then making acid with hydrochloric acid. In this way no iron is occluded. We tried this method of precipitation with feces in order to avoid, if possible, the removal of phosphate by filtration, but the results obtained were not satisfactory.

IMPROVEMENTS IN GAS ANALYSIS APPARATUS.

By Alfred H. White and E. D. Campbell.

Received March 24, 1905.

The accuracy of gas analysis is so largely dependent on methods of manipulation and details of construction of apparatus, that it is worth while to record anything which adds to the simplicity or accuracy of existing methods. The apparatus described in this article differs only in details from the usual form of Hempel apparatus, but the changes that have been introduced have been prompted by experience, and have proven their value by actual use in our gas analysis laboratory for from four to twelve years. During this period, the glass parts of apparatus have been made from our sketches by Greiner and Friedrichs, of Ilmenau, in Thuringia, and the stands have been made in our own shops. Changes in detail have been gradually introduced in the effort to render the process simpler and more accurate, and the apparatus less liable to breakage. These sketches of our present apparatus are now presented in the belief that they represent slight improvements in simplicity, durability and accuracy.

The perspective view shows the apparatus as it appears in service, while some details are given in the other sketch. The burette-stand, it will be readily evident, is made from an ordinary iron stand, one of whose rings of external diameter slightly greater than the water jacket of the burette has been provided with a brass collar, thus making a cup in which the rubber stopper of the water jacket rests without binding. Another ring large enough to slip loosely over the water jacket, serves to keep the burette vertical. A segment is sawed out of the front of this ring to allow an uninterrupted view of the graduations, and it is wrapped with chamois skin until it fits as snugly as desired. By this simple arrangement the burette may be raised, lowered, or swung to one side at the convenience of the operator, and may be tipped in any position while carrying, without danger of breakage.

By reference to Fig. 1, it will be seen that the burette is a perfectly straight tube. It is closed at the bottom by a one hole rubber stopper, which need not even be wired in, unless the burette is to be filled with mercury. To clean the burette, all that is necessary is to take out the rubber stopper, and lift the burette and its jacket out of the rings when it may be turned upside down, and swabbed out as an ordinary burette.

The greatest source of manipulative error in gas analysis is apt to be in making the connection between the burette and pipette. Unless this is very skilfully done, there will be either loss or gain in the gas volume in transferring the gas. The three-way stop-cock shown in Fig. 1 has allowed a very satisfactory solution of the problem. By a quarter turn of the stop-cock from the position indicated in the figure, access to the burette is cut off, and communication opened from the capillary connecting tube through the horizontal bore of the cock to the outside air. The pipette may now be connected to the burette by the usual bent capillary, without any reference whatever to how much air there may be in the connections, and by means of the rubber tube shown attached to the second bulb of the pipette, the reagent may be blown over to the stop-cock expelling all air as it goes. When the reagent has reached the cock, by a quarter turn communication with the burette is established, and the gas is then passed over into the pipette. In drawing the gas back to the burette, the reagent is in the same way drawn up through the capillary tubes until it has just reached the stop-cock, and the gas is again all in the burette. A quarter turn of the cock again establishes communication with the air, and the reagent at once siphons back into its pipette. The pipette is disconnected, and the capillary connecting tube is washed out without removing it from the burette, by means of the wash-bottle shown, when everything is in readiness for another absorption. By this method of manipulation, it is easy to transfer the gas from burette to pipette without loss or inclusion of air. Furthermore, since the volume of the capillary is entirely immaterial, it may be chosen of larger diameter than usual, permitting more rapid work and lowering the pressure necessary to force the gas through it rapidly. It has been found advantageous to have the stop-cock left-handed, as indicated, so that the hand manipulating the stop-cock, may not interfere with a clear view of the meniscus of the liquid advancing along the capillary tube. The only change

in the pipettes (Figs. 2, 3 and 4) lies in the elimination of the deep U-bend from the capillary tube. The advantage of such a bend disappears with the manipulation indicated, and its elimination does away with the disadvantage caused by drops of reagent collecting in the bottom of the U, to be subsequently carried into the burette. Wooden stands are preferred to metal ones for mounting pipettes. Iron corrodes more rapidly, and the iron

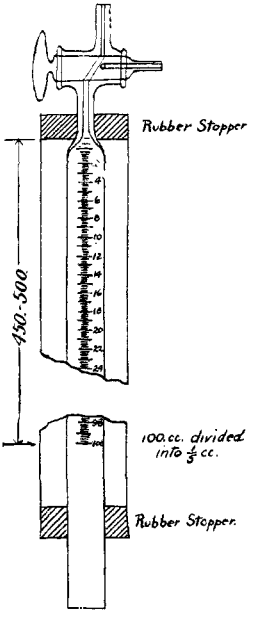


Fig. 1.

