"On the Electrical Conductivity of Air and Salt Vapours." By HAROLD A. WILSON, D.Sc., M.Sc., B.A., Allen Scholar, Cavendish Laboratory, Cambridge. Communicated by Professor J. J. THOMSON, F.R.S. Received March 14,—Read March 28, 1901.

(Abstract.)

The experiments described in this paper were undertaken with the object of obtaining information on the variation of the conductivity of air and of salt vapours with change of temperature, and on the maximum current which a definite amount of salt in the form of vapour can carry. They are a continuation of the two researches* on the same subject published in 1899.

In the paper on the Electrical Conductivity and Luminosity of Flames (*loc. cit.*) some observations on the variation of the conductivity with the temperature at different heights in the flame are given. They indicate a rapid increase in the conductivity with rise of temperature.

The method employed in the experiments described in the present paper was the following:—

A current of air containing a small amount of a salt solution in suspension in the form of spray was passed through a platinum tube heated in a gas furnace; this tube served as one electrode, and the other was fixed along its axis. The temperature of the tube was measured by means of a platinum platinum-rhodium thermo-couple, and the amount of salt passing through the tube was estimated by collecting the spray in a glass-wool plug.

From the temperature variation of the conductivity the energy required to produce the ionization can be calculated, and this compared with the energy required to ionize bodies in solutions.

Since the publication of the researches just referred to, several papers† on the conductivity of salt vapours in flames by Dr. E. Marx have appeared. The first part of the present paper contains a discussion of some of Marx's conclusions, which bear on my previous work.

The rest of the paper is divided into the following sections:—

(1.) Description of the apparatus used.

* "The Electrical Conductivity and Luminosity of Flames containing Vaporised Salts," by A. Smithells, H. M. Dawson, and H. A. Wilson, 'Phil. Trans.,' A, 1899; "On the Electrical Conductivity of Flames containing Salt Vapours," by Harold A. Wilson, 'Phil. Trans.,' A, 1899.

† "Ueber den Potentialfall und die Dissociation in Flammengasen," Von Erich Marx, 'Gesellschaft der Wissenschaften zu Göttingen,' 1900, heft 1; 'Annalen der Physik,' 1900, No. 8. "Ueber das Hall'sche Phänomen in Flammengasen," Von E. Marx, 'Annalen der Physik,' 1900, No. 8.

(2.) Variation of the current with the E.M.F.
(3.) Variation of the current through air with the temperature.
(4.) Variation of the current through salt vapours with the temperature.
(5.) Summary of results.

The relation between the current and E.M.F. in air was found to depend very much on the direction of the current. When the outer electrode was negative the current attained a saturation value with an E.M.F. of about 200 volts, but when the outer tube was positive it increased rapidly with the current, even with an E.M.F. of 800 volts, so that a much greater E.M.F. would be necessary to produce saturation, that is, assuming that saturation can be produced at all.

With salt vapours the relation between the current and E.M.F. was not much affected by reversing the current. The current was always greater when the outer tube was negative, the reverse being the case with air alone. At low temperatures the current attained a saturation value, but above 1000° C. it was found to increase more nearly proportionally to the E.M.F.

The variation of the current at constant E.M.F. with the temperature for air was found to be approximately capable of being represented by a formula of the type $C = A\theta^n$, where C is the current, θ the absolute temperature, and A and n constants. The constant n depends on the E.M.F. used. With 240 volts it was 17, and with 40 volts 13. The current, therefore, does not begin suddenly when the temperature is raised, but always increases regularly with the temperature, so that the lowest temperature at which the current can be detected depends entirely on the sensitiveness of the galvanometer.

The energy required to ionize 1 gramme molecular weight of air was estimated by supposing that the fraction of the gas dissociated into ions is proportional to the current at small E.M.F's. By means of the ordinary thermo-dynamical formula giving the variation of the dissociation with the temperature, the energy in question can then be obtained. The result for air is 60,000 calories between 1000° and 1300° C. This amount of energy is of the same order of magnitude as the energy set free when H and OH ions combine to form water in a solution.

The relation between the current and temperature for salt vapours was found to be rather complicated. With KI, using an E.M.F. of 800 volts, the current had the following values ($1 = 10^{-4}$ ampere) :—

Temperature	500°	600°	700°	800°	900°	1000°
Current	0·7	1·8	3·0	4·0	4·5	4·0

Temperature	1100°	1150°	1200°	1300°
Current	3·5	3·6	7·0	7·0

Using an E.M.F. of 100 volts, the following values of the current were obtained ($1 = 10^{-5}$ ampere):—

Temperature	300°	400°	500°	600°	700°	800°
Current	0·2	1·9	5·1	5·4	5·5	5·5

Temperature	900°	1000°	1100°	1200°	1300°
Current	5·5	5·3	6·8	8·2	9·2

Thus the current has a maximum value near 900° C., and rises very rapidly near 1150°. Similar results were obtained with other salts.

The energy required to ionize 1 gramme molecular weight of KI at about 300° C. was estimated to be 15,000 calories in the same way as was done for air.

The maximum current carried by the salt vapour (at 1300° with 800 volts) was found to be nearly equal to that required to electrolyse the same amount of salt in a solution.

This fact must be regarded as considerable evidence in favour of the view that the ions are of the same nature in the two cases.

"Further Observations on Nova Persei, No. 2." By Sir NORMAN LOCKYER, K.C.B., F.R.S. Received and Read March 28, 1901.

In continuation of two previous papers, I now bring the observations of the Nova made at Kensington to midnight of March 25. Since the last paper* of March 7th, estimates of the magnitude of the Nova have been made on ten evenings, visual observations of the spectrum on eight evenings, and photographs of the spectrum on four evenings up to the evening of the 25th.

In consequence of the greater faintness of the Nova, the 6-inch prismatic camera has not been utilised, but the 10-inch refractor to which it is attached has been used for eye observations of the spectrum with a McClean spectroscope.

With the 30-inch reflector four photographs have been secured on the evenings of the 6th, 10th, 24th, and 25th by Dr. Lockyer, and with the 9-inch prismatic reflector seven photographs on the nights of 10th, 21st, and 25th by Messrs. Butler and Hodgson.

Change of Brightness.

Since March 5th the magnitude of the star has been gradually decreasing, but between the nights of the 24th and 25th the light of

* *Supra*, p. 142.