Letters

Emission Standards: Costs and Benefits

It is reported by Constance Holden (News and Comment, 27 Sept., p. 1142) that the National Academy of Sciences (NAS) has okayed auto emission standards. Indeed, the recent NAS study (*1*) prepared for the Senate Public Works Committee endorses the numerical emission standards set out in the 1970 Clean Air Act and sees "no substantial basis for changing the standards." It claims that the standards are justifiable in cost-benefit terms. It reaches this conclusion by finding "that the benefits in monetary terms . . . are commensurate with the expected cost" of about $5 billion to $8 billion per year.

Unfortunately this conclusion is not justified: the optimum point of operation is not one at which the dollar benefits are equal to the dollar costs, but one at which the *marginal* (or incremental) benefits are equal to the *marginal* costs (Fig. 1). This optimum point generally occurs where the costs are much lower than the benefits. At the optimum, a $1 increase in cost would buy an additional $1 of benefits; at the point where costs equal benefits (which is well past the optimum), it would buy substantially less. The summary report only hints at this possibility. But the detailed results of the study itself can be used directly to support the following contrary conclusion: Relaxing the emission standards, or reducing their geographic coverage to cities with serious pollution problems, or delaying the implementation of the standards would lower the costs drastically without an important reduction in benefits.

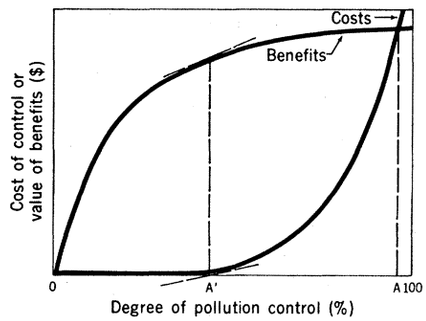

Fig. 1. Schematic diagram of costs and benefits versus degree of pollution control (*2*, p. 949). The optimum level of pollution is not at point *A*, where costs equal benefits, but at point *A'*, where the marginal quantities (slopes) are equal.

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1. Coordinating Committee on Air Quality Studies, National Academy of Sciences–National Academy of Engineering, *Air Quality and Automobile Emission Control*, vol. 1, *Summary Report* (Government Printing Office, Washington, D.C., 1974).
2. Modified from S. F. Singer, *Eos (Trans. Am. Geophys. Union)* **55**, 948 (1974).

Agricultural Development

I commend Eugene Brams and James Kirkwood (Letters, 23 Aug., p. 649) for trying new methods to improve international agricultural education. I am not sure, however, if such programs will bear fruit.

Most instructional modules, including those described by Brams and Kirkwood, are based on the conditions in the developed countries. But are these modules applicable to conditions in countries such as India, where the social structure is altogether different from that in the United States? Success in producing more food grains in the Third World has been achieved, as is evidenced by the so-called Green Revolution. But the development of agriculture in India involves many departments of the government other than the agriculture department. In the Punjab state, considered the granary of India, continuous problems with agricultural development arise because of the lack of coordination among the various governmental departments, not because of the lack of technical know-how or the skill to communicate (*2*). And this probably holds true in many other developing countries.

Another reason why the United States has often failed to give effective assistance to the developing countries may be because they have not always sent competent advisers to those countries, although there have been some excellent men on such assignments. In this connection, Singh states, "In my social contacts with these foreign experts I have found them more knowledgeable on tiger-hunting in India than on the country's agriculture" (*3*).

The answer to the question of whether the United States, after 25 years, $150 billion, and the dedicated efforts of thousands of experts, has learned how to carry out an effective development project in a developing nation is given in the title of a book by Paddock and Paddock (*4*). Let us hope, wait, and see if Prairie View's new methods succeed.

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1. J. M. Brewster, in *Agricultural Development and Economic Growth*, H. M. Southworth and B. F. Johnston, Eds. (Cornell Univ. Press, Ithaca, N.Y., 1967).
2. A. S. Kahlon, A. C. Sharma, P. C. Deb, in *Serving the Small Farmer: Policy Choices in Indian Agriculture*, G. Hunter and A. F. Bottral, Eds. (Croom Helm, London, 1974).
3. S. Singh, *Ceres (FAO Rev.)* **4**, 33 (1971).
4. W. Paddock and E. Paddock, *We Don't Know How* (Iowa State Univ. Press, Ames, 1973).