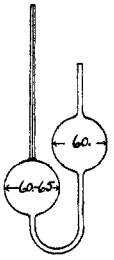


Fig. 2

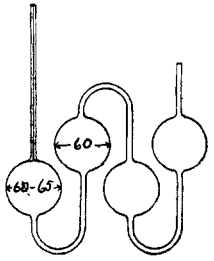


Fig. 3

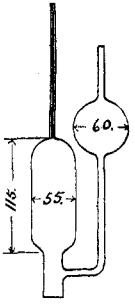


Fig. 4

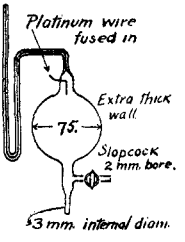


Fig 5.

Scale 50 mm

Scale 100 mm.

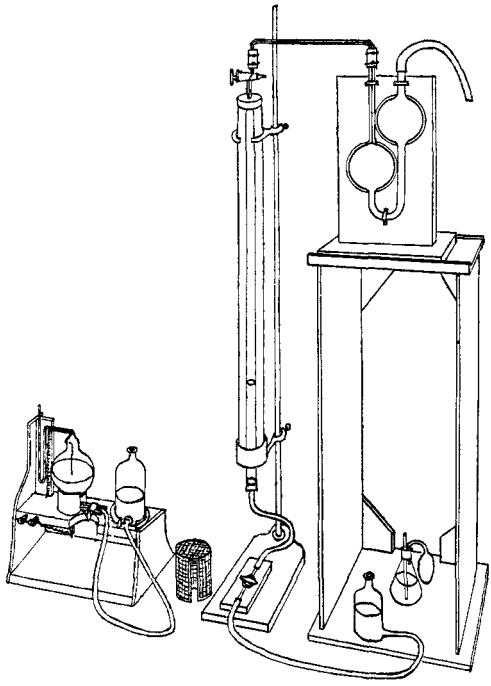
All capillary tubing to be 1 mm. internal diameter and 6-7 mm. external diameter

All dimensions in millemeters

frames are more apt to break other apparatus, if they are carelessly knocked together. The wooden stands should preferably be paraffined and not shellacked, as the shellac is more readily attacked by reagents, which may be spilled.

The explosion pipette adopts the valuable modification proposed by Gill, of introducing one of the platinum wires from the

bottom of the pipette. The difficulty of keeping the joints of the Gill pipette tight, led us to change to the form indicated in Fig. 5. The upper wire is fused through the glass, while the lower is held by a column of sealing-wax, sucked while molten, through the conical stem of the pipette almost to the outlet tube. This lower platinum wire must be stiff, and should preferably be almost a millimeter in diameter. No difficulty has been experienced in making the joints tight, and the method of sealing possesses the



advantage that the distance between the two platinum wires may at any time be changed to suit the induction coil.

The stand upon which this explosion pipette is mounted is shown in the sketch. The bulb rests in a hemispherical block, which is cut away to allow the passage of the stem and side arm, asbestos paper being used as a padding to make it rest evenly. Bits of cork keep the side arm supported, and prevent a strain being brought upon it by the weight of the mercury in the rubber

tube. Fine copper wires soldered to the platinum wires lead to binding-posts as indicated. The upper wire is brought smoothly up to the capillary, and tied there with thread in order that it may not be caught by the wire basket placed over the pipette to stop the glass in case of explosion. This basket, as shown in the sketch, is of very heavy wire of about ¼-inch mesh lined with heavy 12-mesh wire screen. One side is slit so as to sit astride the capillary of the pipette, and the rough surfaces are bound with tin so that they may not catch on the wires. The bottom of the basket is cut out enough to allow manipulation of the stop-cock of the explosion pipette, while the basket is in place. The method of connecting this pipette to the burette and of transferring the gas is the same as for the other pipettes.

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[CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CINCINNATI. NO. 65.[1]]

A METHOD FOR THE DETECTION OF THE MORE COMMON ACIDS.

BY STANLEY R. BENEDICT AND J. F. SNELL.

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THE following systematic scheme for the detection of the acid radicals (anions) was suggested by the reasonably successful attempts of Bailey and Cady,[2] and of Abegg and Herz,[3] to reduce the analysis for anions to a system resembling that commonly used in the detection of the cations.[4]

This method, though differing radically in its present form from that of Bailey and Cady, grew out of the use of the latter with classes in the University of Cincinnati, and provides for the detection of the same anions with the addition of the nitrite and sulphide ions.

[1] Read before the Cincinnati Section of the American Chemical Society, November 9, 1904.

[2] Bailey and Cady: "A Laboratory Manual of Qualitative Analysis," 4th ed., 1901.

[3] Abegg and Herz: *Zeit. anorg. Chem.*, **23**, 236; "Chemisches Praktikum," 1900, pp. 113-114.

[4] W. A. Noyes, in the fifth edition of his "Qualitative Analysis," 1901, describes a method based on that of Abegg and Herz, but materially modified and expanded.