

The values of the ratio a/p with dry air then obtained have been confirmed more recently in some experiments by a method, yet unpublished, in which the nature of the photoelectric stream is examined at various distances from its source while the pressure and electric force are kept constant. With dry air and several other gases this method showed that for appropriate values of pressure and electric force the nature of the stream changes progressively with the distance from its source.

These experiments were not designed to give information about the formation of negative ions near the emitting surface, but by means of the theory and observations given in 1925 it is easy to calculate an upper limit for the ratio of the number of ions formed initially to the number formed in the gas. Such a calculation shows, for example, that this ratio is less than one in dry air at a pressure of 22.6 mm. with an electric force of 10 volts/cm. Moreover, if Prof. Wellish's conclusions be true, it would be practically impossible in any of these experiments to observe the attachment of electrons in the gas.

With regard to the evidence adduced by Prof. Wellish, it is remarkable that the curves *A* and *B* in his diagram are less consistent with his own views than with the theory that negative ions may be formed quite as notably in the gas as near the cathode. This is shown clearly in Table 1, where the observed values of the ordinates y_A, y_B (for the curves *A* and *B* respectively) for different values of the abscissa x are compared with values calculated on the two theories.

TABLE 1.

Constants adopted: mobility $k=1.8, f_A=0.5, f_B=0.52$.

x .	y_A .	y_B .	α .	θ .	
0.01	Observed	0.49	0.35		
	Theory of attachment	0.486	0.35	0.15	0.84
	Theory of non-attachment	0.483	0.35	0	0.67
0.02	Observed	0.45	0.22		
	Theory of attachment	0.448	0.22	0.20	0.60
	Theory of non-attachment	0.440	0.22	0	0.42
0.04	Observed	0.375	0.13		
	Theory of attachment	0.376	0.13	0.50	0.64
	Theory of non-attachment	0.344	0.13	0	0.25

TABLE 2.

X/p		0.85	0.424	0.212
$(a/p) \times 10^3$	Wellish	2.5	3.4	8.5
	Bailey	2.1	3.1	—

In Table 2 a comparison is made between the values of a/p thus deduced from Prof. Wellish's experimental results and two values obtained by me in 1925, and this shows good agreement between them.

If the value adopted for the ionic mobility be 2.1, similar calculations show that the theory of attachment in the gas is still in better agreement with the above observed values of y_A and y_B than is the other, but less markedly so than is shown by Table 1.

It may then be concluded that for air pressures up to 59 mm. the formation of negative ions by attachment of electrons to molecules in the gas is no less notable a process than the formation of negative ions near the cathode.

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Spectroscopic Evidence of Arsenic Hydride.

MESSRS. Kimball and Bates¹ have recently described some bands, emitted by a carbon arc, running in an atmosphere of hydrogen. The negative electrode was drilled and filled with arsenic. Because of this, the authors consider the bands to be due to AsH and As₂. I find, however, strong arguments for the bands being identical with the CH bands $\lambda 3143 \text{ \AA}$., already investigated by Fortrat² and Hori.³ Even the conditions of activation, mentioned by Kimball and Bates, agree with my conclusions; namely, that the bands were missing when the arsenic was placed in the positive carbon. This can be explained by the fact that the presence of a metal in the positive carbon strongly reduces the temperature of the arc, and the activation of the CH bands is very sensitive for the temperature.

The unresolved band at 31802.6 cm^{-1} is surely identical with the Q branch in the CH band. The measurements of Fortrat are in good agreement with this, as well as with the values calculated from the formula of Kimball and Bates. In Hori's measurements a constant error appears, owing to the low dispersion used by him. Mr. T. Heimer, photographing the CH band in the second order of the 6.5 m. concave grating in this laboratory, also finds this error in Hori's measurements.

Directly repeating the experiments of Kimball and Bates, I find no signs of a band spectrum due to AsH.

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¹ NATURE, 128, 969, Dec. 5, 1931.
² C.R. Acad. Sc., 178, 1272; 1924.
³ Z. Phys., 59, 91; 1930.

The Spinning Photon and its Scattering by Molecules.

THE observed fact that a molecule in scattering light may change its state of rotation, itself conveys the suggestion that the photon has an intrinsic spin, the alternative explanation of a conversion of the linear momentum of light into the angular momentum of the molecule during the collision being *prima facie* highly improbable. The suggestion gains strength when we notice how simply the conception of the spinning photon explains both the selection rules in Raman scattering and the accompanying phenomenon of the reversal of circular polarisation. Nevertheless, to the critically minded, such considerations may fail to carry complete conviction. The reality of photon spin is, however, established¹ by quantitative studies of (1) the intensity of the lines in the rotational Raman spectra of gases, (2) the depolarisation of the Rayleigh scattering when separated from the rotational scattering. The Kramers-Heisenberg theory of dispersion as developed by Manneback² fails to give correct results on both of these points, while a modified theory based on the concept of the spinning photon meets with complete success.

A further test of the theory of the spinning photon is furnished by quantitative studies of the state of polarisation of the vibration lines in Raman spectra. In certain simple cases, it is possible to associate these lines with linear modes of the vibration of the molecule. Each such vibration line should be accompanied by faint rotational companions on either side of it, the ratio of the intensity of which to that of the parent line is determined by the state of polarisation of the latter. The change in the depolarisation of the Raman line, when measured with a nicol and a spectrograph, using alternately a very wide and a very narrow slit, enables this ratio to be determined. As