DISCUSSION

MULTIPLE STROKES IN LIGHTNING

THE recent interesting note by H. L. Dean on "Stroboscopic Illusions caused by Lightning"[1] prompts me to report a somewhat similar series of observations, which also included an impromptu measurement of the average interval between successive discharges in a multiple stroke.

These observations were made by the writer in the evening of June 8, 1938, while driving westward in gathering dusk through a rainstorm, in that part of northwestern Oklahoma which is called "The Panhandle." The country is table-like, treeless and sparsely settled. The road was excellent, and deserted, so that for twenty miles or more (during which no hills and only two curves were encountered) the machine was held at such a uniform speed that the period of the windshield wiper was very nearly constant. In the gathering night, the wiper blade could be seen only indistinctly except when illuminated by lightning. During a particularly brilliant flash, it was noticed that the wiper blade was executing an apparently stepwise movement (such as is sometimes seen when the blade and windshield are dry), although close inspection in the weak but steady light of twilight showed that it was moving steadily and smoothly on the thoroughly wet glass. Thereupon, the illusion of interrupted movement was recognized as the result of a periodic interruption in the source of illumination.

This observation of the stroboscopic behavior of the blade was made not less than 15 times during the storm. Not every flash showed the pulsating or multiple character. Nor did all flashes occur within those directional limits which permitted satisfactory observation. Presumably, in such a level, treeless area, many flashes are strokes to ground; and McEachron points out[2] that a high percentage of strokes to ground are multiple.

During a multiple flash the wiper blade appeared at 4 points (sometimes only 3), more or less uniformly spaced and all together occupying an arc which was about one third of the swing of the blade. Retinal retention and the duration of the flash may have mixed effects toward determining the number of blade images seen. Retinal fatigue also made it apparent that the intervals between the pulses were not quite uniform in length.

A count of the swings of the wiper showed it to be making from 115 to 120 half-vibrations per minute. The half-period was thus approximately 0.5 sec. The time occupied by the 4 blade images in one third the arc of the blade was 0.17 sec. Thus the average interval between the maxima of two successive pulses was 0.04 second.

This rough measurement, made with apparatus at hand, is not in disagreement with precise measurements made by McEachron and McMorris[3] from photographs made with a moving-lens camera employing the general principle of the Boys camera. Of 9 intervals which they recorded in a typical multiple stroke, the 5 intervals, 0.029, 0.028, 0.024, 0.022 and 0.053 sec., are of the same order as the 0.04 second reported here. Holzer, Workman and Snoddy[4] also report intervals as large as 0.033 and 0.047 sec., but they do not give the distribution of the intervals which they recorded.

The data given here are from a note-book entry of June 10, 1938. In consideration of the well-known detrimental effect which *prae judicio* knowledge may have upon any measurement in which the human factor is high, it may be noteworthy that at that time the observer had no information concerning the lengths of flash intervals, although he was aware that such data had been published.

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TYROSINE DETERMINATION

THE recent article by Reiter[1] raises the question as to whether the value given for the tyrosine content of egg albumin of 3.72 per cent. is to be taken as correct rather than the earlier values found by Looney[2, 3] of 4.20 and 4.10 per cent. If we assume that egg albumin has a molecular weight of 33,800 as proposed by Cohn[4] and contains 8 molecules of tyrosine, the calculated percentage composition would be 4.28. If the value of 35,700 given by Bergmann[5] is correct, then the theoretical percentage becomes 4.06. The value of 4.10 given by Looney[3] would appear to approach the theoretical value more nearly than the lower values given in the literature by other methods, and therefore the original method of Folin and Looney would still seem to be the most reliable method yet proposed. The method can also be used for 50 mg amounts of protid by reducing both the volume of the digest and also the final volume of the colored solution to 25 ml and all the reagents in proportion.

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[1] SCIENCE, 88: 2285, 352.

[2] *Elec. Engineering*, 53: 1633–37, 1934.
[3] *Gen. Elec. Rev.*, 39: 494, 1936.
[4] *Jour. Applied Phys.*, 9: 136, 1938.

[1] C. Reiter, SCIENCE, 88: 378, 1938.
[2] O. Folin and J. M. Looney, *Jour. Biol. Chem.*, 51: 421, 1922.
[3] J. M. Looney, *idem.*, 69: 1926.
[4] E. J. Cohn, J. L. Hendry and A. M. Prentiss, *Jour. Biol. Chem.*, 63: 721, 1925.
[5] M. Bergmann, *Chemical Reviews*, 22: 423, 1938.