

LETTERS TO THE EDITOR

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'Clean up' under Canal Ray Discharge

'CLEAN UP' in discharge tubes is a phenomenon that has often proved of interest, and is characterised by a sudden diminution of pressure, on initiating the discharge. The chief mechanisms¹ by which these are brought about are (1) through the agency of a "getter", (2) by the action of the electrical field in driving the ions bodily into the walls of the discharge tube and the metal electrode. It is conceivable that (1) and (2) may operate simultaneously and may, in fact, be mutually helpful. It is clear that (2) will be more prominent under conditions of the canal ray discharge on account of the higher operating voltages, etc. As the effect had a certain interest from the standpoint of another phenomenon, it was studied with picein² vapour as the "getter" with hydrogen as the gas in the discharge tube.

Since it was impossible to measure these rapid fluctuations in pressure by means of any elaborate measuring apparatus, attention was restricted to observing the fluctuations in the voltage, as measured by a sensitive H.T. voltmeter of the Kelvin-Whyte type, keeping the other electrical parameters, like the discharge current, the wattage input to the H.T. transformer, constant, during the course of the experiment. Under these conditions the voltage becomes a sufficiently accurate index of the pressure,

On the first addition of the getter to the discharge tube, the secondary voltage rose up rapidly as was to be expected, when it was tried to restore the pressure by allowing small amounts of hydrogen. At each such measure, the voltage fell down momentarily only to rise again to its high value, though the time rate of increase diminished after each addition. Finally, a stage was reached when the voltage after rising to its maximum, automatically fell down and showed signs of attaining a steady

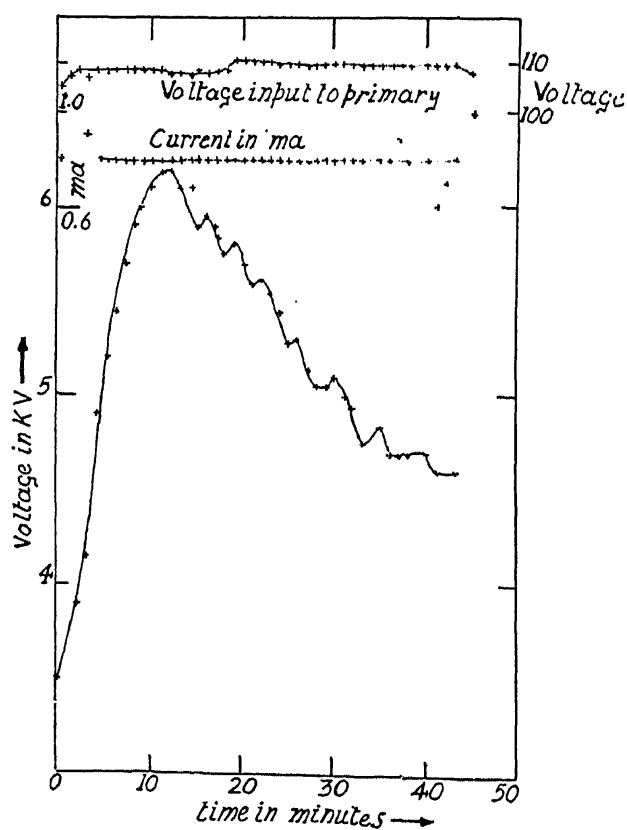


FIG. 1

value. This fall was characterised by a series of rapid fluctuations of small amplitude. In some experiments the same cycle of initial rise and subsequent fall was repeated. Significant changes in the colour of the discharge³ accompany these fluctuations; in the absorption regime when the voltage is increasing, the colour of the discharge is that of hydrogen, during the regime of de-absorption, when the voltage is falling, there is a preponderance of the bluish white colour.

Figs. (1) and (2) show two typical curves giving these fluctuations as function of time. Observations showed that they were present even after a lapse of two hours, which is very remarkable. In Fig. (2) curves A, B, C show the changes after successive additions of hydrogen.

In view of the repetition of cyclic changes in some of the cases, the results cannot be explained in terms of breaking up of an initial

