169. *Preliminary Note on the Spectrographic Investigations of Long Electric Sparks.*

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(Rec. Nov. 25, 1926. Comm. by T. TERADA, M.I.A., Dec. 12, 1926.)

In the course of the previous studies¹⁾ on the form and structure of long electric sparks, it appeared desirable to obtain some knowledges on the nature of light emitted from various parts of spark. One of the authors (Y. F.) proposed to take the spectrograms of single sparks by replacing the spark itself for the slit of an ordinary spectrograph; viz., by removing the slit from the collimeter of an ordinary prism-spectrograph and passing the spark vertically at its position.

For this purpose we took a large flint prism (13 cm in base and 10 cm in height) made by Hilger. The lenses of the collimeter and camera were those fitted to it. Besides the spectrograph an ordinary camera was also used to take an ordinary photograph of the spark simultaneously. As the electric source of the spark a Wommelsdorf's condenser machine was used, with a Leyden jar of a capacity ($C \approx 1$ m.) connected in parallel. No special inductance was introduced in the discharge circuit. The spark length was varied, say from 3 cm to 6 cm, producing different types of spark.

The spectrum lines thus obtained represent the peculiar form of the spark (Fig. 1). On examining a number of spectra obtained, the following facts were observed²⁾:

i) *Lines observed.* Most of the measured lines belong to air lines. They are rather sharp except the two very diffuse nitrogen lines $\lambda\lambda$ 4237 and 4041, which were pointed out by Fowler to have the same series character³⁾. pp' groups of nitrogen (λ 4650– λ 4600) predominates remarkably. H α line (λ 6563) could be observed easily and it may be taken as the criterion of the character of discharge.

1) T. Terada and U. Nakaya, Proc. Imp. Acad. 2 (1926) 258.

2) The measured wave lengths are given in Fig. 1.

3) A. Fowler, Proc. Roy. Soc. A. 107 (1925) 31.

ii) *Broadening of H α line.* H α line often shows peculiar intensity at several points along the spark (Fig. 1, a), while all the other lines not. At the surfaces of both electrodes there are always definite broadening of H α (Fig. 1, b).

iii) *Bearings to the structure of spark.* At some parts of the spark all the lines except H α become very diffuse and apparently diminish their intensities, while H α alone is rather enhanced (Fig. 1, c & 2, a). The corresponding ordinary photograph shows that the spark reveals a certain characteristic structure or texture¹⁾ in luminosity at that parts. Thus, it appears that those parts with texture correspond to those with rather strong "spark character". With the shorter spark for which the texture is more conspicuous, this spectrum is also pronounced.

iv) *Relative intensities of the line.* The relative intensities of the lines vary remarkably at various parts of the spark, especially at the above said parts. It had been noted that²⁾ in the spectrum of lightning some lines differ remarkably in relative intensities along its path.* The result of our laboratory experiment agrees with it qualitatively to some extent.

v) *Continuous spectra.* Besides the line spectra of air, continuous spectra appear at many points of the spark as shown in photographs reproduced. Some of them may be due to the coincidence of the direction of the track of spark with that of the line of sight. It seems, however, also probable that there exist some really continuous spectra among them. They may be also closely connected with the internal structure or texture of the spark.

vi) *Metal lines.* The metal lines are limited to very small region near the electrodes (Fig. 2). Most of them belong to the spark lines of zinc and copper, the constituents of electrodes. In one case H and K of Ca appeared near the electrodes and also apart from them (Fig. 1, d).

vii) *Sparks in other gases.* As for the sparks excited in gases other than air, some experiments were made with oxygen and carbon dioxide. The results obtained will be reserved for a next communication.

Lastly, we are much indebted to Prof. T. Terada for his kind advice and discussion.

1) T. T. and U. N. loc. cit.

2) Philip Fox, *Astrophys. Jr.* 18 (1903) 294.