Quantum Relationship of the Light-emitting Process of Luminous Bacteria*

WE have studied the relation between the oxygen consumption and the light intensity of a suspension of luminous bacteria (*Photobacterium phosphoreum*) by measuring simultaneously, at different concentrations of potassium cyanide, the oxygen consumption by the ordinary Warburg method and the light intensity with the aid of a photometric method.

It could be shown that the oxygen consumption consisted of two main parts: one of which was inhibited completely by about 0·001 mol. potassium cyanide, whereas the other decreased slowly with increasing concentration of the cyanide and in proportion to the light intensity.

In plotting the light intensity against oxygen consumption, the lower part of this curve was a straight line, giving the percentage of oxygen consumed in the light-emitting process. This proved to be 19 per cent of the total amount of oxygen consumed.

As the light emission could be measured in absolute units, the number of molecules of oxygen consumed per quantum of light emitted could be computed. At 16° C. the mean value obtained was 500 molecules of oxygen per quantum.

It seems remarkable that, whereas the percentage of oxygen consumed in the light-emitting process proved to be constant under different conditions and at different temperatures, the light intensity varies a great deal. It must be concluded, therefore, that the efficiency of the light-emitting process is dependent on various, as yet unknown, factors.

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The Lower Regions of the Ionosphere

IN our recent letter to NATURE[1], we did not mean to infer that reflections from the 60 km. level had not been found before. So early as 1930, Appleton[2] noticed reflections of this type. In 1935, Mitra and Syam[3] recorded reflections from this level using the pulse method of Breit and Tuve. The only addition we made to existing knowledge was that this high level forms the top of a region extending from 40 km. to 55 km. and that there is a lower region from 5 km. to 30 km. high. Practically the same discovery was made in England by Watson Watt and his co-workers[4]. In accordance with Mitra's suggestion[5], we propose to call these the *D* and *C* regions.

The following observations may be of interest. The height of the lower boundary of the *C* region is less in summer than in winter; it rises slightly during the night. The *C* region is so strongly reflecting in the summer months that it weakens the reflection from the *D* layer. Hence the *D* layer is usually found in the winter season. When thunderstorms or strong winds are present, the *C* region is very turbulent.

On April 22, 1936, a violent magnetic disturbance was recorded at Cheltenham, Md. On the same day, we observed that the *C* region was fluctuating violently (Fig. 1) and its lower edge approached very close to the earth's surface (1–5 km.). At that time no signals were received upon the 20-metre transmission band from any distant stations.

When the U.S. stratosphere balloon *Explorer II* passed through the 60,000 ft. level, its signals became weak[6]. Our explanation of this phenomenon is that the balloon was actually above the top of the *C* region; hence the signals, which had been reflected back to the earth when the balloon was in the *C* region, were later reflected out into space.

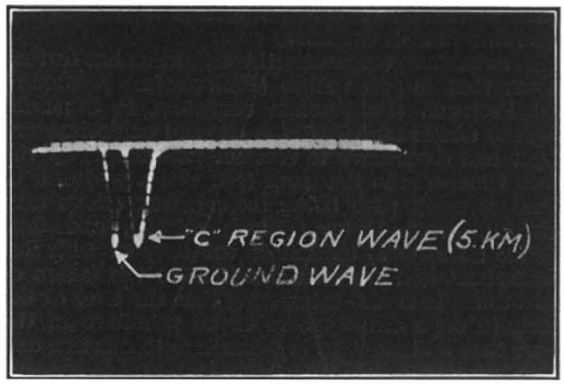

FIG. 1. Ground pulse and its reflection from the *C* region. On this scale, the *E* layer would appear about three inches and the *F* layer about six inches to the right.

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[2] Appleton, *Proc. Roy. Soc.*, A, **126**, 542 (1930).
[3] Mitra and Syam, NATURE, **135**, 953 (1935). Syam, *Ind. J. Phys.* **10**, Part 1, 13 (1936).
[4] Watson Watt, Bainbridge-Bell, Wilkins, Brown, NATURE, **137**, 866 (1936).
[5] Mitra, NATURE, **137**, 867 (1936).
[6] Stevens, *Nat. Geog. Mag.*, **59**, 693 (1936). NATURE, **137**, 896 (1936).

Stereoisomeric Nature of Oxidation and Fermentation

I HAVE investigated with the aid of the Warburg technique the action of optically isomeric nicotines upon alcoholic (*Torula utilis*, *Saccharomyces exiguus*) and lactic (*Bacterium Delbrücki*) fermentations of glucose dissolved in the external solution; upon oxidation of exogeneous glucose by *T. utilis*, *S. exiguus*, *Oidium lactis*, *Bacillus subtilis*, *B. mycoides*, *Sarcina lutea* and *Bacterium Schützenbachi*; upon oxidation of lactate by *O. lactis* and of ethyl alcohol by *B. Schützenbachi*; and upon respiration of stored glycogen in *T. utilis*, *S. exiguus* and *B. subtilis*. It was found that in these microbes all fermentations are more strongly depressed by *l*-nicotine than by *d*-nicotine, but all oxidations are, conversely, more strongly depressed by *d*-form.

I have also investigated the action of optically isomeric nicotines upon the metabolism of slices of