from the cyclotron. After the exposure, the irradiated seedlings together with the controls were put on a wooden plate, floating on tap-water in a two-litre glass beaker, and their roots were placed separately in glass tubes, which were hanging down from the plate into the water. The beaker was kept in the dark thermostat at 30° C., and the lengths of the main roots were measured every 24 hours after the exposure.

The average growths in length of the main roots of fifty irradiated seedlings during the intervals of 24, 48, 72 and 96 hours respectively after the beginning of irradiation, are given in the second row (R) of the accompanying table, and σ is the standard error of mean. For comparison, the corresponding data of fifty non-irradiated controls are given in the third row (C) of the same table. From the standard errors obtained, we can see a clear retardation of growth even in 24 hours after irradiation. The ratio R/C decreases with the lapse of time after the exposure, and becomes 46 per cent after a period of 92 hours. Further, we found that side roots never appeared in the irradiated specimens within 4 days, while in controls 94 per cent of the individuals have sprouted lateral roots by this time.

Period after radiation	24 hr.	48 hr.	72 hr.	96 hr.
R (length in mm.)	16·7 (σ = 0·8)	22·7 (σ = 1·0)	24·5 (σ = 1·2)	24·7 (σ = 1·0)
C (length in mm.)	23·7 (σ = 0·8)	39·5 (σ = 1·0)	48·9 (σ = 1·3)	52·9 (σ = 1·4)
R/C (per cent)	70·4	57·4	50·3	46·9

While we were carrying out these experiments, retarding actions of X-rays upon the main root of the same species were determined, in exactly the same manner, by Misses M. Sudô and S. Imai in the laboratory of one of us (M. N.). According to their experiments, the ratio R/C at an interval of 4 days after one hour irradiation with X-rays (160 kv., 0·5 mm. Cu, 0·5 mm. Al) for calculated doses of 200 r., 300 r. and 400 r. are 59, 52 and 40 per cent respectively. The intensity of our beryllium-deuteron radiations under the present conditions thus corresponds to about 6 r./min. of X-rays when measured by the retarding action in 4 days after the exposure on the main root of *Vicia Faba*.

In conclusion, our thanks are due to Prof. S. Nishikawa, Dr. Y. Nishina and other members of the Nishikawa laboratory as well as of this laboratory for their kind suggestions and valuable assistance, especially in connexion with the operation of the cyclotron. We wish to thank the Japan Wireless Telegraph Company for the electromagnet and other equipment used for the cyclotron, and the Mitsui Ho-onkwai Foundation, Tokyo Electric Light Company and Tôsyogû Tercentenary Memorial Endowment for financial support.

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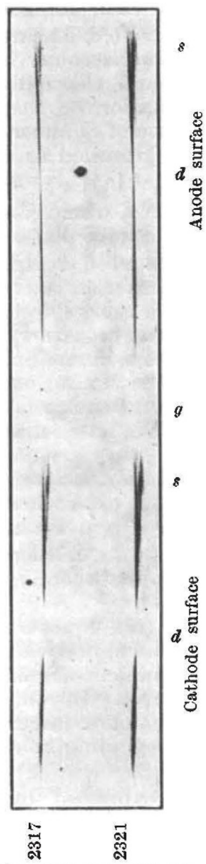
Pure Stark Effect observed in Metallic Arcs

IT has been generally accepted that in an arc the observation of the pure Stark effect can scarcely be expected, as the drop in potential in the immediate neighbourhood of the electrodes is of the order of the ionization potential of the gas, and the dark space is so thin (10^{-3} cm. or less) that its detection is extremely difficult; the uncontrollable fluctuation of the arc and the effects due to pressure and inter-ionic fields may give rise to further complexities, which manifest themselves in the anomalous behaviour (diffuse broadening or shift) of spectral lines.



Terminal potential diff., 48 volts; current, 2·13 amp.; arc length, 3·5 mm.

In spite of these expectations, we have now succeeded, by proper choice of arcing conditions, in observing the pure Stark effect for a number of lines of iron, copper, silver, nickel and aluminium, most of which belong to the spark type. An enlarged reproduction of a small segment of the spectrogram of silver is given in the accompanying illustration.

Important points to be noted, as the results of the present investigation, are (1) that in a steady metallic arc there can exist at least two regions s, where the field intensity is so great that the pure Stark effect can be observed, namely, at a certain distance (*c.* 1·5 mm.) from the lower (positive or negative) electrode and in the immediate neighbourhood of the upper electrode; (2) that there are fairly large drops of potential occurring in *two* steps at *each* electrode, the indication of which is the appearance of the spark lines, and so there are three points along the arc where the field intensity becomes a minimum—at two regions d about 0·8 mm. distant from the electrodes and at the centre g of the arc; (3) that, when the pressure is reduced, no essential change is produced in the potential distribution along the arc; (4) that, as the length of the arc is varied, the length of the region g changes linearly with it, while the behaviour of the lines near the electrodes remains the same.

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An Application of a New Limitation in Physical Theory

IN attempts to understand the relation between the quantum theory and the theories of relativity and electro-magnetism, a certain limitation, applicable to the motion of a particle of electromagnetic mass m_0 and of charge e, is brought to light. It appears that the expression $(m_0c^2d\tau - e/c\Sigma\varphi_m dx^m)$ can assume only those values which are multiples of Planck's constant[1].