TABLE OF FACTORS CORRESPONDING TO $\frac{100}{144 - \frac{t}{2}}$

Degrees Centigrade.	*Factors.*	*Degrees Centigrade.*	*Factors.*
10°	0.719	26°	0.763
11	0.722	27	0.766
12	0.724	28	0.768
13	0.727	29	0.771
14	0.730	30	0.774
15	0.732	31	0.777
16	0.735	32	0.780
17	0.738	33	0.784
18	0.740	34	0.787
19	0.743	35	0.790
20	0.746	36	0.793
21	0.749	37	0.796
22	0.752	38	0.800
23	0.754	39	0.803
24	0.757	40	0.806
25	0.760		

XXIII.—AN APPARATUS FOR THE RAPID ANALYSIS OF MIXTURES OF GASES.

BY ARTHUR H. ELLIOTT, PH.B, F.C.S.

The apparatus is of the type of those in which the various gases are absorbed by the use of liquid reagents added in a certain order. This was carried out by Raoult* in a graduated tube with a stop-cock above and another below, and the upper stop-cock surrounded by a cylindrical funnel. But the washing out of each reagent before adding a new one, and a somewhat risky manipulation of the tube and stop-cocks to insure measuring the gas without pressure, makes this method troublesome. Wilkinson further modified this method of Raoult, by introducing another vessel in which the burette stood in water, doing away with the lower stop-cock. By this means, the level of the water in the burette, and the exterior tube, could be adjusted by means of a stop-cock on the latter, and the gas measured

*F. M. Raoult, *Compt. Rend.*, 1876, 844.

without pressure. This was an improvement over the method of Raoult, but it still left the washing out of the reagents as a drawback.

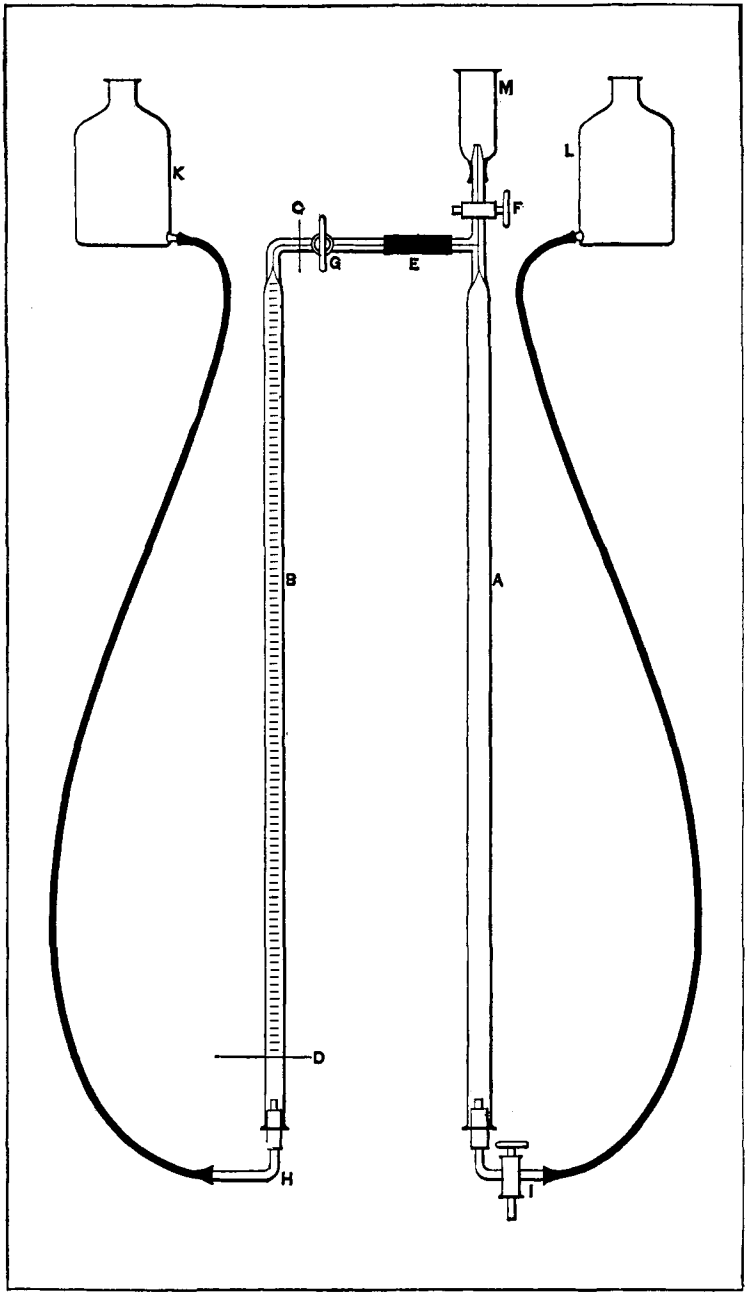
This washing becomes very important in many cases. For example, if we have a mixture of gases rich in olefient gas and ethylene, and after treating with potassic hydrate and pyrogallate of potassium, we wash out the alkali, before adding bromine to absorb the illuminants (olefient gases). The water necessary to remove this alkali, will reduce the volume of the illuminants as much as two per cent.

