NICOTINIC ACID AND TOBACCO METABOLISM

RECENT interest attached to nicotinic acid in the vitamin B_2 complex[1, 2] prompts publication of the following observations on the marked effects obtained when nicotinic acid was supplied to green tobacco leaves. Using a specially developed method, tobacco plants were cultured with their cut stems in dilute aqueous solutions of nicotinic acid hydrochloride. Control plants were similarly cultured in tap water. Samples of 45 to 50 leaves were collected from each group for analysis. Preliminary observations showed large and apparently specific influences of nicotinic acid upon the degree and the duration of leaf turgidity, the rates of uptake of solution and of dry weight accumulation, and the postponement of permanent wilting. There was also an effect upon the synthesis of nicotine. One experiment conducted in diffuse light for five days revealed an increase of 190 per cent. in the amount of solution absorbed, a loss of only half as much dry weight, a survival period at least twice as long and an increase in total nicotine content of 31 per cent. compared with the corresponding values for the leaves of those plants cultured in water. Three subsequent experiments conducted for periods of two days each and in full light gave average increases of 52 per cent. in the amount of culture solution absorbed, 700 per cent. in the amount of dry weight gained, at least 100 per cent. in the length of the survival period, and 29 per cent. in the total amount of nicotine formed above the corresponding values for the controls.

These observations were incidental to an investigation of nicotine metabolism in the tobacco plant. A study of the significance of nicotinic acid in the metabolism and water relations of plant tissues is to be undertaken. The author wishes to express his sincere appreciation for the generous counsel and cooperation given by Professor Carl G. Deuber, whose efforts have made this and other studies possible.

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[1] W. J. Dann, SCIENCE, 86: 616–617, 1937.

[2] P. J. Fouts, O. M. Helmer, S. Lepkovsky and T. H. Jukes, *Proc. Soc. Exp. Biol. and Med.*, 37: 405–407, 1937.

A FUNDAMENTAL PROBLEM CONCERNING THE LORENTZ CORRECTION TO THE THEORY OF REFRACTION

THE relation between the constitution of a conducting medium and its refractive index is a fundamental problem of classical physics to which attention has been devoted for many years but which even now is not completely solved. The question at issue is whether the force per unit charge exerted by an electric field upon an elementary charged particle in the medium should be taken simply as the Maxwellian electric intensity **E** (the Sellmeyer theory), or whether there should be added a contribution $(4\pi/3)\mathbf{P}$ (the Lorentz theory), **P** being the electric moment per unit volume produced by the electric field in the neighborhood of the charged particle under consideration.

For conduction electrons in metals under the influence of the steady and alternating electric fields ordinarily encountered in electrical engineering the validity of the Sellmeyer theory is universally taken for granted. The Lorentz theory would be inconsistent with Ohm's Law and would in fact render the medium electrically unstable. For the same reasons it may be regarded as beyond question that, for a rarefied gas rendered conducting by ionizing radiation, it is the Sellmeyer theory which must be used at sufficiently small oscillation-frequencies. When the discovery of reflection of radio waves from the ionosphere aroused particular interest in the electrical properties of an ionized medium, it was at first assumed that for such a medium the oscillation-frequency could be raised to the values used in radio communication without affecting the validity of the Sellmeyer theory. This view was challenged in 1929 by Hartree,[1] who expressed the opinion that it is the Lorentz theory which should be used in the ionosphere at radio frequencies. There followed considerable discussion which culminated in 1934 in a theoretical treatment of the subject by Darwin,[2] which seemed to point to the conclusion that the Sellmeyer theory should hold good in the ionosphere at radio frequencies.

An experiment for deciding between the two theories was first indicated by Ratcliffe[3] and subsequently described in detail by Goubau.[4] Goubau shows that, for reflection from the ionosphere of radio waves of frequency less than the gyromagnetic frequency, there is in middle latitudes a clear-cut distinction in the behavior of the extraordinary wave according to the two theories. Over the past year a large number of records showing magneto-ionic splitting of ionospheric echoes at these wave-frequencies have been obtained at the Kensington (Maryland) Experiment Station of this department, using the automatic multifrequency equipment developed here. Details of these observations will be published elsewhere. Comparison with Goubau's theoretical treatment leads us to believe that it is impossible to interpret these observations in terms of the Sellmeyer theory, but that no objection exists to their interpretation in terms of the Lorentz theory. It

[1] *Proc. Camb. Phil. Soc.*, 25: 97–120, 1929; 27: 143–162, 1931.

