Letters

PCB's in Microscope Immersion Oil

Polychlorinated biphenyls (PCB's) are widespread and persistent environmental contaminants (*1*, *2*). Many persons carry measurable body burdens of PCB's derived from food, inhalation, and skin contact (*3*). Repeated skin applications of PCB's can kill experimental animals in 11 to 98 days (*4*). More than 1000 persons have been poisoned by ingestion of rice oil containing PCB's (*5*).

PCB's are sometimes used in electrical capacitors and transformers and have been used in vacuum pump oils (*1*). Mizuhira (*6*) informed us that microscope immersion oils used in Japan contain PCB's. Since laboratory workers are frequently exposed to electrical, vacuum, and immersion oils through skin contact and inhalation of vapors, we endeavored to evaluate (*7*) the PCB hazard posed by exposure to oils used commonly in research laboratories.

We found no PCB's in any of 31 samples of electrical, vacuum pump, and ultracentrifuge drive oils used in our laboratories. Nine samples of microscope immersion oil marketed in Europe, North America, and Japan under the brand names of Cargille, Crown, Nikon, Zeiss, Fisher, Harelco, and Carolina Biological Supply Co. all contained 30 to 45 percent PCB's, averaging about 5 to 6.3 chlorines per biphenyl residue, in hydrocarbon vehicles, but their labels carried no indication of PCB content or hazard.

Microscopists frequently permit immersion oil to make contact with skin, especially when wiping lenses or slides with lens paper. We now use cedar oil for routine light microscopy and reserve immersion oils containing PCB's for special use, as in fluorescence microscopy.

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6. V. Mizuhira, personal communication.
7. Infrared spectrograms were recorded from each sample. Those with spectrograms characteristic of PCB's were analyzed further by the method of P. W. Albro and L. Fishbein, *J. Chromatogr.* **69**, 273 (1972).

Plastic Sandbags

I recently returned from an investigation of the effects of the March and April floods in the St. Louis–St. Charles, Missouri, area. Aside from the farmland and property damage, which I expected to see, the thing I found most disturbing were the tremendous rows of sandbag dikes still scattered throughout the area. What was quite startling was that the bags were predominantly of a green, interwoven, nonbiodegradable plastic, rather than the standard biodegradable cotton in use for decades. Cotton bags rot away within a year under normal circumstances.

Further investigation showed that the sandbags were provided by the U.S. Army Corps of Engineers as part of a massive effort to minimize property damage. The St. Louis office of the Corps provided 6.5 million sandbags—of which 60 to 80 percent were of the nonbiodegradable plastic. In addition, the St. Louis office informed me that there are no funds available for cleanup of the bags placed in the fields.

The use of the new plastic bags ensures that these flood dikes will remain in the fields for an indefinite period of time. In an age of superconsciousness about solid waste problems and the environment, it seems odd that the federal government and its agencies have no concern about the long-range effects of their actions. Perhaps a coordinated effort by the Environmental Protection Agency and other federal agencies, such as the Army Corps of Engineers and the Soil Conservation Service, could prevent future repetitions of this type of unthinking action, while not interfering with the well-meaning activities of the agencies.

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Women in the Job Market

We have made an observation that might partially explain the low percentage of female job applicants reported by Beverly R. Green (Letters, 10 Aug., p. 496). Among many of the married, recent Ph.D.'s with whom we are acquainted, there seems to be a consistently followed pattern of job hunting. The husband applies for jobs, and, when he finds one, he and his wife move to the new area. Only then does the wife begin seriously to look for a job; frequently all she can find in her geographically limited search is a position as a technician or a "soft-money" research associate.

We suspect this is a general but unrecognized feature of the position of women in the job market, although our sample size is limited. It would appear that, even among highly educated couples, the man is considered to be the primary job candidate, and the woman's career is regarded as of secondary importance.

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Invading the Unknown

The polemic engaged in by Henderson, Stein, and Stetten (Letters, 4 May, p. 448) on how far research should, or can, be planned runs out of steam largely because they fail to agree on definitions of research and research planning. The issues are (i) how much of the thinking, reading, and talking that precedes the first experiment can be regarded as planning; and (ii) should the term "research" be applied to work in already charted areas of science?

Surely the former is immaterial. What

is essential is that all plans, hypotheses, work-programs, or other preliminaries are regarded as disposable. Great advances may emerge from a scientific exercise carried through to the last of a series of preplanned experiments. However, many have arisen from the inspired pursuit of ideas engendered by chance observations that were either irrelevant to the planned exercise or were embarrassingly awkward. It is second nature to bacteriologists to discard cultures with stray infections. Fortunately Fleming did not (*1*), and we have antibiotics. A parasitologist, Keilin, was curious to learn what happened during pupation to the intracellular hemoglobin of the botfly larva. He could find no hemoglobin in the adult, but he did find a pigment that he named cytochrome (*2*). Working on his own, he established the role of cytochrome in cell respiration and ushered in a new era for biochemistry.

Although Stetten's dictum, "Research is the invasion of the unknown" (Editorial, 18 Aug. 1972, p. 565), is applicable to such ventures, a more explicit expression of his views would be, "research is the unplanned invasion of the unknown." Earlier planning brought Fleming and Keilin to the points where they could make their crucial observations. Did each, thenceforward, in pursuit of the unknown, work without plans? With Henderson, I believe that Szent-Györgyi's nocturnal digestion (*3*) is a process of metabolizing yesterday's experiences into tomorrow's plans of action. Certainly it is not research if you know what you are going to find, but it is research to set out, plans in hand (as many of us do), in an attempt to reach a defined but hitherto unattained objective. Even Stetten's "trudging through the jungle" calls for a modicum of planning—for example, a decision on a compass bearing lest he walk in a circle. To Stetten, planning means strategic planning; for Henderson and Stein, as for myself, planning may be both strategic and tactical.

Sanger's brilliant elucidation of the amino acid sequence of insulin (*4*) was research of a high order, but what of the sequence determination of cytochrome c from yet another species? Yet from accumulated data on cytochrome c has developed the exciting concept of the functional evolution of proteins (*5*), and fuller development of this concept requires still more sequence determinations (*6*). With techniques fully charted, the growing tedium of such exercises calls urgently for automation (*5*), although current knowledge of structural homologies enables guesswork to play a useful role in sequence determination (*7*). Is this research? I say that it is, since my criterion is not the means but the end; not the originality of the techniques but the growth of comprehension.

Among laymen there persists a picture of the researcher as one prodding at the unknown by hit-and-miss methods. This view was expressed with inane felicity by Belloc (*8*): ". . . anyone of common mental and physical health can practise scientific research. . . . Anyone can try by patient experiment what happens if this or that substance be mixed in this or that proportion with some other under this or that condition. Anyone can vary the experiment in any number of ways. He that hits in this fashion on something novel and of use will have fame. . . . The fame will be the product of luck and industry. It will not be the product of special talent." As Stein reminds us, since the public provides most of the money, it is essential that the public come to appreciate the principles and logic of scientific research. Presenting it as a game of chance, unplanned and lacking objectives, is not only misleading but a disincentive to the holders of purse strings. Equally misleading, and also amoral, is the premise that expenditure of x million dollars over y years will ensure a desired result (for example, a cure for cancer). Sponsors must become convinced that the essential conditions for innovative research are freedom to think laterally and freedom to risk taking a chance, to ponder not only the route to the declared objective but also the experiment that fails and the result that sticks out like a sore thumb; and to respond to the promptings of intuition—with new plans.

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