DEFLECTION OF A FLAME IN THE ELECTRIC FIELD.[1]

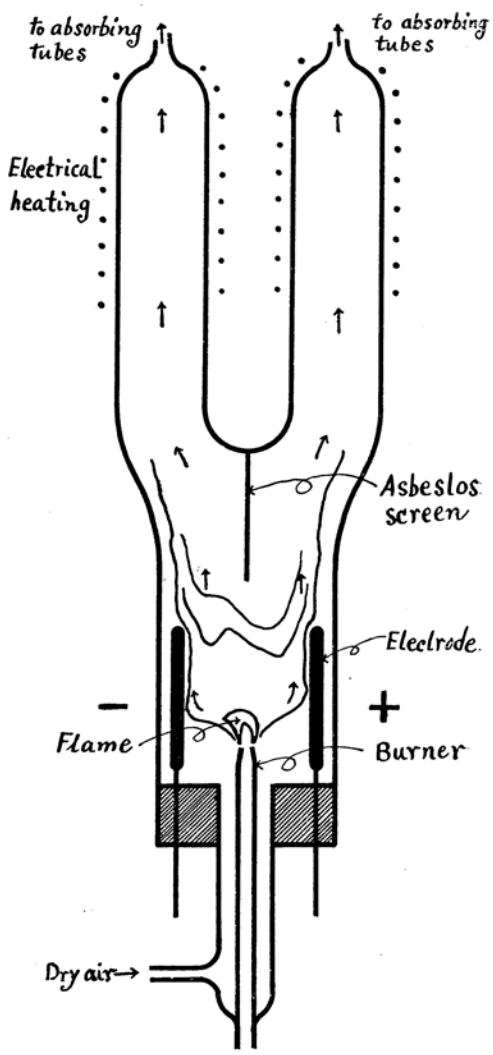
By Yuzaburo SHIBATA.

Received November 4, 1925. Published February 28, 1926.

It is well known that[2] a flame deflects itself when it is brought into an electric field. This fact can be explained as the result of the migration of the oppositely charged ions of a flame in different directions in an electric field. So we can catch differently charged particles in separate vessels and analyse them.

Ordinary Coal Gas Flame. If we put a small non-luminous flame of an ordinary coal gas burner in an electric field, the visible part of the flame is deflected towards the negative pole. But the flow of the hot gas produced by the flame streched itself almost symmetrically towards both electrodes. This fact can easily be observed by its shadow on a screen projected by strong illumination. The following experiment has been carried out to study the chemical compositions of the different parts obtained by electrical deflection.

A small ordinary coal gas flame is burnt in a two wayed glass cylinder as shown in the accompanying figure, the electric field being applied by a Wimshurst machine. Then the hot gases which was splitted by the field will go up



(1) Read before the Chemical Society of Japan, December 5, 1925.

(2) J. J. Thomson, Conduction of Electricity Through Gas. 1906, page 230.

separately along the two ways. By use of the tubes of calcium chloride and soda lime, the relative amounts of carbon dioxide and water were determined in each portions. The results are shown in the following table, together with the blank tests.

Electrode	Carbon dioxide	Water vapour	$\frac{CO_2}{H_2O}$	Ratio
	gr.	gr.		
Left (+)	0.494	0.341	1.45	1.02
Right (−)	0.615	0.415	1.48	
Left (+)	0.855	0.604	1.42	1.05
Right (−)	0.953	0.642	1.49	
Left (+)	0.519	0.375	1.39	1.02
Right (−)	0.560	0.396	1.42	
Left (−)	1.353	0.982	1.38	1.03
Right (+)	1.243	0.930	1.34	
Left (−)	0.825	0.551	1.50	1.04
Right (+)	0.553	0.385	1.44	
Left (−)	0.269	0.2095	1.28	1.04
Right (+)	0.177	0.143	1.24	
Left (no field)	0.2595	0.1675	1.55	1.00
Right	0.1865	0.1205	1.55	
Left (no field)	1.064	0.6375	1.67	1.00
Right	0.804	0.4825	1.67	

As seen from the above table, carbon dioxide is always in excess at the negative electrode than at the positive. The reason of this fact might be explained as follows. The molecules of a gas will split up into atoms or atomic groups in the intermediate stages of combustion, and some of the atoms or the atomic groups thus formed will be charged. It is probable that the carbon atom or the atomic groups CH, CH_2 CH_3 etc. have the positive charges, for the glowing carbon particles of a luminous flame in an electric field are strongly attracted to the negative electrode.

Flame Containing Sodium Chloride Vapour. In this case the sodium atom is supposed to be charged positively, and the chlorine atom negatively. This has been shown by the following experiment. When small silver plates are placed perpendicular to the electric field at a small distance from the flame at each side on the electrode, a purplish white deposit of silver chloride is seen on the surface of the silver plate on the side of the positive electrode, notwithstanding that the flame is deflected to the negative electrode as a whole.

Flame Containing Cupric Chloride. The flame has been obtained by blowing the ammoniacal solution of cupric chloride into the coal gas flame. In this case the copper atom is charged positively, and the chlorine atom negatively, which has been shown by a similar experiment as above. Reddish deposit of copper was seen at the negative electrode, while whitish deposit of silver chloride at the positive electrode.

The auther's thanks are due to Prof. Sameshima for his kind guidance.

Laboratory of Physical Chemistry,
Faculty of Science, Tokyo Imperial University.