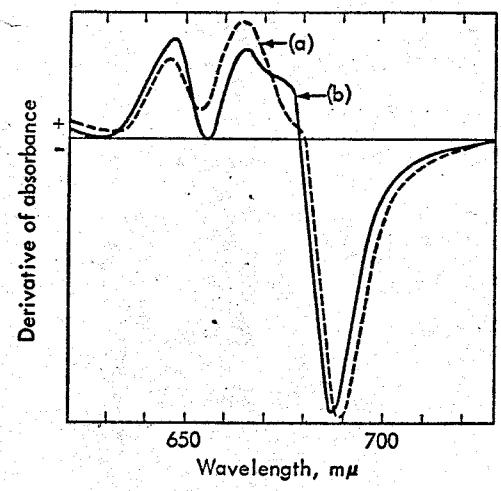

Fig. 9. Derivative absorption spectra of *Dunaliella* and *Stichococcus* cells.

proportions of these two forms of chlorophyll *a*.

The spectrum for *Dunaliella* is typical of most green algae and higher plants. By comparison *Stichococcus* has a higher proportion of chlorophyll *b*, and the proportion of C_a685 to C_a670 is also significantly higher. This organism may be valuable for investigation of the nature of the chlorophyll forms and for study of the function and formation of chlorophyll *b*.

Photosynthesis in *Stichococcus*

Govindjee

Measurements of action spectra of photosynthesis and comparisons between action and absorption spectra have been used for a long time in the evaluation of the role of different pigments in photosynthesis. Dr. Jeanette S. Brown has isolated and cultured a particular strain of a green alga, probably a *Stichococcus*, which contains a high proportion of chlorophyll *b* as described in this report.

Rates of photosynthesis of this alga were measured by means of a platinum electrode as described elsewhere (*Year Book 60*, p. 362). The circulating medium (Knop's solution + 1 *M* $MgSO_4$) was gassed with 5 per cent CO_2 in air, and its temperature was 22°C. The action spectrum of oxygen evolution was measured by the automatic action spectrophotometer (*Year Book 58*, p. 323), using a constant number of incident quanta at different wavelengths.

Figure 10 shows a typical time course of oxygen evolution in *Stichococcus* with 670-mμ light. Upon repeated illumination, the rate of photosynthesis reaches a steady state after about 2 minutes. If the cells were left in the dark for a period of 10 to 12 hours it took 1 to 1½ hours to attain the steady state. In addition, an initial spike was clearly noticeable. The time course of oxygen exchange in darkness (after illumination) shows an immediate sharp drop followed by a slower decline (see arrow in fig. 10).

Gingras, Lemasson, and Fork have observed a clear positive peak in the time course curve of *Chlorella* after white light was turned off. When DCMU was added just before the light was turned off, oxygen evolution in light was strongly inhibited but the positive peak was relatively unaffected, showing that the peak was not due to oxygen evolution. It is therefore believed to be due to a transient decrease of cellular respiration. On the basis of these considerations it may be inferred that the observed kinetics in *Stichococcus* may be simply due to an interaction of two opposing effects of

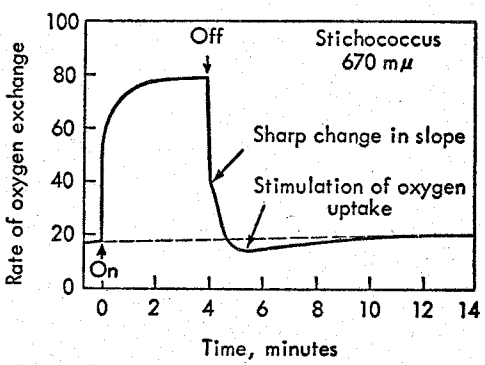

Fig. 10. Time course of oxygen exchange in *Stichococcus*.

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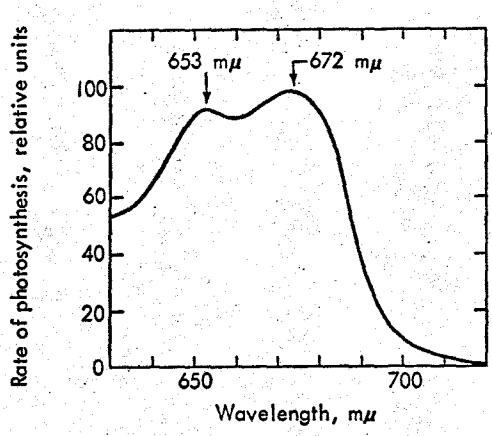

Fig. 11. Action spectrum of photosynthesis in *Stichococcus*.

light on oxygen uptake—an inhibition and a stimulation of oxygen uptake. A clear stimulation in oxygen uptake is noticed as the rate curve dips below the original dark rate. An inhibition effect of light during the illumination period has been observed by Hoch and co-workers in several algae.

Figure 11 shows the action spectrum of photosynthesis made on a thin suspension of *Stichococcus*. There are two peaks —one at 672 mμ due to chlorophyll *a*, and the other at 653 mμ due to chlorophyll *b*. The ratio of the relative height of chlorophyll *b* to chlorophyll *a* peaks, observed in the action spectrum of photosynthesis in this alga, is 0.94—a very high ratio in comparison with that found in other green algae. This higher activity observed in the chlorophyll *b* region is paralleled by the findings of Brown that *Stichococcus* contains a high proportion of chlorophyll *b*.

The enhancement phenomenon was studied by using 650-mμ and 710-mμ light separately and in combination. As shown in table 4, an enhancement of rate of photosynthesis ranging from 1.2 to 2.3 was obtained between the two wavelengths. The occurrence of enhancement indicates that two photoreactions are also necessary for *Stichococcus* photosynthesis.

The same culture that showed enhancement at one time failed to show it at another time under very similar conditions. A difference in the effect of light on respiration (during illumination) in separate and in combined lights may complicate the observed results. Unless the effects of light on respiration are very variable, however, such different results should not be found in enhancement studies. The factors responsible are under investigation. Why enhancement is not always observed is still an open question. Perhaps the occurrence of enhancement depends on the pool of an unknown compound, and a change in pool size (indirectly affected by respiration) may be the cause of variable results on enhancements.

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TABLE 4. Enhancement in *Stichococcus*, 22°C, 5 Per Cent Carbon Dioxide in Air
Rate of photosynthesis in arbitrary units

A 710 mμ	B 650 mμ	C Sum of 710 and 650 mμ	D 710 and 650 Combined Lights	E Emerson Enhancement*
12.8	22.0	34.8	37.5	1.2
12.8	45.0	57.8	63.0	1.4
18.2	182.0	200.2	224.0	2.3

* The Emerson enhancement is defined here as E = (D − B)/A.