

Second, some other important pollution problems are so complex that cause and affect relationships are not well worked out. Abatement technology may be costly and inefficient. Since our control efforts can be fully occupied on the gross and obvious problems, a time period for research is available to deal with these more important contaminants. Productive science and engineering in the next few years can give us a much improved control capability. Ingenious abatement methods can lower costs and ameliorate the change of habits and practices which improved environmental quality may require.

We should not, need not, and will not wait upon research to act where we recognize the problems and have feasible solutions. On the other hand, it would be wasteful of time and resources to pursue a crash program where quality deterioration is only vaguely established or where abatement costs probably outweigh benefits. A great deal of hard work is necessary to replace, therefore, conjecture an anecdote with practical control procedures.

Therefore, the current hearings are focused on the research programs of the Federal agencies which must produce an expanded basis of facts and technical options to make our pollution laws work. We believe the testimony will show that it is shortsighted indeed, to consider goals for restoring and maintaining the quality of the environment apart from the supporting research and development.

From our past hearings, a number of specific conclusions and recommendations were drawn. I would like to quote from our report, "Environmental Pollution—A Challenge to Science and Technology," a few items which pertain to the Federal research strategy:

Federal Government scientific activities are not yet channeled to support announced goals in pollution abatement. There is no organization or coordinating group capable of systems analysis and broad management of Federal projects. Insufficient funding has made support of research spotty and disproportionate among problem areas. Agency missions may inhibit long term and comprehensive ecological studies. "Pollution" can cover an enormous variety of Federal agency programs ranging from water resources research to agricultural engineering. Limitations of definition will be necessary for effective program coordination.

To improve our knowledge of what we are about, scientific activity in ecology and related fields should be immediately expanded to provide—

- (a) Baseline measurements in plant and animal communities and the environment—an ecological survey.
- (b) Continued monitoring of changes in the biosphere.

As an example, I would interject here that there have been alarming stories in the past few years that the accumulation of carbon dioxide in the atmosphere from fossil fuel combustion might cause a "greenhouse effect" and raise the temperature of the earth. Such a climate change would upset the world's weather, melt icecaps, and so forth. Last summer, HEW scientists reported that the mean annual world temperature actually was falling. The reason given (Science Vol. 156, p. 1358) was that particles in the atmosphere were increasing, thereby reflecting more sunlight and decreasing solar radiation reaching the ground. This may be a lesson for us that early impressions of environmental effects are often incomplete and that public statements should be tempered until adequate studies are completed.

- (c) Abilities to predict the consequences of man-made changes.
- (d) Early detection of such consequences.
- (e) Knowledge of the environmental determinants of disease.

Ecological surveys and research should be centralized as to management in some one science-based Federal agency. The scientific activity should be performed (whether in Government laboratories or under contract by local