34. NITROGEN IN THE SUN

(*Nature*, **117**, 268, 1926)

The occurrence of nitrogen in the sun is still an open question. No familiar lines, for example, λ3995, have yet been detected in the Fraunhofer spectrum, but the presence of the element is indicated by the cyanogen bands.

It appears that the difficulty of identifying nitrogen by its line spectrum can be traced to the nature of the spectrum itself. Under the ordinary conditions of excitation, nitrogen gives several classes of band spectra, while lines obtained under a higher stimulus, including λ3995, have been assigned by Fowler to N^+. The arc lines of nitrogen itself are evidently lost between these two stages. Kiess (*Journ. Opt. Soc. Am.*, June 1925) has recently elucidated this point. He finds that the chief lines of nitrogen lie either in the extreme ultra-violet or in the extreme infra-red, so that workers confining themselves to the usual spectroscopic region miss them completely.

Kiess has given, in the paper mentioned above, a provisional classification of the arc lines. The principal lines are in the Schumann region, λ1742·81, 1745·31, etc., . . ., but the next strongest group from λ8656 to λ8629 constitutes a *pp'* combination. There is another *pp'* group at λ8200, but they come from a higher level. It is interesting to see whether these lines occur in the Fraunhofer spectrum. On examining the excellent photographs of the infra-red spectrum of the sun given by Meggers (*Astro. Journ.*, vol. 47, p. 1), the presence of some of the lines was clearly observed, while the others were found to occur rather faintly. A complete comparison was not possible, as the author had no access to a full list of the wave-lengths of the infra-red solar lines. Miss C. Payne in her recent monograph "On Stellar Atmospheres" does not mention the occurrence of any nitrogen line in the sun or in any low temperature star. The only nitrogen line which can be identified without ambiguity in the stellar sequence is λ3995. This, however, does not occur in the sun; it occurs, according to Payne, first in the *Ao* class, and Fowler assigns it to N^+.

If this identification of the arc lines of nitrogen in the sun is verified, it will enable us to fix with some definiteness the energy of dissociation of N_2. Some years ago, the present writer calculated from the experimental data of Langmuir that the energy of dissociation of N_2 is of the order of magnitude $1{\cdot}50 \times 10^5$ gm. calories. Recently, Eucken (*Annalen der Chemie*, Band 440, p. 111) has discussed the thermo-chemical data on this point, and he comes to the conclusion that the energy of dissociation of N_2 cannot be less than $4{\cdot}4 \times 10^5$ gm. calories, or thrice the value calculated by the present writer. If this were the case, nitrogen would not be dissociated at all in the sun, and the atomic spectrum cannot occur there. Calculation shows that it would be appreciably dissociated only in the *Ao* class. But, as we have already mentioned, these stars show the lines of N^+, coming from a level ($2s$) higher than the normal. Hence Eucken's calculations seem to be quite beyond the mark.

Eucken finds from the same line of argument that the energy of dissociation of O_2 cannot be less than $4{\cdot}25 \times 10^5$ calories.

If this were true, no atomic oxygen can occur in the sun. But it is well known that Runge has identified the oxygen triplet λλ7772, 7774, 7775 in the Fraunhofer spectrum. According to Hopfield, the excitation potential for these lines is from 8 to 9 volts, so that in the sun, oxygen is not only completely dissociated, but also a considerable fraction of O-atoms is brought to a higher level. The argument is, therefore, fairly decisive that in the case of O_2, Eucken's calculations are very wide of the mark.

Physics Department,
University of Allahabad,
December 26, 1925.