

calculated for sodium and chlorine according to the rule given above, and the observed F curve when proper corrections are made for temperature (James, Waller, and Hartree, *Proc. Roy. Soc., A*, **118**, 334; 1928), and we feel that this is much the most direct type of test to which the theory can be subjected.

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Kinetics of Absorption of Ultra-sonic Waves.

RECENT work by Pierce (*Proc. Amer. Acad. Arts and Sci.*, **60**, No. 5; 1925, and Abello, *Proc. Nat. Acad. Sci.*, **13**, p. 699; 1927) has directed attention to the high attenuation experienced by ultra-sonic waves in passing through carbon dioxide and, to a lesser extent, hydrogen or helium. It is possible to correlate this absorption and the attendant frequency variation of velocity with the mechanisms of collisions of the first and second kinds.

The mean kinetic energy of the molecules varies from the regions of rarefaction to those of condensation, so if we associate with each small volume element a corresponding temperature, we may speak of the translational energy temperature variation in space and time. For low sound frequencies the collision mechanism is adequate to allow the distribution of molecules in the internal states to readjust itself to the slow fluctuations in translational temperature. Using the language of the old quantum theory, we define for each stationary state an associated temperature for which under equilibrium conditions the number of molecules would be that actually present for particular space-time values. For increasing frequency there is a phase lag and also a diminution in the relative amplitudes of the internal and translational energy temperature variations. This amplitude diminution is slight for some states and more marked for others. Accordingly, the gas begins to behave as if these latter states were absent and others only partially present; or, put otherwise, the specific heat decreases and the velocity of sound increases. The absorption on this theory is due to the out-of-phase components in the internal temperature changes, and also to the radiation loss of energy from excited states. The detailed analysis will be published in the *Physical Review*—the final results (except for some idealised cases for which reference may be made to Jeans's "Kinetic Theory of Gases" and to Herzfeld and Rice, *Physical Review*, April 1928) involve collision excitation probabilities and co-ordinate the experimental sound data with atomic structure knowledge.

Evidently, increasing the collision frequency acts to diminish the discrepancy between internal temperatures and the translational temperature. General considerations (applicable also if a viscosity explanation is offered) suggest that the absorption coefficient is to a first approximation dependent directly on the number of molecules in the path of the sound beam and inversely on the frequency of collision. It may then be shown that in a mixture of gases A and B , the ratio of the resulting absorption to the absorption of pure B at the same pressure is

$$e^{\alpha(aN_A^2 - bNN_A)/(aN_A^2 - bNN_A + cN^2)}$$

where N and N_A refer to the concentrations of molecules of both types and of type A alone, respectively; α is proportional to sound path length, and the constants a, b, c satisfy the inequalities $c > b > a \geq 0$. $a \neq 0$ if one assumes that because of resonance or coupling effects collisions between similar molecules are on the

average more effective in promoting energy transfers than collisions between dissimilar ones.

Abello's empirical conclusion from his data was that the exponent supra is proportional to N_A . However, on referring to Abello's graphs for hydrogen and carbon dioxide, it is seen that the experimental absorption for N_A large is uniformly greater than predicted on his assumption of a linear dependence and seems rather to bear out the relation given above.

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Abstracts of Royal Society Papers.

THE issue of NATURE of Mar. 24 contained a paragraph (p. 483) referring to a paper entitled "Statistical Experiments on the Motion of Electrons in Gases," by Mr. R. d'E. Atkinson, communicated to the Royal Society at a meeting on Mar. 15. Previous to the meeting the abstract of this paper written by Mr. Atkinson had been circulated to members of the Society.

The abstract contains definite statements which have led uninformed readers to believe that there are many errors in my publications on the subject of electricity in gases and in those of other physicists who have collaborated with me. Several people interested in this subject have expressed surprise that no answer has as yet appeared to the statements contained in the abstract.

I should like to direct attention to the fact that I wrote an answer to the statements contained in the abstract early in May and sent it to the *Philosophical Magazine*, but publication was refused on the ground that the abstract circulated by the Royal Society is not 'official,' and consequently no answer can be made to the statements contained in it.

If this view be accepted, it becomes possible for authors to have statements circulated and placed in a position so privileged that there is no opportunity of answering them except in a foreign journal.

It is perhaps not generally known that even after an 'abstract' has been circulated, the whole paper, or parts of it, may be refused publication by the Royal Society.

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Oxford, July 11.

Does Methylene Blue penetrate Living Cells?

MISS IRWIN (NATURE, June 16, p. 939) implies that her observations affect the validity of vital staining with methylene blue. As one who has used this method extensively, may I ask whether the method depends upon "penetration of blue dye" as Miss Irwin assumes?

A muscle nerve preparation taken from a frog previously transfused with dilute solution of methylene blue behaves like a normal physiological preparation in respect of vigorous contraction on electrical stimulation through its nerve for upwards of an hour after the appearance of intensely stained nerve-endings. The muscle itself appears pale green by transmitted light, and the dye is evidently present in a reduced or partially reduced form. This applies to the whole of the muscle; but it is rare for more than half the nerves to be stained. I suppose the contracting muscle is alive; to think otherwise would do some violence to accepted vital criteria.

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