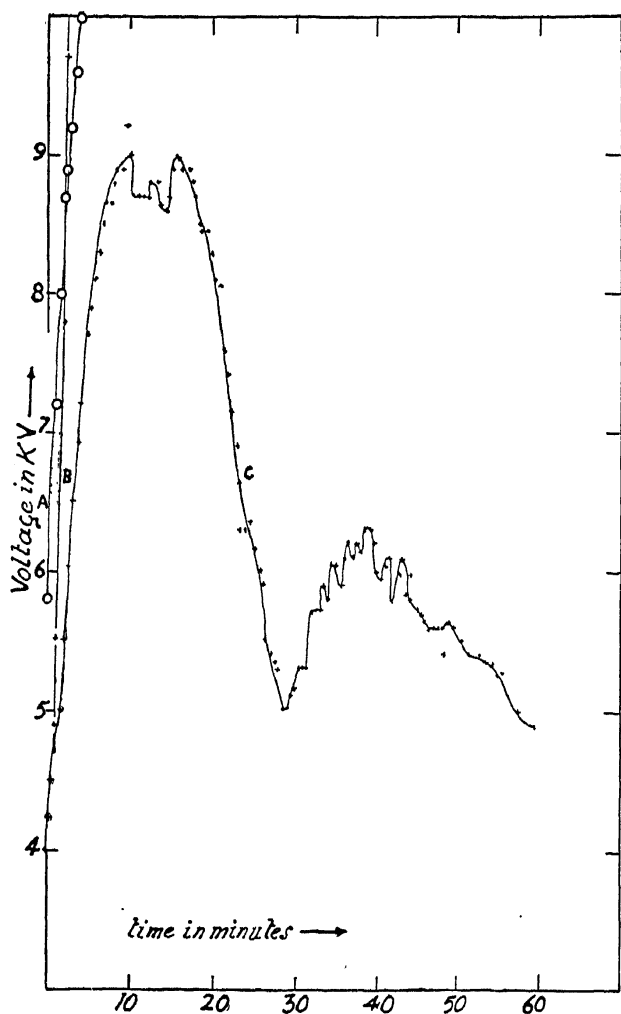


FIG. 2

layer on film by the subsequent effects of the discharge thermal or otherwise. One is led,

therefore, to conclude that it is an instance of a periodic reaction (possibly adsorption). The pressures of the gas used in these experiments are of the order $10^{-2} - 10^{-3}$ cm. of mercury. The electrodes are both of aluminium.⁴

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¹ Koller, L. R., *Physics of Electron Tubes*. (McGraw Hill), 1934, pp. 86-97.

² Chiplonkar, V. T., *Proc. Ind. Sci. Congress, Lahore, 1939, Phys. Maths. Section*, pp. 25-26.

³ Delaplace, R., *Comptes Rendus*, 1936, **202**, 1986.

⁴ Wien, W., "Kanalstrahlen," *Handbuch der Experimental Physik*, Akademische Verlags-gesellschaft, Leipzig, 1927, p. 468.

The Effect of Muscular Work on Protein Metabolism in the Ruminant

A review of the extensive literature on the effect of muscular work on the metabolism of proteins reveals the existence of two conflicting schools of thought, the one led by Mitchell, holding the view, that normally, and given a diet of sufficient calorogenic intake, increased protein metabolism is "not an inevitable consequence" of muscular work; and the other led by Cathcart, that work results in a definite, though often small, increase in nitrogen output, calling for an augmented protein intake to meet the extra needs.

Nearly all the available evidence on this subject has been obtained with experiments on humans. In the course of an investigation in this laboratory, on the protein requirements of working bullocks, it was noticed that muscular work resulted inevitably in a heightened catabolism of protein, reflected in an increased output of urinary nitrogen.

The experiments were conducted on four experimental animals, Bullocks of the Kangayam breed, well known for their hardiness and capacity for work, of as similar physical conditions as possible, with a live weight of 900-1,000 lbs. The ration fed consisted of Cholan (Sorghum) straw of uniform quality, and cotton seed as concentrate, throughout the long series of experiments. The roughage was

fed *ad lib.* all residues being measured to the nearest gram, the concentrate being adjusted by a preliminary run of nitrogen balance experiments to give a nitrogen equilibrium with the mixed ration fed, as determined by the balance sheet method. The muscular work performed was baling water at the Mhote for a measured number of hours, the number of buckets raised per hour being recorded by a hand-operated tally (45-50 buckets per hour), the lift being 20-25 feet for 40 gallon buckets. The nitrogen metabolism was studied for three 4-day intervals during continuous periods of work for 4, 6 and 8 hours of work.

From the results obtained for the nitrogen balance by determining intake and output in faeces and urine, linear regression equations were determined for the total nitrogen requirement at different levels of work, and their adequacy tested by the usual statistical methods. The results are given below:—

Equation (i) $y = 4.79x + 46.7$,

where y = Total nitrogen requirement (gms. per diem)

and x = Number of hours of work at the Mhote.

TABLE I

Fitted Regression

(Total nitrogen. Grams/Diem)

Hours of work	Actual value Y	Calculated value y	(Y - y)	(Y - y) ²
0	46	46.7	-0.7	0.49
4	67	65.9	1.1	1.21
6	76	75.4	0.6	0.36
8	84	85.0	-1.0	1.00

TABLE II

Analysis of Variance

(Total nitrogen)

Variation between hours of work due to	Degrees of freedom	Sum of squares	Mean square
Linear regression	1	801	801
Deviation from linear regression	2	4	2
TOTAL	3	805	..

A similar equation was fitted for the nitrogen excretion in urine, as determined by analysis, representing the endogenous nitrogen metabolism of the animals. The results are given below:—

Equation (ii) $y = 2.56x + 16.6$,

where y = Endogenous nitrogen output (gms. per diem)

and x = Number of hours of work at the Mhote.

TABLE III

Fitted Regression

(Endogenous nitrogen. Grams/Diem)

Hours of work	Actual value Y	Calculated value y	(Y - y)	(Y - y) ²
0	17	16.6	0.4	0.16
4	26	26.8	-0.8	0.64
6	33	32.0	1.0	1.00
8	37	37.1	-0.1	0.01

TABLE IV

Analysis of Variance

(Endogenous nitrogen)

Variation between hours of work due to	Degrees of freedom	Sum of squares	Mean square
Linear regression	1	229	229
Deviation from linear regression	2	2	1
TOTAL	3	231	..

From the results presented above, the following conclusions may be drawn:—

(i) Muscular work is necessarily followed by an increase in the metabolism of protein, as is shown by the need for increased protein in the diet to produce nitrogen equilibrium to meet the increased output of endogenous nitrogen.