admits light, ventilation, and improvisation. It prospers through flexibility, excellence in management, risk-taking, and good luck. Choices are considered, and directions readjusted or rejected at hundreds of nodes throughout the public, proprietary, and academic systems; decisions are reached for a multitude of objectives that may, or may not, bear upon the economic or national security goals of transient administrations. And because all this disaggregation yields a fine harvest, periodic calls for a national policy for science go begging.

Against this backdrop, the House Committee on Science and Technology is launching a massive inquiry into the contemporary arrangements for propagating science in the United States. It is a friendly search but one that will drive the congressional spade deeply into the turf of institutional self-satisfaction, which may be a very good thing. It will certainly go back to basics in the sense of recalibrating the efficacy of government's procedures for making investment choices, testing them against the new realities of sale, costs, and competitiveness that characterize the fruits of the past four decades. What we have here is a useful reminder that the Congress is equipped to exercise its voice as to priorities and objectives for science, along with its responsibilities to ponder the balance between national self-interest and global accountability relative to the hot pursuit of scientific and technical opportunity, its work may prove instructive.

If the recent elections reflect that state of popular preferences, as seems to be the case, one is led to think that government's roles will be increasingly limited and that pragmatism will strongly color its choices. The question then turns to time constants, to the difference between a pragmatism that hugs the short view and one that reaches for the longer term. It is a critical difference where science is concerned if for no other reason than that science is not an American monopoly. A kind of pragmatism that builds and solidifies joint scientific ventures with partners from other nations, in lieu of going it alone, would tilt toward the longer view. A version of pragmatism that consigns scientific knowledge to the category of trade secrets would take the other route. Seeing the difference with clarity is a key to the elegance of choosing.—WILLIAM D. CAREY


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For a book: G. N. Baturin, *Phosphorites on the Sea Floor* (Elsevier, Amsterdam, 1982), pp. 83–87.

For a paper in a compilation: J. W. Fitzgerald and D. W. Johnson, in *Sulphur 82*, A. I. More, Ed. (British Sulphur Corporation, London, 1982), vol. 1, pp. 411–426.

For unpublished material: A. Giraud, paper presented at the American Nuclear Society Conference, Washington, D.C., November 1976.

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