

May we send you some questions?

Dr. BUCKLEY. Yes.

(Additional questions and answers for the record may be found in vol. II.)

(The complete prepared statement of Dr. John L. Buckley follows:)

PREPARED STATEMENT OF DR. JOHN L. BUCKLEY, ECOLOGICAL RESEARCH COORDINATOR, OFFICE OF THE SCIENCE ADVISER, U.S. DEPARTMENT OF THE INTERIOR

Chairman Daddario, members of the subcommittee, I am delighted to have the opportunity to discuss with you the "adequacy of technology for pollution abatement." Your committee is certainly to be commended for its effort to stimulate creative thinking about environmental protection as a whole. The Research Management Advisory Panel report is itself a perceptive document that will stimulate creative thought in attempts to face up to the issues it raises.

We all recognize that pollution is a matter of serious concern, and I shall not dwell on how bad the situation is. Many of the witnesses who have appeared before you have discussed in detail needed hardware and instrumentation and integrated systems for effective control of pollution. I plan to confine my remarks largely to the inadequacies in basic knowledge rather than to technology and my personal interest is greatest in understanding the "risk" side of the benefit-risk equation.

Of course, I agree with the statement of the panel " * * * it appears obvious that the basic issue in the field of environmental pollution relates to the definition of goals. The definition must be specific enough to form a basis for policy formulation. Answers are needed to questions such as: How clean should this stream be? What limits should be placed on emissions into the atmosphere here? To what extent can this land assimilate man-made wastes or other products?"

While we can probably all agree that as a general goal, we want an environment of a quality truly fit to live in and pass on with pride to future generations, we have not yet agreed on the environmental quality standards that we must specify to meet this goal. A suitable environment will fulfill not only our biological needs, but also our demands for recreation, esthetic gratification and happiness. We cannot yet specify with precision our biological needs and we do even less well with the others.

We can consider the kinds of worlds we might have that would meet our needs as a spectrum extending from the completely "natural" to the totally artificial. At one end of the spectrum would be a world in which the influence of man is essentially nil, and where he makes do with what is present. For millennia we lived just thus—the existence of man as a species is evidence that man, at least in limited numbers, can survive in such a natural world. Even if we could, few of us would exchange our modern comforts and standards of living for the vagaries and uncertainties of a world in which we passively accepted what was present.

At the other end of the spectrum is a totally controlled environment in which each of the requirements of man is provided in just the right amount at the right time. We do this now in the controlled environment of a space ship. Perhaps in the future we may be able to do so for the earth as a whole. But the spaceship environment still requires inputs of energy and materials gathered from the earth. At this point in time it is not self-sustaining; moreover we don't expect its occupants to live out their lives in its confines. Even though we might accept such an artificial environment, we have far to go before we can replace the materials and services provided by the natural world. So the real world in which we live is somewhere between these two extremes, and our goal must be to manipulate it in such a way as to meet our needs.

Man, though comparatively adaptable, has certain biologically fixed requirements and limitations. He must have oxygen to breathe, water to drink, certain kinds of nutrients. Beyond these basic essentials are certain aesthetic requirements which we cannot yet quantitatively specify—but which are none the less real.

We cannot yet meet these biological needs without certain services rendered to us by living organisms. We depend on green plants to capture energy from the sun, and combine it in organic compounds where it is stored in a form