A New Band System in Nitrogen

A new band system of N_2 has been discovered in the spectrum of the radiation emitted in the discharge tube first described by me last year.[1] These bands correspond to some of the members of the so-called ϵ-series observed by Vegard[2] in the luminescence of solid nitrogen and also recently in the spectrum of the Aurora Borealis. This is the first time these radiations have been reported in gaseous nitrogen. They were obtained in the part of the tube in which the afterglow was very strong and where high vibrational states of the molecule appeared both in the afterglow and in the discharge.[3] Table I shows the agreement between my wave-lengths and those that Vegard obtained in the luminescence of solid N_2. Some of Vegard's bands have multiple heads whereas mine are single-headed, so that the comparison is between my bands and the closest of Vegard's. The assignment of my bands to a vibrational level scheme differs from that of Vegard and indicates that the lower state of this system is the normal state of the molecule. This was also pointed out by Vegard, but on the basis of less certain evidence and a different assignment. According to my scheme the electronic energy of the upper state is 6.41 volts agreeing with the level at 6.3 volts reported by H. D. Smyth in 1919[4] and Levesley[5] in 1927. Until further evidence has been obtained, it seems most reasonable to assume that the initial level is a new electronic level in N_2. I have listed only the strongest and definitely similar bands in Table II. There are many other bands on the plates which agree with members of Vegard's ϵ-system, but I believe that those bands really belong to other known or perhaps even new systems of bands. Vegard's ϵ-system is probably a mixture of bands from several systems. More will be said about these other new bands in the future.

TABLE I.

Kaplan	Vegard	Kaplan	Vegard
2335	2339	2827	2827
2380	2385.7	2932	2934.5
2464	2464.2	3000	3000
2511	2513	3200	3201.5
2605	2605.9	3430	3429
2760	2759.9		

TABLE II.

V' \ V''	4	5	6	7	8
0	λ 2336	2464	2605	2760	2932
	ν42808	40584	38388	36232	34129
1		2380	2511		
		42016	39824		

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[1] Kaplan, Phys. Rev. **42**, 807 (1932).
[2] Vegard, Skrifter Utgitt av Det Norske Videnskaps Akad. i Oslo **2**, 24 (1930); Nature **132**, 682 (1933).
[3] Kaplan, Phys. Rev. **44**, 783 (1933).
[4] Smyth, Phys. Rev. **14**, 409 (1919).
[5] Levesley, Trans. Faraday Soc. **23**, 552 (1927).

A Convenient Proton Source

In this investigation, whose object was the development of a convenient proton source, the discharge employed was a low voltage arc of the type described by Langmuir and Jones.[1] This type of discharge was suggested by Dr. Langmuir as an efficient ion source. The experimental tube contained an oxide-coated platinum-strip cathode; a concentric cylindrical auxiliary cathode three centimeters in diameter and six centimeters long; and two circular anode end plates each three centimeters in diameter. The one-eighth inch platinum strip was in the form of a hairpin extending the entire length of the tube with supports and leads passing out through holes in the anode end plates. The coating material was a mixture of barium and strontium oxides.

The arc was operated at hydrogen pressures ranging from 0.1 to 0.5 mm of Hg. One ampere arc current to the anode was easily realized with only 25 volts between emitter and anode. The ion current to the auxiliary cathode was about 150 milliamperes. A small fraction of these ions was drawn out through a slit in the side of the cylinder and was analyzed in the mass-spectrograph previously described.[2]

The ratio of proton current to total current in the ion beam was studied as a function of the negative voltage of the cylinder with respect to the anode. For very low negative voltage the above-mentioned ratio was between 10 and 15 percent. With increasing negative voltages and increasing pressure this ratio increased rapidly, reaching a value between 80 and 90 percent at 100 volts. Before this result could be obtained it was necessary to operate the tube for a number of hours in order to clean the metal surfaces by ion bombardment.

Mixtures of hydrogen and helium with as much as twenty-five parts helium to one part hydrogen were also

[1] Langmuir and Jones, Science **52**, 380 (1924); Phys. Rev. **31**, 357 (1928).
[2] Overton Luhr, Phys. Rev. **44**, 459 (1933).