Ultrasonic Holographic Instrument

There is an error in the Research News article by Jean Marx (18 Oct., p. 247) on "Diagnostic medicine: The coming ultrasonic boom." I estimated that it will take 2 or 3 years before the feasibility of an ultrasonic holographic instrument can be demonstrated at the RCA Laboratories, rather than that we are 2 to 3 years away from marketing such a device. Further, an additional period of several years would be required to test a diagnostic machine in a clinical environment.

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Scientific Manpower Survey

The article by Deborah Shapley (News and Comment, 31 May, p. 967) on the 1973 survey (*1*) by the National Research Council (NRC) of doctoral scientists and engineers overlooks a fundamental difference between that survey and others with similar purposes. The population base from which a representative sample was drawn in

the NRC survey was compiled from the NRC's doctorate records file, which contains records of essentially all doctoral degrees awarded by U.S. institutions, and from sources of information about foreign-earned doctorates. Hence the 42,456 survey responses received (not 59,086, as reported in *Science*) accurately reflected the employment situations of *all* doctoral scientists and engineers, and not just the situations of the members of professional societies.

Some other criticisms of employment surveys in general that were cited in Shapley's article do not apply to the NRC survey. Information about scientists and engineers who had accepted postdoctoral appointments, had retired, had taken part-time positions, or were unable to find science positions—information often overlooked—was collected from this survey. Similarly, individuals not seeking employment or employed in fields other than those in which they were trained could be identified from data collected by the NRC. In fact, the NRC is presently using 1973 survey data to investigate the characteristics of doctoral scientists and engineers who might be regarded as either unemployed or "underemployed" and expects to make the results known in future reports.

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References

1. *Doctoral Scientists and Engineers in the United States: 1973 Profile* (National Research Council–National Academy of Sciences, Washington, D.C., 1974).

Shapley's article states, "What no one knows, or has bothered to determine, is how the non-elite segments of the technical work force are faring." This statement and related discussions in Shapley's article seem to overlook both the program of the National Science Foundation (NSF) to measure periodically the nature and activity of the nation's total scientific and engineering labor force and the role of the NRC doctorate survey in this program.

The NSF's Manpower Characteristics System is the successor to the National Register of Scientific and Technical Personnel. It is composed of three subsystems, each of which examines a particular segment of the labor force. One of these subsystems is the Doctoral Roster, which conducts a biennial survey of doctoral scientists and engineers in the United States. This particular survey is carried out by the NRC for the NSF. The results of the first of these surveys are described in the NRC report discussed by Shapley.

The second component of the system is the National Sample of Scientists and Engineers, which was developed jointly by the NSF and the Bureau of the Census. This sample population includes personnel at all degree levels, including those who function as scientists and engineers and hold no academic degrees. Data are collected biennially. The initial survey of this group, based on the 1970 biennial census, was conducted during the first half of 1974, and the results should be available by the end of the year.

The third component of our system will provide information on those individuals who have entered the labor force since 1970. It involves follow-up surveys of freshmen classes conducted 4 to 6 years after their entry into college. A survey is currently being conducted for the NSF of the 1967, 1968, and 1969 entering classes by the Laboratory for Research on Higher Education of the University of California at Los Angeles.

It should be evident that we are very much concerned about all segments of the scientific and engineering community and have taken steps to provide data on the employment and utilization of all its components.

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Speaking Plainly

I read with amusement "Speak plainly and eschew neologisms" by Robert Gillette (News and Comment, 18 Oct., p. 240). This is what I have been trying to teach my graduate students for years (inculcate).

I particularly recommend Fowler's essay on "elegant variation" (*1*). The following is a short relevant passage.

> It is the second-rate writers, those intent rather on expressing themselves prettily than on conveying their meaning clearly, and still more those whose notions of style are based on a few misleading rules of thumb, that are chiefly open to the allurements of elegant variation.

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1. H. W. Fowler, *A Dictionary of Modern English Usage* (Oxford Univ. Press, New York, ed. 2, 1965), p. 148.