[2] *Proc. Roy. Soc.*, A, 146: 17–46, 1934.

[3] *Wireless Engineer*, 10: 354–363, 1933.

[4] *Hochfrequenz.*, 44: 138–139, 1934.

would appear therefore that it is the Lorentz theory which must be used in the ionosphere at oscillation-frequencies employed in ordinary broadcasting. But since it is the Sellmeyer theory which must be used at sufficiently small oscillation-frequencies we are faced with the following problem: At what frequency and in what manner does the transition from the Sellmeyer to the Lorentz theory take place?

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SCIENTIFIC BOOKS

THERMODYNAMICS

Text-book of Thermodynamics. By PAUL S. EPSTEIN, xii + 406 pages, 15 × 22.8 cm. John Wiley and Sons, New York, 1937. $5.00.

THIS book will fill a need which in the last few years has rapidly become acute, namely, for a treatment for the physicist which should adequately discuss the applications of thermodynamics to the many new experimental facts, particularly those involving quantum phenomena. Until the appearance of this book any one giving a course in advanced thermodynamics had to refer his students to the periodical literature for such important topics as: low temperature phenomena, in particular specific heats, degradation phenomena and the phenomena of supraconductivity; the calculation of specific heats from spectroscopic data; the thermodynamics of electron clouds; the thermodynamics of magnetic behavior, particularly in the neighborhood of the Curie point; and the thermodynamics of the transformations of matter into radiation. All these, as well as the conventional critical exposition of the fundamentals and applications to systems in which chemical reactions may take place, are treated with adequate fullness.

The treatment is mostly from the phenomenological point of view, and in this respect marks a return to an earlier practise, the tendency in recent years having been to treat classical thermodynamics and statistics simultaneously. But the development of subject-matter in the last few years has proceeded to such a point that the simultaneous exposition of the phenomenological and the statistical points of view has become so cumbersome as to demand, in the opinon of the author, a return to the earlier practise. It may be added that there is a great gain in the logical coherence of an exposition mainly from the one point of view. At the same time some statistical analysis can not well be avoided; in particular, the probability interpretation of the second law receives due attention.

It is, I suppose, unavoidable that in a subject where it appears to be necessary to devote as much attention as in thermodynamics to a critical examination of fundamental concepts differences of opinion should arise. In this respect physicists seem open to the same reproach that they have so often directed against the philosophers of not being able to come to agreement. Thus, personally, I have never liked using the idea of a perfect gas to give the approach to the second law and the absolute temperature scale, in spite of the fact that it is the method of Planck and the method adopted in this book. It is admitted that the perfect gas is an idealization; it has always disquieted me logically to think that perhaps the second law might possibly have been slipped in somewhere in the process of idealization. The logical tactics of the whole situation, I believe, are modified essentially since the day of Planck's treatment by the discovery that no substance can obey the perfect gas equation down to 0° Abs. without violating natural principles. When the student comes to the discussion of the degradation of all gases near 0° Abs. will he not be justified in saying, "What right did you have to assume that the existence of a particular kind of idealized substance was compatible with the first and second laws when you now know that it is inconsistent with the 'third law'"?

The book contains a number of minor slips which could be easily corrected in a later edition. On page 82 is the statement, "Processes (in an isolated system) attended by an augmentation of the entropy are not only permissible, as the second law states, but one of them will necessarily take place spontaneously." Any one who has waited for a piece of graphite shut up in a box to turn into a diamond will realize that there is something the matter with this. On page 115, the phase rule states, not that no more than three phases can be simultaneously in equilibrium, but that if more than three phases are in equilibrium there is some special relation between their properties. On page 120 the melting and regelation of ice under skates is usually thought to be connected with the one-sided pressure in the ice under the runners, not the hydrostatic pressure. The depression of the melting point by one-sided pressure is roughly ten times greater than by hydrostatic pressure. On page 130 I think it is recognized that the arguments of Keesom and von Laue against the existence of transitions of the second kind are invalidated by considerations which Epstein does not suggest, because a crossing of the potential curves may correspond to negative masses on one side of the point of intersection and so be physically meaningless. It is highly probable that various order-disorder transitions in alloys are actual examples of