

*Letter to the Editor*

**Robert Emerson, a major contributor to Photosynthesis, had pioneered research in Respiration in the 1920s, under Otto Warburg**

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**Robert Emerson (1903-1959)** is well known for major discoveries in photosynthesis (see Rabinowitch, 1959, 1961; Govindjee, 1963, 2001). He discovered (1) the concept of “Photosynthetic Unit”, i.e., hundreds of chlorophyll (Chl) molecules serving a “photoenzyme” (now reaction center”) (Emerson and Arnold, 1932a, 1932b); (2) the existence of the “Red drop” in photosynthesis (Emerson and Lewis, 1943), where only the long-wavelength spectral forms of Chl absorb light; (3) the minimum quantum requirement for the release of one oxygen molecule is 10-12, not 3-4, as the 1931 Nobel laureate Otto Warburg had claimed (see e.g., Govindjee, 1999; Nickelsen and Govindjee, 2011)); and (4) the two-light (the Emerson Enhancement) effect in photosynthesis (Emerson *et al.*, 1957) that led to the current two-light-reaction—two pigment system of photosynthesis (see e.g., Govindjee *et al.*, 2017, for the evolution of the current Z-Scheme of photosynthesis).

However, what is not known is that Emerson had done pioneering research in the field of respiration, in late 1920s, under the mentorship of Otto Warburg. This was published in a paper (Emerson, 1927a) and in his historical PhD thesis (Emerson, 1927b). Since the thesis is in German, it is not known to most students and scientists, around the World. Thus, I invited Hartmut Lichtenthaler (of Germany) and Lars Olof Björn (of Sweden) to translate it in English for all of us to read and appreciate this elegant, but brief, research in the late 1920s, carried out in Otto Warburg’s lab.

I am delighted that C.P.Malik, the Chief-Editor of the Journal of Plant Science Research, has accepted to publish this translation of Emerson’s

thesis (Lichtenthaler and Björn, 2020) that follows this *Letter to the Editor*. This is highly befitting since this journal has recently published, for the first time, Emerson’s 1948 Stephan Hales lecture given to the American Society of Plant Biology (Govindjee, 2018; <https://community.plantae.org/path/5105915226511902577>)

Although there are several take home messages of Robert Emerson’s PhD thesis, it really explores in depth the phenomenon of the absence of inhibition of respiration, in several algae, by hydrogen cyanide (HCN) and carbon monoxide (CO); in fact, an acceleration was observed. I urge experts in this field to write a current minireview on this topic to educate us on the molecular understanding of the phenomenon that baffled both Robert Emerson and his advisor Otto Warburg.

I end this letter with two photographs of Robert Emerson. **Figure 1** shows Emerson sitting in the 1940s in a group at the Carnegie Institution of Washington (now Carnegie Institution for Science) at Stanford, California, USA (see Emerson and Lewis, 1943, for the work he did there). **Figure 2** shows Emerson, standing in 1954 on a street in Utrecht, The Netherlands, and not far from him is another stalwart of photosynthesis Robin Hill, the discoverer of the Hill reaction in chloroplasts (see Govindjee *et al.*, 2017, for the history of the Z-Scheme of photosynthesis). Lastly, **Figure 3** shows a recent photograph of the Natural History Building at the University of Illinois at Urbana-Champaign, where Emerson had discovered the Emerson Enhancement Effect (Emerson *et al.*, 1957).



**Figure 1.** Robert Emerson, 2<sup>nd</sup> from right, in second row, in a group at the Carnegie Institution of Washington (CIW), at Stanford, in the mid 1940s. This photo was provided by Emerson's family to Govindjee. At CIW, Emerson had discovered the "Red drop" in photosynthesis and showed that the minimum quantum requirement for the evolution of one molecule of oxygen was 10-12.



**Figure 2.** Robert Emerson, extreme left, with Robert (Robin) Hill (extreme right), visiting Utrecht, The Netherlands, in the early 1950s. The person in the middle was listed as Mr. Kesler(?); this photo was provided by Emerson's family to Govindjee.



**Figure 3.** Natural History Building (NHB) of the University of Illinois, as seen from the Matthews Avenue in Urbana, Illinois, USA. Photo, taken in 2018, by G. Govindjee. Emerson’s laboratory was in room 157 NHB, and Emerson entered the building through the right door in the picture. This is where Emerson discovered the “Two-Light Effect”, known as the Emerson Enhancement Effect in photosynthesis.

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