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Dugdale R C & Goering J J. Uptake of new and regenerated forms of nitrogen in primary productivity. *Limnol. Oceanogr.* **12**:196-206, 1967.
[Institute of Marine Science, University of Alaska, College, AL]

In this paper, the concept of "new production" of phytoplankton was laid out. Based on the uptake of nitrogen from new inputs (nitrate) rather than regenerated sources (ammonium) from zooplankton grazing or from bacterial activity, "new" production ultimately sets the upper limit of the yield of an ecosystem. [The *SCI*® indicates that this paper has been cited in over 285 publications since 1967.]

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Having done my dissertation on midges and the iron cycle of Lake Mendota, I wanted to expand my horizons to nutrient cycles on a larger scale, such as the oceans. This opportunity was provided by John Ryther of Woods Hole Oceanographic Institution, who had an active research program at Bermuda Biological Station located in the heart of the Sargasso Sea. Biological productivity there was very low for most of the year and seemed to be based on nearly undetectable nitrogen concentrations. Ryther suggested that nitrate and ammonium uptake measurements could be used to differentiate between the uptake of ammonium from grazing sources and the suspected input of nitrate from nitrate-rich subsurface water. John Goering, who like me was a student of John Neess at the University of Wisconsin, joined my laboratory, residing first at Bermuda Biological Station and then at my home institution at that time, the University of Alaska. Together we made some cruises out of Woods Hole to the Sargasso Sea and to the Indian Ocean. We used the stable isotope ^{15}N to measure nitrogen uptake rates of phytoplankton. The data obtained from the Bermuda work and from the cruises provided the basis for the paper.

The only real obstacle to the research was the development of techniques suitable for use at sea and in remote locations. Mass spectrometers were not generally so available at that time, and, as it was desirable in the early stages to have some results on shipboard, it was necessary to take relatively complex and cantankerous machines to sea.

It was great fun to be in at the beginning of an exciting period for biological oceanography and to contribute something basic to it. I hope from my description it is clear that the paper was the result of an evolutionary process in which a number of individuals played important roles. It is even more gratifying to see that the concept presented in the paper has been useful to others and is being modified by further studies.

The paper has been cited often because it set the basis for understanding or at least for studying the role of nitrogen and the sources thereof to phytoplankton. The data presented showed that very little productivity could be removed as yield from nutrient-poor seas, such as the Sargasso, since productivity there depended for most of the year on recirculation of nitrogen as ammonium. As more researchers[1-3] have joined in studying production processes in the ocean, the paper is cited often in conjunction with geochemical flux studies.

1. **Eppley R W & Peterson B J.** Particulate organic matter flux and planktonic new production in the deep ocean. *Nature* **282**:677-80, 1979.
2. **Platt T & Harrison W G.** Biogenic fluxes of carbon and oxygen in the ocean. *Nature* **318**:55-8, 1985.
3. **Jenkins W J & Goldman J C.** Seasonal oxygen cycling and primary production in the Sargasso Sea. *J. Mar. Res.* **43**:465-91, 1985.