In the apparatus I have devised, the gas is removed from the absorbant liquid and measured in another vessel, without washing.

The apparatus is shown in the accompanying drawing. The tube A is of about 125 c.c. capacity, whilst B, although the same length, holds only 100 c.c. from the point D, or zero, to the mark on the capillary tube at C, and is carefully graduated in $\frac{1}{10}$ c.c. The attachments to these tubes below are seen from the drawing, except that the stop-cock I is three-way and has a delivery through its stern. The bottles K and L hold about 1 pint each. The tubes A and B are connected above with one another, and also with the cylindrical funnel M, by a series of capillary tubes about 1 millimeter in diameter inside. There is a stop-cock at G and another at F, whilst the funnel M, which holds about 60 c.c., is ground to fit over the end of F above. At F is a piece of rubber tubing uniting the ends of the capillary tubes, which are filed square to make them fit as close as possible.

In beginning the analysis of a mixture of gases, the stem exit of the three-way cock I is closed by turning it so that L and A are connected through the rubber tubing; the stop-cocks F and G are opened, and water is allowed to fill the apparatus from the bottles K and L, which have been previously supplied.

When the water rises in the funnel M, and all air-bubbles have been driven out of the tubes, the stop-cocks F and G are closed, the funnel M removed, and the tube delivering the gas attached in its place. By now lowering the bottle L slowly, and simultaneously opening the stop-cock F, the tube A is nearly filled with gas, and the stop-cock F is closed. The tube delivering the gas is removed, the funnel M replaced, the bottle L raised, the bottle K lowered, and by opening the stop-cock G, the gas is transferred to the graduated tube B. By placing the bottle L on a stand at about the height of the water in A, the level in B and in the bottle K can be adjusted to the


M
K
L
Q
F
G
E
B
A
D
H
I

zero point, and the stop-cock G is closed. The excess of gas in A is expelled by opening the stop-cock F and raising the bottle L. The gas remaining in the capillary tube between C and the vertical part is disregarded, or its value may be ascertained and an allowance made; but usually it is too trifling to be worth notice.

Having measured the gas, it is now transferred by means of the bottles K and L into the tube A, and the fluid chemicals added by placing them in the funnel M and allowing them to flow down the sides of the tube A slowly, care being taken *never* to let the fluids run below the level of the top of the vertical tube in the funnel. It is best to have a mark on the outside of the funnel at least three-fourths of an inch above the top of the level of the vertical tube, and never draw the fluid down below this point.

Having treated the gas with the chemical, it is transferred by means of the bottles, to the tube B to be measured. If the chemical gets into the horizontal capillary tube, the passage of a little water from the bottle K will remove it, before transferring the gas. When the gas residue is in B, and the fluid of A has been adjusted at the mark C on the horizontal tube, the stop-cock G is closed, the bottle K is lowered till the level of liquid in it and in the tube B are the same, and the reading is then made. The tube A is now filled with the chemical, just used as absorbant, and water, by turning the stem of the three-way cock I, so that it communicates with A, and also opening the stop-cock F, the contents of the tube can be run out, and water run through the funnel M to clean the tube for a new absorption. When the tube is clean, by turning the stop-cock I so that A and L are connected, the water is poured into A, and the whole is ready to receive the gas in B for new treatment.

By this method a mixture containing carbonic acid, oxygen, illuminants and carbonic oxide, can be analyzed in from 20 to 30 minutes, according to the amount of practice the operator has had with the apparatus.

Compared with Orsat's apparatus, the work can be done with the above described apparatus in one-fourth the amount of time, and with identical results.

The water used in the apparatus should have the same temperature as the room in which the analysis is made; and by careful handling, little or none of the chemicals get into the bottle L. When working in a warm place, the tube B should be surrounded with a water jacket to prevent change of volume in the gas while under treatment.

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