PROPOSAL FOR STUDYING AN ENVIRONMENTAL "ZOO"

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MEMORANDUM

To: H. Raiffa

Date: August 30, 1973

From: M. Fiering

Subject: Proposal for studying an Environmental "Zoo"

1. Some theorems of ecology:

   a. Man reduces the number of species in the world. This is NOT necessarily BAD.

   b. But reduction implies a loss of stability and most would agree this is bad.

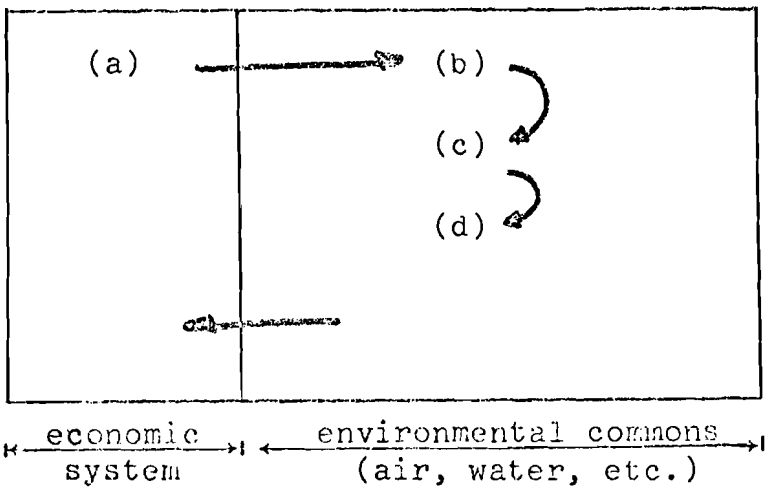
   c. The food web is NOT the same as a network because information in a network still comprises one message if it is redundant. Not true for natural systems.

   d. Energy (or food) passes through a network in an active, not passive, mode. It is grabbed or pushed or eaten, and does not flow of its own accord. Passivity implies stability, but it is not real. Economics is active.

   e. Aquatic and terrestrial models are necessary because these two systems are very different. They may be the only systems. Among the differences are the time constants for these systems, ranging from centuries (for forests) to hours (for small, dependent animals). These differences form the basis of my proposal.

   f. Food sources for one organism are typically negatively correlated with those for another; in sum, the correlation is nearly zero but this is because they cancel correlations, not because each is zero.

2.



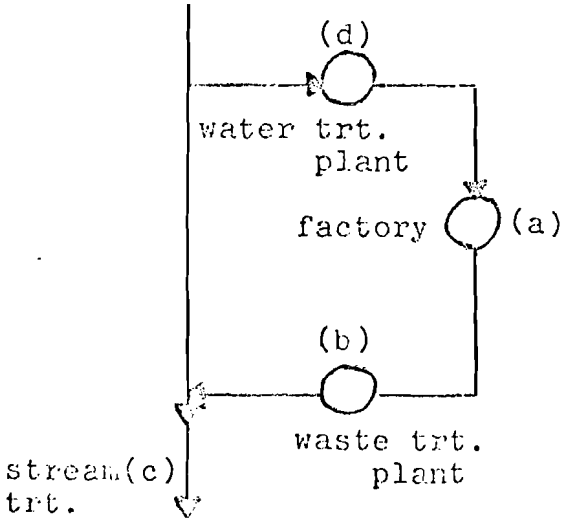
Pollution control can be affected by:

a) economic controls (e.g., low sulfur fuels, standards for adaptation and reuse, etc.)

b) treating wastes to make them innocuous (traditional role of sanitary engineering)

c) treating the environment itself so as to accommodate the wastes (future role of sanitary engineering)

d) dealing with pollution (gas masks, water treatment plants, earplugs, cleaning out shellfish, etc.).



We need (e)--the "Zoo"--and (f)--capacity for instrumentation and monitoring.

3. An ecologist is concerned with nature's way of doing it, and there is little reason to suspect that this is the best way for man to do it. It is unlikely that our solutions to ecological

problems will follow some natural methods, mainly because we can compress time. This results in an enormous competitive advantage for man, and history shows that whenever it has happened in the past, it has led to massive and complete replacement of fauna or flora by the new type.

4. The Concept of a Zoo

Two major features of ecosystems are (i) environmental pollution due to significant random accidents which disturb homeostasis, and (ii) the slow rate of recovery from such accidents. We should consider a "zoo" from which it would be feasible to re-seed damaged ecosystems with organisms of appropriate types, in numbers sufficient to trigger rapid recovery of homeostasis (or "ecolibrium"); the zoo would function as an ecological flywheel. We consider below a water resource system.

To maintain such a zoo might cost less than preventing pollution (type a) or reducing it before (type d) or after (type b) the water is used. It is almost surely cheaper than stream treatment (type c). A small injection of organisms might suffice to trigger natural recovery of damaged species, and one should be able to estimate the probability with which episodes of environmental insult occur.

Traditional engineering calls for removal of pollutants from a watercourse; I propose here to stabilize ailing ecologic balances by adding organisms, "hardening" natural riches, and perhaps noting that ecolibria, with different combinations of organisms, will result from this hardening.

5. a) We would have to invent measures of ecologic stability, dispersion, recovery, etc. Much has been done along selected lines, but there are no major breakthroughs.

b) We would have to deal with stochastic processes, biometry, standards, monitoring, economics, chemistry, etc....The problem cuts accross many IIASA areas.

c) The problem of specifying when to add which organisms is an exquisite problem in mathematics; we could devote some time to noting the sensitivity of solutions to different objectives--if indeed there are widely different solutions at all.

d) Institutional issues are a major factor, and I feel that concentration on a small ecoshed, say a lake, would be essential. The primary motion in a lake is vertical, and we know much more about these dynamics than about those in a stream, where the primary motion is horizontal.

6. I carry no major brief for this problem, but suggest it to identify the scale and scope of a manageable research effort. The Alpine Lake Problem is another excellent example.