

had started to work on it at a rate of 10 percent of our expenditures on space research.

I have described our problem as a systems problem. Let me hasten to say that I do not suggest that this is the sort of systems problem that can be written down in mathematical expressions and answers derived in a few minutes or even a few hours time on a computer. I say this for two reasons. First, and foremost, we simply do not know enough about our problem to write the necessary expressions. Secondly, if we could write the necessary equations, there is every reason to believe that we do not have today a computer big enough to solve them. But a systems problem does not have to be solved by a mathematical equation and a computer. Basically, a systems analysis requires that we know something about the goals which we are striving for, and the capabilities and costs of solutions which would contribute to these goals. With systems analysis techniques, we would then seek to find the optimum combination of solutions for the attainment of our stated goals. Systems analysis requires an orderly, but not necessarily mathematical approach, to a problem.

If we wish to approach the pollution system realistically, we must do several things. These are:

- (1) Define with reasonable accuracy the sources and quantities of pollutants now and estimate these data for future years.
- (2) Identify the effects of these pollutants on man.
- (3) Define with considerable clarity our goals for pollution abatement.
- (4) Describe the technically feasible methods of dealing with each major pollution source with reasonable cost estimates.
- (5) On the basis of the foregoing information, determine the most efficient combination of methods to deal with the problem.

There is little hope that we can or will deal with the total environmental pollution problem as a single systems analysis problem. It is too big and would take too long. Indeed, it may never be fully solved. New sources of pollution will develop. New abatement techniques will be found. The details of the problem will shift continuously. However, if we approach the problem systematically, we can hope that our efforts will yield the maximum possible achievement.

Pollution is the sum total of many different substances from many sources. The need for an inventory of these substances seems obvious, yet I know of no such inventory. Some pollutants are more harmful than others; some are easier to deal with. With a reasonably accurate inventory as a start we can begin to identify those substances and sources for which abatement offers the most immediate payoff. Because we are planning for the future we need estimates of future pollution sources and substances. Most important are some educated guesses at which substances, now nonexistent or unimportant, might be problems in the future. The problems which can be recognized in advance may never become problems. The inventory would seem to be a responsibility of the Federal Government and one which should proceed as rapidly as possible. In a sense it parallels the inventory responsibility of the Federal Water Resources Council, but the pollution inventory is a much more complex job than a water supply and demand inventory.

Item 2 of my list requires definition of the effects of various pollutants on man. This includes direct physical effects on health, eco-