Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 235.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Light of the Night Sky

I HAVE succeeded in exciting the auroral green line under conditions which indicate that it must have been produced in a manner similar to that in the light of the night sky. In order to describe my experiments properly, it is necessary first to recall the excitation of the green line in active nitrogen[1]. In that experiment it was possible for the first time to produce the green line under conditions which give some clue to its production in both the aurora and the night sky, since there are metastable nitrogen molecules in active nitrogen, and one would certainly expect metastable nitrogen to play an important rôle in the upper atmosphere. My recent discovery of a new modification of active nitrogen[2], the afterglow of which was a very faithful reproduction of that part of the auroral spectrum which is due to nitrogen, added an argument for the hypothesis that the green line is excited by metastable nitrogen molecules.

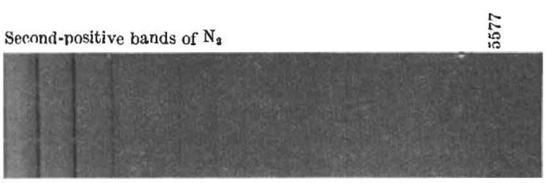

FIG. 1.

In the new experiments, a very small amount of oxygen, about one per cent, was introduced into the tube in which the new afterglow was discovered. The discharge, and not the afterglow, was photographed with the current in the tube interrupted periodically. At first the interruptions were spaced so that the current was on long enough to allow the current in the bulb of the tube to reach its full value. The discharge in the bulb was green-white, and the green line was absent under these conditions. When the current was interrupted more rapidly, the discharge in the bulb was much weaker and its colour was red. Certain very profound changes took place in the spectrum of the discharge in the bulb. The most important one was the presence of the green line, with an intensity which resembles very closely its intensity in auroral and night sky spectra, and also unaccompanied by other oxygen lines (Fig. 1). The first-negative bands of N_2^+, which are strong in the discharge when the current is allowed to reach its full strength, were almost completely missing. The second-positive bands of N_2 were present. The recently discovered Vegard-Kaplan intercombination bands of nitrogen were excited, but in the rapidly interrupted discharge the high wave-length members of the system increased greatly in intensity relative to the other N_2 bands, as compared with their intensity in the slowly interrupted discharge. The Goldstein bands, to which attention was directed recently by Hamada[3] in connexion with the light of the night sky, were missing in the rapidly interrupted discharge, although they were present in the slowly interrupted one.

The most important results of these experiments are the excitation of the green line, the increased intensity of the long wave-length members of the Vegard-Kaplan system and the absence of the Goldstein bands. The first two indicate that the members of the Vegard-Kaplan system probably occur in the night sky, and the absence of the Goldstein bands casts some doubt on Hamada's identification of the X_1 and X_2 lines as members of that system. The absence of the first-negative bands is in good agreement with their very feeble excitation in the light of the night sky. Longer exposures have been started in an attempt to observe the red oxygen lines which usually accompany the green auroral line and also to observe the visible members of the Vegard-Kaplan system. It is believed that we have a very good reproduction of the light of the night sky in these experiments and hence a means for identifying the radiations which are actually observed in the night sky.

With regard to the identification of the two X_1 and X_2 lines, 4416 and 4168, it may be said that Dufay observed two lines in the night sky at 4422 and 4171 which are probably identical with Rayleigh's line. The Vegard-Kaplan bands (2,14) and (3,14) lie at 4423 and 4170 respectively. Dufay also observed lines at 4268, 4044, 3984 and 3951. Vegard-Kaplan bands nearest to these lines lie at 4271, 4043, 3978 and 3947. These agreements, together with the above mentioned experimental results, indicate that we have definitely identified some of the radiation in the night sky.

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Dec. 29.

[1] Kaplan, *Phys. Rev.*, **33**, 154; 1929.
[2] Kaplan, NATURE, **133**, 331; 1934.
[3] Hamada, NATURE, **134**, 851; 1934.

Zero Point Energy and Physical Properties of H_2O and D_2O

THE marked differences between the physical properties of H_2O and D_2O (and of all polar compounds of H and D) cannot be due to intramolecular differences, which are far too small, but must be connected with differences of effective intermolecular forces. It is possible to account for these differences in a quantitative way by taking into consideration the differences in the frequency of angular vibration or *libration* of a molecule in the field of its neighbours. The mean frequency in ice can be calculated from the model of the water molecule already put forward[1]. The frequency found, $\nu_B = 14 \cdot 3 \times 10^{12}$ sec.$^{-1}$, is large enough to have a zero point energy of 17 per cent of the total energy of ice. As in such a libration only the hydrogens