The Problem With Phosphorus...

The following short, whimsical note makes some significant points in an unorthodox way. I hope it adds a bit of spice to your day.

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Phosphorus is King of the aquatic plant kingdom. It would be a mistake to assume that it is equally powerful in all parts of the ocean. This simple principle has been concealed from a generation of aquatic scientists seduced by the powers of the Queen Consort, Nitrogen.

If Phosphorus is King and Nitrogen is Queen, then a naive observer of the Chess Game of Life might prematurely conclude, after watching the moves unfolding on the board, that the Queen is all powerful and controls the game. She can move both diagonally and laterally across the board and travel long distances in one jump. Clones can be created from thin air on the back row.

The King, on the other hand, is indeed a subtle prince, spending his life sequestered on the back row. He exerts little if any influence on the flow of the game, scarcely moving except perhaps to exchange places with his cornerstone vassal in the event of a threatened weak-side attack, and sallying forth at a single-step pace only near the end in a reckless attempt to avoid capture. He is the least dynamic member of the aristocracy, dividing his time between hiding and running away.

Our observer might not discover the significance of this King until near the end of the game. Phosphorus is a weak King.

Notes

1. If the ultimate purpose of life on our planet is the evolution of an optimum energy (information) transfer system based on harnessed sunlight, then Phosphorus availability is the single most likely chemical control on the ability of the global aquatic ecosystem to transform the Sun's energy into useful chemical bonds. P limits the biomass and productivity of the global oceanic ecosystem. This self-evident truth is unprovable on time scales of human endeavor and space scales less than global but has been forcefully argued from observational, experimental, and theoretical evidence.

2. All forms of life on Earth require Phosphorus for their energy transmission systems (ATP), for information storage and retrieval across generations (DNA), and for mediating the delicate biochemistry of life from the cellular level to the ocean (phospholipids in cell membranes).

3. Hutchinson, 1951; Redfield, 1958; Broecker, 1974; Schindler, 1977; and a few others.

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5. Phosphorus is chemically leached from rocks into solution very slowly, probably via a mechanism that is not biologically intermediated. An ecosystem can not produce P out of thin air at any cost.

6. Phosphorus limitation is usually observable only under carefully contrived conditions.

7. Phosphorus is a trace element which is particle reactive. It reversibly sorbs off of and onto particle surfaces, playing hide-and-seek with both scientists and plankton.

8. An endgame consisting of a solitary King and an opponent's Queen and a few pawns can result in "creation" of a Queen. A system without fixed Nitrogen but with its King and a pawn will use every last resource to produce fixed Nitrogen and the game goes on. Without dissolved Phosphorus, the game is ended.

9. The real problem with Phosphorus is weakness in chemistry.

References


Redfield, A. C., The biological control of chemical factors in the environment, Am. Sci., 46, 205, 1958.


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