Benzene and its lower boiling homologues appear to be present in the tar in only small amount. No positive evidence of their presence was obtained, although it has been shown that benzene is present in the gas.

Naphthalene is present in considerable amount and was identified by melting-point and boiling-point.

Anthracene is also present and was identified by melting-point and by conversion into anthraquinone. An approximate quantitative determination of the amount of anthracene was also made, showing the presence of about 0.35 per cent.

From the portion coming over at about 425° there was obtained, by crystallization, a solid melting at 250° and probably crysene.

From the portion boiling still higher a green crystalline solid melting at about 240° was obtained but not in sufficient amount for its identification.

Attempts to isolate phenol were unsuccessful, though it is probably present in small amount.

The results of the investigation confirm the conclusion of Armstrong and Miller that benzene and allied hydrocarbons may be formed, at high temperatures, from hydrocarbons which bear no simple relation to them.

In conclusion we wish to express to Mr. J. J. Kirkham, Superintendent of the Terre Haute Citizen's Fuel and Gas Company, our thanks for many favors shown us in the course of the work.

[CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF THE ROSE POLYTECHNIC INSTITUTE. V.]

THE DETERMINATION OF BENZENE IN ILLUMINATING GAS.[1]

BY W. A. NOYES AND W. N. BLINKS.

SOME time since Hempel and Dennis[2] described a method of determining benzene vapors in illuminating gas which depends on their absorption in a very small quantity of absolute alcohol. The amount of mercury required and the difficulty of applying the method as described by these authors led us to

[1] Read at the Brooklyn meeting, August 15, 1894.

[2] *Ber. d. chem. Ges.*, 24, 1162. Also the translation of Hempel's Gas Analysis by L. M. Dennis, p. 221.

attempt the determination with the use of a Bunte burette. The results were so satisfactory that it seems worth while to describe our method of procedure.

One hundred cc. of gas are taken in the burette and measured, either as usual, with a column of water of definite height above, or, perhaps better, with a side tube or bottle attached below so that the gas is brought to atmospheric pressure. The water is then completely removed from the cup of the burette above and the water in the burette is drawn down to the lower stop-cock as usual for the introduction of reagents. Instead of introducing the alcohol from below, however, two or three cc. of absolute alcohol are poured into the cup above and allowed to enter the burette, one cc. at a time. After each admission of the alcohol enough time is given for it to thoroughly run down before more is admitted and care is taken that the walls of the burette are uniformly moistened with the reagent. After withdrawing the alcohol below in the usual manner, two or three cc. of water are admitted above and withdrawn below and then more water is admitted above till the gas is brought to the original pressure, and the volume read.

To test the accuracy of the method, several determinations of the amount of benzene in the gas described in the last paper, were made. This gave 1.2, 1.3, 1.2, 0.5, and 1.2 per cent. The fourth determination was evidently in error for some unknown reason.

Twelve cubic feet of the same gas were passed through a meter, then through two large calcium chloride drying tubes, and then through three Drechsel wash-bottles containing absolute alcohol and a fourth empty bottle to condense vapor carried over, all being surrounded by ice. On dilution with salt-water, 16.8 cc. of liquid hydrocarbons were obtained. Considering these hydrocarbons to consist of benzene they would occupy in the form of vapor at 20° a volume of 4.46 liters. Twelve cubic feet are equal to 340 liters, of which 4.46 liters is 1.31 per cent. When we consider that a portion of the hydrocarbons obtained must have consisted of toluene, naphthalene and other hydrocarbons, whose vapors would occupy a smaller volume than benzene for a given weight, the agreement is satisfactory.