duced by "repeated long-term high level exposures." The attitude expressed in Clark's letter, however, illustrates the major point that caused concern to the Committee on Scientific Freedom and Responsibility. The extremely ominous findings in the animal studies did not trigger any major alarm until cases of cancer in factory workers exposed to vinyl chloride began to be reported. This has been in the past the general attitude regarding such problems; I believe that it is now out of date. New reagents introduced into industry on a large scale should be regarded as dangerous until proved safe. Precautions to protect workers from inhaling or absorbing them should be built in from the very start, rather than being superimposed later, after damage has become apparent. Carcinogenic substances usually take years to produce cancers; we should not wait for the cancers to appear in human subjects before taking action. Fortunately the work of Ames *et al.* (*1*) and others has shown that carcinogens are generally mutagens. Screening of chemicals for mutagenicity can be carried out fairly rapidly. With the techniques available today we can thus often obtain an early warning of danger, but negative results on mutagenicity tests should not be cause for complacency. Highly toxic substances may be nonmutagenic.

I thank Edwards and others for correcting the erroneous statement that DDT brought a halt to a cholera epidemic. It was of course a typhus epidemic that was halted by DDT. How this error slipped through I do not know; the error is in any case mine, not that of the committee. This point will be corrected in all reprints.

One can add to the references cited by Edwards a recent review on insecticides by Jukes (*2*) which contains a vigorous defense of the value and safety of DDT. Some of the environmental damage that has been charged to DDT was probably unreal or greatly exaggerated; some was probably due to other substances, such as the polychlorinated biphenyls (PCB's), which most analysts long failed to distinguish from DDT and its breakdown products. Nevertheless the official decision to ban DDT for nearly all uses *in the United States* was not arbitrary or capricious; it was taken after prolonged hearings, with presentation of a profusion of evidence by both sides. The case for using DDT in countries where malaria is a serious problem is far stronger. To my knowledge there is no adequate substitute for the spraying of interior walls of houses with DDT solutions as an essential element in a malaria control program. I would oppose any policy of denying such countries the ability to purchase and use DDT for these purposes. The need of the future, however, is to develop less persistent and more specific pesticides that can be directed against a narrow range of target species, while doing little or no damage to others.

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References

1. B. Ames, F. D. Lee, W. E. Durston, *Proc. Natl. Sci. U.S.A.* **70**, 782 (1973).
2. T. Jukes, *Naturwissenschaften* **61**, 6 (1974).

Energy Equivalents

The recent interest in alternative energy sources—in particular, energy derived from solid wastes—has prompted what may be described as a new parlor game of quoting energy equivalents of the new sources. For example, the potential of a new fuel is frequently quoted as the equivalent of so many barrels of oil, implying that the new fuel could be so converted. The potential for deriving some form of energy from solid wastes expressed this way clearly ignores the laws of thermodynamics. To avoid error and confusion, I propose a new vocabulary.

I suggest that the product of the given mass of fuel, M, the heat of combustion, ΔH_c, and the conversion factor, F, that is commonly used to express the energy value in barrels of oil (or some similar newspeak unit) be termed the *arithmetic equivalence*, $M\Delta H_cF$, of the new source. This term could serve to alert audiences that scaling of new sources in such units does not mean, nor imply, that the new source could physically or chemically be converted to the form described by the unit.

Besides being used as a fuel directly (for example, in incineration) solid wastes may be converted to some other form by mechanical, chemical, or biological means to produce a unit of new fuel with a higher heat of combustion, $\Delta H'_c$. The conversion process will use energy, and the law of conversion of mass-energy dictates $M\Delta H_c \geq M'\Delta H'_c$ where M' is the mass of product fuel. Therefore, the *conversion equivalence* of feedstock M can be defined as $M'\Delta H'_cF$. Alternatively, the conversion equivalence may be defined as the arithmetic equivalence less the energy input and losses of the particular process. The two definitions of conversion equivalence differ slightly, particularly in ease of computation. However, the differences in value may not be great.

The new fuel source may be used as a supplement to, or substitute for, a commonly used fossil fuel, with or without passing through a conversion process. Examples would be raising steam in an incinerator using raw refuse, or in a suspension boiler designed for processed refuse-derived fuel, or using the fuel gas from pyrolysis of solid wastes. In a given application, the new form of fuel may operate with the same, greater, or lower efficiency than the fuel it is replacing. Thus the *substitution equivalence* is defined as the amount of fuel in the new form that must be used to replace the conventional fuel in a specific application. The substitution equivalence should be used as the basis for energy policy planning and not the arithmetic equivalence, as seemingly is done now.

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Misplaced Research

I wish to draw attention to the fact that Banting and Best worked at the University of Toronto and not at the University of Ontario, as indicated in Thomas H. Maugh's article on diabetes (Research News, 30 May, p. 920). A University of Ontario is nonexistent.

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Sounds of Science

This autumn quarter I will conduct, for the second time, a seminar entitled "Songs about science." I would appreciate donations of lyrics or music relating in any way to any area of science in its broadest sense. If you have taped or recorded material which you could reproduce, or if you want to sing or play some science songs, I will be pleased to send blank cassette tapes. There is relatively little professionally recorded music relating to science. Most science songs are written and performed by amateurs (usually students and scientists); few of these are ever published or recorded and, in general, are rapidly lost. Frequently these amateur works provide penetrating commentaries on science and scientists. Thus I feel that this rare art form should be collected, preserved, and studied.

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