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[15] *Wahnschaffe, F.* Über die Gliederung der Glazialbidungen Norddeutschlands und die Stellung des norddeutschen Randlosses. *Zs. Gletscherk,* **5,** 1911 (321–338).

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THE SPECTRAL ENERGY DISTRIBUTION AND OPACITY OF WIRE EXPLOSION VAPORS

BY J. A. ANDERSON

MOUNT WILSON OBSERVATORY, CARNEGIE INSTITUTION OF WASHINGTON

Communicated, May 22, 1922

It has been shown[1] that a fine wire, through which is passed the discharge of a large high voltage condenser, vaporizes so rapidly that the phenomenon is best described as an explosion. The actual time required for the wire to pass from the solid to the vapor state is probably less than one millionth of a second. If the explosion is made to take place in the space between two parallel planes from 2 to 3 millimeters apart, such as a slot in a block of wood, its spectrum is continuous, the lines of the metal exploded appearing as absorption lines. The maximum intensity of the light is very great, being of the order of that to be expected from a black body at a temperature of about 20,000° K.

A preliminary study of the spectral energy distribution given by the explosion of iron wires has been made, using a quartz spectrograph with a vacuum thermo-couple[2] and galvanometer. The value of $E\lambda d\lambda$ increases very rapidly from the infra red to about λ4300; from this point to the ultra violet the great groups of iron absorption lines cause the values of $E\lambda d\lambda$ to oscillate considerably but its general tendency is upwards and the highest values are reached between λ2600 and λ2150. From λ2150 to λ1990 the values fall off rapidly, in part, perhaps, due to the absorption of the quartz lenses and prisms, and to that of the air.

Spectrograms of the explosions of the following metals have been made using a one meter focus grating spectrograph: copper, silver, gold, magnesium, zinc, cadmium, aluminum, tin, lead, tungsten, iron and nickel. All of these give continuous spectra of the same general intensity most of them appearing rather more intense than iron on account of the numerous absorption lines of the latter. Copper, silver and gold are anomalous in that the pure wires of these metals will not explode properly when placed in a slot in a block of wood, the main discharge always seeking a path around the outside of the wooden block. By very slightly amalgamating the surface of the wires they explode normally, giving fine continuous spectra crossed by their own absorption lines, the lines due to Hg not having been observed.

That a layer of these metallic vapors only a few centimeters thick should give a continuous spectrum is somewhat surprising, especially so, since the average pressure is certainly much lower than it was earlier[3] thought to be. Professor Henry Norris Russell suggested that it would be of some interest to find out whether the vapors are transparent to radiation or not. The following experiment was accordingly performed: A short spark gap connected in series with the wire to be exploded was (*a*) placed immediately in front of the wire, so that the light from the explosion had to pass through the spark on its way to the spectrograph; (*b*) placed immediately back of the wire, so the light from the spark had to pass through the explosion vapors before reaching the spectrograph. The spark and explosion would be exactly simultaneous, since they were connected in series. Iron wires were used, and the spark terminals were made of brass in order to make use of the bright emission lines of zinc throughout the spectrum and those of copper in the extreme ultra violet.

Using the arrangement (*a*) the spectrogram showed the bright zinc and copper lines very distinctly superposed on the regular iron absorption spectrum. It was also clear that the iron lines were less dark than usual, that is they were partially filled up by the continuous background in the light from the spark. With the arrangement (*b*) no trace of the zinc or copper lines could be seen, the iron spectrum being exactly the same whether the spark gap was used or not, thus showing that the light from the spark can not pass through the explosion vapors.

This experiment proves that 4 centimeters of iron vapor as here used is perfectly opaque, but it does not show how far the light from the spark was able to penetrate the vapor before it was absorbed, in other words, the absorption coefficient has been shown to be fairly large but has not been measured. Other observations make it probable that a layer about 2 mm. thick is very nearly opaque—but further experimental work is required, and will be undertaken as soon as possible.

[1] *Proc. Nat. Acad. Sci.*, **6** 1920, pp. 42–43; *Astroph. J.*, **51** 1920, pp. 37–48.

[2] The thermo-couple was kindly placed at my disposal by Mr. Edison Pettit.

[3] *Astroph. J.*, **51** 1920, pp. 44–46.

Acknowledgment. Since my Note on the Definition of a Linear Functional was published in the February number, I have learned that the principal theorem stated on page 27 has been proved by Fréchet by means of Fourier series, and that it is also a special case of a theorem by F. Riesz. See *Trans. Amer. Math. Soc.*, **8**, p. 439, and *Math. Ann.*, **69**, p. 475. CHARLES A. FISCHER

Erratum. Page 145, line 20. For "the majority of the stars of" read *about 20% of the stars of the.*