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PHYTOPLANKTON PHOTOSYNTHETIC PERIODICITY AS A FUNCTION OF LATITUDE

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THE data, in which the daily periodicity in the ability of phytoplankton to photosynthesize under uniform conditions, found by Doty and Oguri (1957), were obtained within about 10° of the Equator. Yentsch and Ryther (1957), in confirming this periodicity, worked with phytoplankton from about 41° North Latitude. The former authors found, in general, a five- to six-fold variation between the values attained, while the latter found only a two-fold variation.

At the Productivity Symposium convened at Bergen, Norway, in conjunction with the 1957 annual meeting of the International Council for the Exploration of the Sea, various reports of this rhythm were made : from freshwater lakes by W. Ohle and W. Rodhe, and from marine waters by Robert Holmes and E. Steemann-Nielsen. The reports on marine waters were of as much as twelve-fold in one experiment near the Equator to a 20 per cent variation at about 56° N. Lat.

Grim Berge, working in the Norwegian Sea, seemingly obtained no periodicity ; however, his work was not designed to reveal one. Recently, Shimada (1958) has reported a range of about 2 to 3 from 18° N. Some of our results from Indonesian waters,[1] 5° S. to 4° N. Lat., average out to about a ten-fold variation.

The author is not aware of any report of such a periodicity in the photosynthesizing ability of algae raised under constant illumination as algae are usually raised in culture. After many generations, and often years of growth, under uniform conditions it would be surprising if a photosynthetic rhythm were to be found. On the other hand in a tropical marine phytoplankton crop growing under natural conditions (Verduin, 1957),[2] a pulsing by regular day-length light variations is experienced. Such conditions would be most favourable for the establishment of such a rhythm in photosynthesis, as Doty and Oguri (*l.c.*) reported. Hypothetically, it seems likely that at much higher latitudes such a phenomenon would be less pronounced or absent, for the populations[3] are exposed to extended periods of continuous darkness or light with rapidly changing lengths of intergrading day and night between times. At intermediate latitudes exposure would be to different day lengths with differing time of year. Again, as the Equator is approached the shortening of the twilight period and the lessening of variation in day length would result in the most pronounced pulsing effect. Since the Bergen meetings, the experimental establish-

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[2] Verduin records a similar variation in the photosynthesis-respiration activities of freshwater phytoplankton.

[3] R. W. Holmes tells us (personal communication : 26-VI-1958) there are virtually no populations, e.g., in the Labrador Sea in Winter.

ment of rhythms in cells of algae, as reviewed by Tamiya (1957), has been brought to our attention. This lends further support to our explanation of the present phenomenon in nature.

In the course of defining this problem and setting up an hypothesis which could be tested experimentally, a plot of the factor (daily variation factor) resulting from the maximum rate for the day divided by the minimum rate obtained for the day was plotted (Fig. 1) as a function of latitude. The data at hand for this are too few and variable in nature to provide more than a very low level of confidence in any uniform treatment of them. Thus, in our present data, the apparent regression of

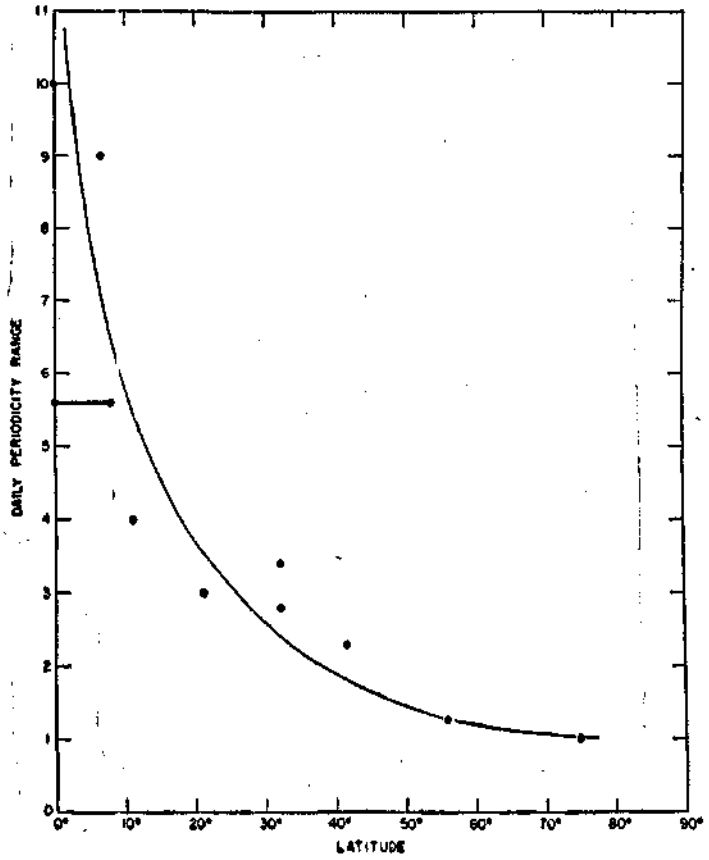

Fig. 1. Maximum photosynthetic rate for the day divided by minimum photosynthetic rate for the day as determined by uptake of carbon-fourteen plotted as a function of latitude. The curve was placed by inspection only.

the daily variation factor on latitude can only serve as a working hypothesis. The curve drawn among the plotted data points in the figure, represents this hypothetical relationship. This work is being extended to incorporate additional data collected to test this hypothesis further.

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