We may identify the long-distance transmissions as being caused by extremely high ionization in the *E* region and, from the observed height and distance, deduce a minimum ionization density which must have obtained on this occasion. The angle of incidence of the transmitted rays upon the *E* layer was such that the critical frequency for normal incidence must have been slightly more than one-fourth of the transmission frequency, or about 15 megacycles. This corresponds to a density of free electrons of about 2.8×10^6 per cm.³, or their equivalent in heavy ions. Too little is known of the effective recombination coefficients at such heights to permit the calculation of the corresponding energy density. On the assumption, however, that the highest frequency normally reflected from the *E* region is about four megacycles, we may say that the ionization-producing energy on this occasion was about 200 times that due to ultra-violet light at noon on a summer day.

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Enhancement of the Sodium *D* Lines in the Twilight Sky Light

Prof. J. Cabannes, Prof. J. Dufay and J. Gauzit¹ state that the twilight enhancement of the yellow radiation of the night sky announced by me² was previously observed by Currie and Edwards at Chesterfield (Canada) during the International Polar Year, 1932-33. To support their opinion, they give a short quotation from a paper published in 1936 by the Canadian physicists³. The complete sentence should have been quoted; it is as follows:

"The fairly uniform intensity of 5940 during moonlight, irrespective of the intensities of the green line and the negative bands, indicates that it is due to a luminescence distinct from that of the aurora and is probably the radiation 5893 Å. observed by Vegard and Tonsberg in the night-sky light."

Thus the band around 5940 Å. appeared to Currie and Edwards remarkably constant during the moonlight periods. It is only upon this observation that they based their suggestion. However, if it is quite certain that the band at 5940 does not belong to the auroral spectrum, it is no less certain, on account of its aspect and evolution, that it cannot be identified with the sky line 5893 Å. Currie and Edwards also state: "It appeared to be a broad, diffuse band extending from about 6000 Å. to 5800 Å. with a mean wave-length of 5940 Å." This broad and diffuse appearance (200 Å.) cannot be that of an atomic line or narrow doublet. On the contrary, it can be explained very exactly by the spectral sensitivity of the plates (Ilford Soft Gradation), which offer a sharp and strong maximum exactly in this region, and by admitting that the so-called band near 5940 Å. originates from the continuous spectrum of the moonlight. In fact, the intense yellow band obtained by Currie and Edwards remains absolutely invisible when the auroral spectrum is photographed, with full moon, on another type of plate (Agfa I.S.S.). Taking into account some supplementary arguments, developed in another paper⁴, it seems beyond doubt that the yellow sky radiation 5893 Å. was never observed by Currie and Edwards. It is thus

clear that their work gave me no information or suggestion likely to guide me in the discovery of the yellow fluorescence or resonance of the twilight sky.

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¹ NATURE, 141, 1054 (1938).

² NATURE, 141, 788 (1938).

³ Terr. Mag., 41, 265 (1936).

⁴ C.R., 206, 1137 (1938).

Use of Non-Conservative Properties of Sea Water to Physical Oceanographical Problems*

IN applying the eddy diffusion equation to the non-conservative properties of sea water (as distinguished from the conservative properties, the concentrations of which change only as a result of physical processes) a knowledge of the time rates of change in their concentrations (as a result of the biological activity in the water mass) is required. Thus, the form of the equation expressing the effect of vertical turbulence alone on a non-conservative property, such as oxygen, would be:

$$\frac{d\alpha}{dt} = A \frac{\partial^2 \alpha}{\partial t^2} - C,$$

where, for dissolved oxygen, α , the term C would represent the rate of oxygen consumption due to the biological activity in the water mass. The consumption of oxygen in the sea as a means of disguising the oxygen transport by turbulence is frequently strikingly brought out at the depths of the oxygen minimum concentration where, regardless of enrichment by eddy diffusion, oxygen concentration actually decreases in the downstream direction due to the greater rate of oxygen consumption.

Information on the rate of oxygen consumption in the depths of the ocean basins is confined chiefly to results obtained for the mid-Atlantic between latitudes 0° and 30° N., where the mean annual oxygen consumption at mid-depths was placed at approximately 0.42 c.c. per litre and that in the deeper water at approximately 0.10 c.c. per litre. Use has been made of the former value in calculating the magnitude of the vertical eddy coefficient at mid-depths (at depth of the minimum oxygen concentration) in the Caribbean basin; where, with certain assumptions, the gain and loss of oxygen in the downstream direction could be formulated, thus:

$$Ct = O_1 - O_2 + A \frac{\partial^2 O}{\partial t^2} t$$

where Ct represents the amount of oxygen consumed in the downstream direction by biological activity as the water layer (at the depth of the minimum oxygen concentration) moved, during the

time, t , from position 1 to position 2; $A \frac{\partial^2 O}{\partial t^2} t$,

the amount of dissolved oxygen gained as a result of vertical turbulence during the same time (effects due to lateral turbulence are neglected); and $O_1 - O_2$, the observed difference in oxygen concentration (at the depth of the minimum oxygen concentration) between positions 1 and 2. The combination of this equation with a similar one involving the conservative property (salinity) at adjacent depths gave two

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