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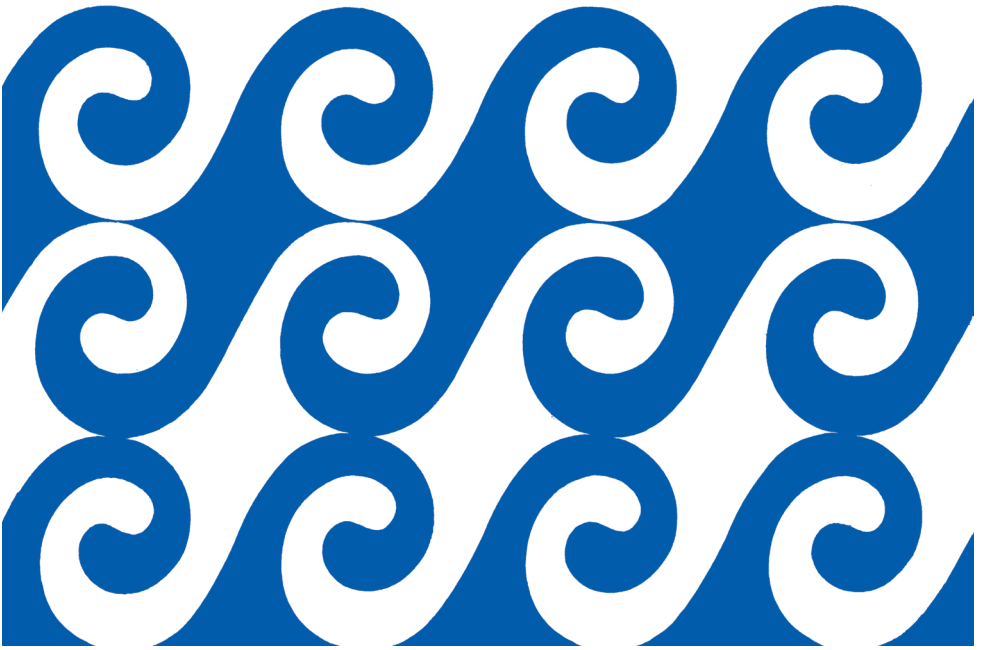

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Journal of Marine Research Classic Articles

The relationship of vertical turbulence and spring diatom flowerings

by Gordon A. Riley

Originally published June 9, 1942, in the *Journal of Marine Research* 5(1), 67–87.

EDITOR'S COMMENTARY

The dynamics of spring blooms of phytoplankton in temperate waters are usually associated with H.U. Sverdrup's 1953 "critical depth" model. However, more than a decade earlier, Gordon Riley published a statistical and mechanistic analysis of data he had gathered over two spring "flowerings" on Georges Bank.

In this work, Riley laid out the foundations that were eventually encoded in Sverdrup's model. Riley's data showed that increasing vertical stratification in the spring the decreased the thickness of the "turbulent zone" through which phytoplankton were mixed. This reduction in vertical mixing allowed net positive phytoplankton growth—decoupled from zooplankton grazing or sinking losses—leading to a spring bloom.

Riley formulated his hypothesis as a rate model, in which the photosynthetic rate was scaled by the ratio of the thickness of the euphotic zone to the thickness of the "zone of vertical turbulence." Though his model was not as mathematically elegant as Sverdrup's, Riley went on to quantify all the parameters of his model, showing that during the bloom, the mean phytoplankton growth rate increased as the turbulent mixing layer thickness decreased.

Riley's remarkably thorough, thoughtful, and careful analysis of the dynamic underpinnings of the spring bloom is underappreciated, and worthy of inclusion in any discussion of the dynamics of spring blooms. Published only five years after receiving his doctorate, Riley's 1942 paper is an impressive contribution to our understanding of physical-biological interactions in the ocean.

—Peter Franks