

VARIATION IN THE COMPOSITION OF COMPRESSED ILLUMINATING GAS WITH PRESSURE AS IT ISSUES FROM THE COMPRESSION CYLINDER.—BY HENRY JERMAIN MAUDE CREIGHTON, DR. SC., F. C. S., Assistant Professor of Chemistry, Swarthmore College, Swarthmore, Penna., U. S. A.

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In the course of another investigation it became necessary for the writer to employ an illuminating gas containing 5 to 6 per cent. of carbon dioxide. As the content of carbon dioxide in the gas of the laboratory was about one-half this amount, a cylinder of purified carburetted water-gas under a pressure of approximately 300 pounds per square inch was obtained through the courtesy of a neighboring gas company. An analysis of the gas prior to compression gave the following results:

	Per cent.
Carbon dioxide	5.5
Illuminants	13.7
Oxygen	0.9
Carbon monoxide	26.9
Hydrogen	35.0
Methane	12.4
Ethane.	1.3
Nitrogen.....	4.3
	100.0

} 53.0

Before employing the gas in the investigation to which reference has been made, the carbon dioxide content in a sample taken from the compression cylinder was determined. To the writer's surprise this amounted to only 3.5 per cent. The same result was obtained with several other samples. On thinking the matter over, the conclusion was reached that the low carbon dioxide content in the samples of gas taken from the compression cylinder must be due to differences in the rates of diffusion of the components of the gas through the very small orifice of the compression cylinder; the heavier carbon dioxide diffusing less rapidly than the lighter hydrogen and methane. In order to substantiate this conclusion, and to ascertain the manner in which the composition of the diffused gas altered with the diffusing pressure, analyses were made of samples of gas taken from the compression cylinder as the pressure therein was gradually decreased.

The reducing valve of the compression cylinder was connected with a gas-meter, which in turn was attached to a bunsen burner. Samples of the gas were obtained for analysis from a three-way tube placed between the cylinder and the gas-meter. The gas was allowed to flow from the cylinder at a constant rate of 120 liters per hour. Since each division on the scale of the main pressure gauge of the cylinder corresponded to 62.5 pounds per square inch, samples of gas were taken for analysis after each reduction in pressure of this amount. Determinations of carbon dioxide, illuminants, oxygen and carbon monoxide were made in the usual way. Owing to lack of apparatus for the separation and estimation of hydrogen, methane and ethane, these components could not be separately determined. In Table 1 are recorded the amounts of carbon dioxide, illuminants, oxygen, carbon monoxide and the mixed lighter components ($H_2 + CH_4 + C_2H_2 + N_2$) found in samples of gas taken at various cylinder pressures. These results are shown graphically in Figure 1.

TABLE 1

Component	Percentage Composition						Average
	At a pressure (in lbs. per sq. in.) of :						
	312.5	250	187.5	125	62.5	15	
CO ₂	3.8	4.5	5.2	5.8	6.4	6.9	5.4
Ill.	8.2	9.8	11.2	12.9	14.8	16.6	12.2
O ₂	1.0	0.8	0.9	0.7	0.8	0.7	0.8
CO	21.2	23.2	25.3	28.1	30.5	32.0	26.7
H ₂ + CH ₄ + C ₂ H ₂ + N ₂	65.8	61.7	57.4	52.5	47.5	43.8	55.0

It will be observed from the results contained in Table 1, that the averages of carbon dioxide, oxygen and carbon monoxide agree closely with the amounts of these components contained in the gas before compression. The low average for illuminants and the consequent high average for the residue of hydrogen, methane, ethane and nitrogen are quite possibly due

to condensation of a small portion of the heavy hydrocarbons while the gas was under the higher pressures. From the data contained in the table and from the curves it will be seen that, in accordance with Graham's diffusion law, with decrease in pressure the percentage increase for carbon monoxide is less than that for carbon dioxide, and this in turn is less than that of illuminants.

FIG. 1.

