V PRODUCTIVITY THEORY

In the course of a study such as this which involves groping for new procedures, some questions arise that seem to bear on general aspects of the science, such as the following:

Aquatic Stable States

1. Can an ecological aquatic community exist in a stable steady state in which matter and energy flow through the system but standing states quantitatively and qualitatively remain constant? The observations so far suggest that this is possible in a flow system in nature just as in an algal pure culture production machine. It is to be [illegible] however if a steady state aquatic ecological system can be stablized under matter closed conditions The reason for feeling that it can not be stable is two fold: first, most relatively closed-to-matter systems, like bottle cultures, ponds, and lakes oscillate and fluctuate. Second, in a closed system a limiting nutrient must always give rise by successional and relative depletion to some other limiting nutrient. The stability principle says that all closed systems [illegible] by a natural selection process toward a self-regulated system. The question is: where does a mathematically satisfactory solution exist to stabilized circular transfer of material components through organisms with each component passing at a different yet constant rate. Even more simply and operationally, if placed in sealed bottles and placed in the light how many kinds and types of simple communities will stabilize and how many will oscillate.

Pyramid of Production in Streams

2. In flowing streams of usual type a striking feature is the small standing crop of plants in comparison to small animals and especially fishes. There seems to be an important interpretation other than that there is an autochthonous source of primary food matter. In constructing pyramids of production (not standing crop) for a stream one is interested in production per time such as a year. In this time the fish production is the growth of fish located in one place since they have not left the stream. But for plants and for small animals the production is what has drifted downstream for a whole year as well as that which has passed up the food chain. Thus the standing crop of diatoms drifting down stream from sources in bayous is an infinitely small part of the annual crop which involves the whole years downstream drift. It is probable that such pyramids when constructed will show a more usual wide bottom. In fact, production in rivers may be the easiest of all to measure by catching what drifts down as in springs experiment described above. In the springs, of course, the volume flow is such that initially there is no true plankton.

3. In discussion of food chains, the concept of efficiency of food chain transfer has been a useful operational measure that has helped understand natural ecosystems. However, there is one fuzzy aspect of this concept that needs clarification. It is often pointed out that photosynthetic efficiency is of the order of magnitude of 1% or less but that energy transfers further up the chain are of higher order of magnitudes of 10-20% and under some artificial feeding experiments with fish of 50%. Those interested in increasing natural food resources naturally ask what basic differences there are and whether photosynthesis can't be made to possess a higher efficiency.