

IMPROVED FORMS OF MAXIMOWS' AUTOMATIC PIPETTE.

F. M. ANDREWS—Indiana University.

Grafe¹ figures and describes the automatic pipette of Maximows (Fig. 1). The pipette as given by Maximows is very practical but is in part difficult of manipulation and needs some improvements, which I have supplied. In the first place a Woulfe bottle with three openings at the top is not necessary nor is a bottle with a tubulure at the base absolutely essential, although it is convenient. Any bottle having an opening at the top and provided with a stopper having four holes is sufficient. The funnel shown in Maximows' drawing is also unnecessary. If, as Grafe describes, one closes A and B (Fig. 1), and opens C the NaOH in D flows out, creating a partial vacuum in D and causing the desired solution, in this case baryta water, to rise in the pipette E if the pinch cock F is open. If now one opens B air will enter D, allowing the solution in E to sink and thus measure the quantity of fluid. In this last operation is the chief difficulty, for when B is closed after opening the solution in E will generally not cease to sink at once owing to the reduced pressure in D produced by the column of solution in E. Since accuracy is the prime consideration here a slight error is fatal for correct results. Furthermore the glass tube B should extend below the surface of the NaOH or KOH solution to insure the removal of all CO₂ and the outside air not be allowed to enter too rapidly. Also it will be seen according to Fig. 1 that the NaOH or KOH solution would be wasted in the Maximows apparatus. The control of the outflow of the solution in E should be for the sake of accuracy and convenience not at B but at the lower end of the pipette E. Maximows used the funnel A for refilling, which is unnecessary.

The above difficulties I have removed by a modification of Maximows' apparatus as shown in Figs. 2, 3, and 4, which I will now briefly describe. In both Figs. 2 and 3, which are photographs, bottles with one opening at the top could be used instead of the Woulfe bottles.

¹ Grafe, Dr. Viktor—Ernährungsphysiologisches Praktikum der höheren Pflanzen, p. 360.

Fig. 2 shows the apparatus in a position on the ring stand A for filling the pipette E. If one opens C the NaOH solution in D will run into G which, when I is open, will cause the baryta solution to rise in

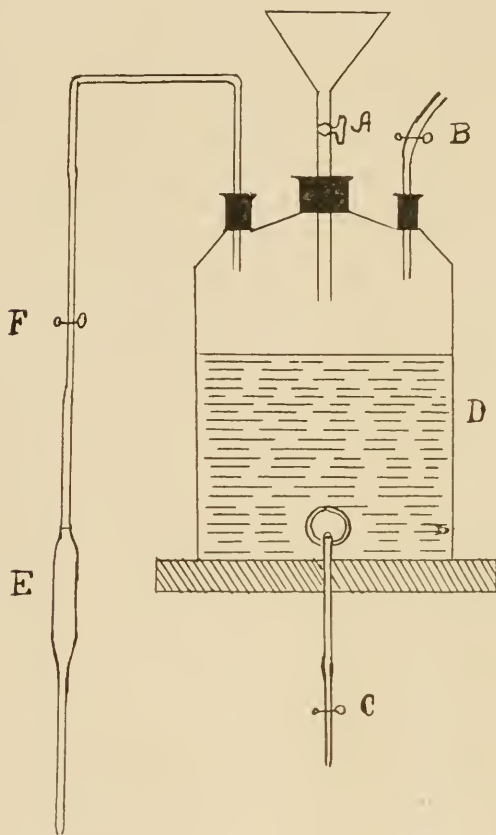


Fig. I

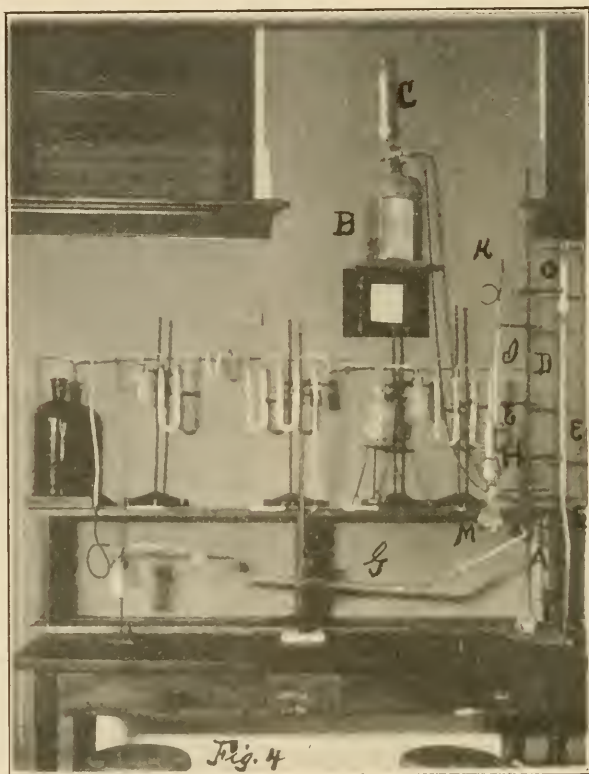
E to the desired height. If now C and I are closed and B opened it will allow the air to enter D when J is opened and the solution allowed to run out. The NaOH or KOH solution in D will arrest any CO_2 present so that the baryta solution will remain clear. The baryta solution in L remains clear since the calcium chloride tube K, which contains

soda lime, extracts the CO_2 of the air as it enters L when any of the solution is drawn into the pipette E. The solution of NaOH or KOH in D in Fig. 1 is not used further after escaping according to Grafe's figure. In Fig. 2 I show that it is collected in another bottle H, which



is similar in size and construction to D. By elevating the bottle G to a position M on the ring stand A above D and opening J, as shown by Fig 3, the same solution of NaOH or KOH runs back into D and can be used again. By this apparatus a large number of measurements may be quickly and very accurately made. The tube F with soda lime is not necessary in Figs. 3 and 4 since the KOH removes the CO_2 .

Figure 4 is a photograph of the apparatus used by Detmer¹ for estimating the amount of CO_2 produced by plants, and including also the titrating apparatus for measuring used by him. The apparatus as shown in Fig. 4 is given only to demonstrate an improved form of



Maximows' automatic pipette, which may advantageously be used in connection with the Detmer apparatus.

If one opens the pinch cock A (Fig. 4), the baryta water in B, freed from the CO_2 by the soda lime in C, flows into the burette D as shown by Detmer and the air in D escaping through E. If now one

¹ Detmer, W.—Practical Plant Physiology. Translation by S. A. Moor, pp. 264 and 267.

closes A and E and opens F the measured baryta water in D will flow into the Pettenkofer tube G. This outflow from D will cause the baryta water in the Erlenmeyer flask M to rise in the pipette I. It goes without saying that for convenience the capacity of D and I should be equal. Next close F and H and open E and J. The air will then enter E when the CO_2 will be removed by the soda lime in O before entering I through K. This will allow the measured baryta water in I to flow out of J into a suitable vessel for titration. In this way the baryta water measured into G, through which CO_2 is to be passed, furnishes the power in a convenient way for filling and accurately measuring an equal amount in I, through which the CO_2 of respiring plants is passed for comparison.

