LXXIII.—*The Effect of Pressure on the Limits for the Propagation of Flame in Ether–Air.*

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In a sufficiently large vessel a wide range of ether–air mixtures can propagate flame upwards or horizontally. Each of these ranges actually consists of two overlapping ranges which differ considerably in character and can be separated under appropriate conditions. Thus the addition of the requisite quantity of acetone to ether–air can give mixtures having two ranges that propagate flame separated

Fig. 1.

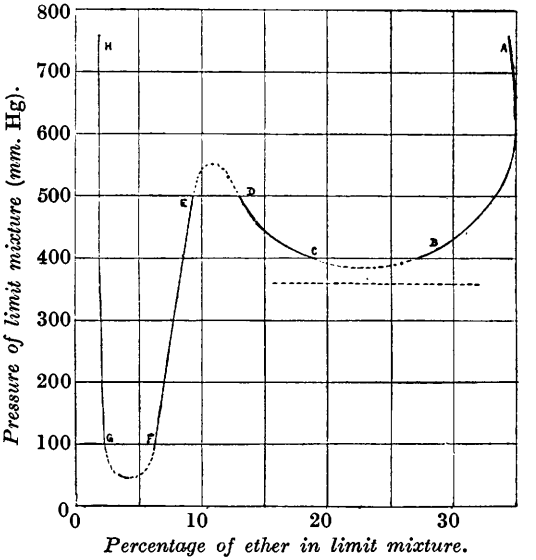

Figure showing the ranges of ether–air mixtures that can propagate flame horizontally at various pressures.

by a range that will not (White, J., 1922, **121**, 2561). A similar pair of ranges is given by ether–air alone for horizontal propagation in a narrow tube (2·5 cm. diam.), and within each range the speed of flame increases to a maximum and then decreases as the ether concentration of the mixture is increased (*idem*, *ibid.*, p. 1244).

The results of an examination of the effect of pressure on the limits for the horizontal propagation of flame in ether–air are shown graphically in Fig. 1, and clearly demonstrate the existence of two entirely different propagation ranges. They also provide an explanation of results obtained during similar experiments by

White and Price (J., 1919, **115**, 1462), when the means of ignition adopted was such that the cool-flame range could normally only be obtained as an extension of the ordinary range.

The first notable effect of reduction of pressure is the separation into two ranges, of which the one containing more ether, the cool-flame range ABCD, diminishes rapidly and disappears entirely before the pressure has been reduced to 360 mm. The lower limit changes little until the pressure is 300 mm., but the upper limit of the "ordinary" range EFGH decreases fairly uniformly from 500 mm. to 90 mm. pressure.

Experimental.

The limits were all determined in cylindrical glass tubes 1·5 m. long and 5·1 cm. in diameter, but their *absolute* values would certainly be altered somewhat by any serious change in the diameter of the tube. The mixture for test was made up in the limit tube by introducing a weighed quantity of ether into the evacuated tube. All mixtures were made up and mixed at the ordinary pressure, and brought to the required pressure just before trial by means of a Gaede box pump. Ignition was effected by either a spark from a Sanax 20-inch coil or an electrically heated helix of platinum wire. The former was more suitable for the production of ordinary flames, and the latter for cool flames. Care had to be taken to use the appropriate means of ignition in any particular case. The flames given within the range ABCD were all of the cool variety and had to be observed in a darkened room. The cool-flame results were determined only to the nearest whole number. The results were all determined at 14—19°, and are given as percentages by volume.

Original pressure of ether–air mixture (mm. Hg).	Ranges of ether–air that would propagate flame horizontally.
758	1·88—34
660	—35
590	1·87—35
500	1·88— 9·25 and 13—33
440	— and 15—31
400	1·88— 8·4 and 19—27
360	1·89— 8·1 No cool flame detected.
300	— 7·5
240	1·98—
190	2·05— 6·9
90	2·32— 6·1

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