Now if the plants run at the same rate of output per area and if size effects hold for plants as well as animals, then small plants like Chlorella if growing in steady state should achieve the same output per area but with less biomass. The large climax rain-forest with big plants on the other hand if adjusted to the same light and optimum efficiency will require a much larger standing crop biomass because of the slower metabolism per pound of tissues.

In Figure 16 below is shown a graph of photosynthetic rate of plants of various minimum diameters under natural light or maximum photosynthetic adjustments. The data are from Verduin.

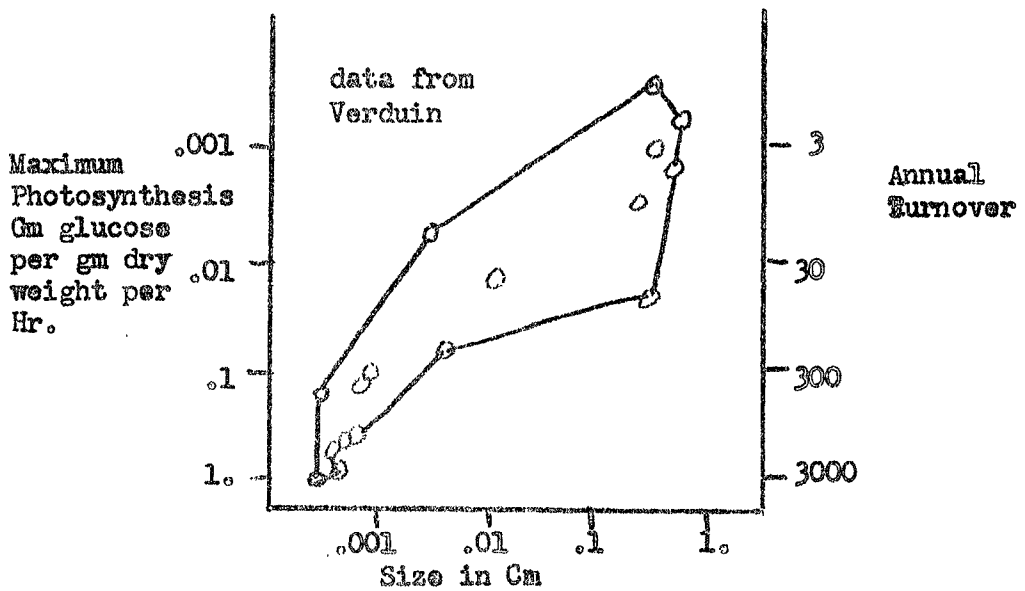

Figure 16. Effect of organismal size on Photosynthesis per weight

It is apparent that there is a size effect over a wide range just as in the heterotrophs. Thus, knowing the light intensity, the size of the producer, and the rough efficiencies found in given environments, one can compute the steady state biomass (carrying capacity).

C. Pyramid Shape and Organismal Size

If as outlined above small sized producers put out the same production per area with a small biomass as do large producers with a large biomass both working at similar efficiencies, one can visualize two extreme types of pyramids as calculated in Figure 17. (For data showing similar efficiencies and production for mass Chlorella culture and grass plots see (Burlew: Mass Culture of Algae--Chapter 5--Warchuk et. al., Carnegie, 1953) In one the size of the organism decreases as one goes up the food chain as in grass--grasshopper--spider. In the other the size of the organism increases as one goes up the food chain as in chlorella, paramecium, and fish. If the same energy passes up through both food chains with the same 10% efficiency for the higher trophic levels, two entirely different shaped pyramids of steady state biomass result because of the different rates of turnover. Some metabolic rate figures are used to compute Figure 17 from Hallmann's text. Photosynthetic values are taken from Figure 16.