Determination of Equivalent Weights of Metals.

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Some years ago I presented to the State Science Teachers' Association a description of an apparatus for determining the equivalent weights of the metals. The object was to devise an apparatus so simple and inexpensive that it might be used in every high school. That apparatus, which consists only of a flask and stopper, gives fairly accurate results, and where more complicated apparatus is not available it may well be used instead of giving up the determination of at least one of these most important chemical constants.

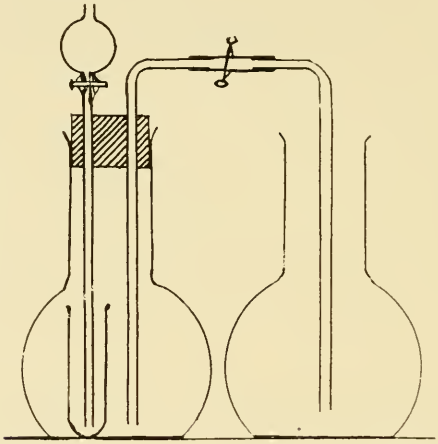
In colleges, however, where a greater variety of apparatus is available, it has seemed desirable to use apparatus which necessitates more care in its adjustment. It is desirable because the student becomes interested in working with complicated pieces, and on that account recalls more vividly the thought back of the method. Also I have found that with the apparatus about to be described the students of average ability obtain results more nearly in agreement with one another and with the theory.

The pieces of apparatus needed are two litre flasks, a two-hole rubber stopper, separating funnel, test-tube, pinch-cock, glass tubing and rubber connection. The accompanying sketch shows the apparatus when ready for use.

A weighed quantity (.6 to 1.0 grm.) of pure zinc is put into a test-tube and this put into one of the litre flasks. The flask is filled with water which has been slightly warmed to expel the dissolved air. The stopper, carrying the separating funnel with the tube long enough to reach to the bottom of the test-tube, and also carrying a tube bent to a right angle and reaching nearly to the bottom of the flask, is adjusted in the flask so that the tube of the funnel will enter the test-tube and reach nearly to the zinc. When pressing the stopper into place the exit tube should be closed with the pinch-cock and the funnel stop-cock opened so that water will fill the tube of the funnel up to the stop-cock or above. Now by allowing water to flow from the funnel

into the flask the exit tube may also be filled with water. When this has been accomplished the apparatus is tested for leaks by closing the stop-cock and opening the pinch-cock. Should there be a leak, water will siphon out. No water should remain in the bulb of the funnel.

When the apparatus is tight an accurately measured volume (15 to 20 cc) of concentrated hydrochloric acid (dilute acid can be used with magnesium) is put into the separating funnel; the exit tube is put into the second flask which has previously had its sides dampened with water. About one half of the acid is now allowed to flow into the tube containing the zinc. A rapid evolution of hydrogen occurs which drives



water over into the second flask. When the action slows down more acid is run in, care being taken that at the end the surface of the acid is just at the stop-cock. When all the metal has dissolved (it may take one-half hour) the surfaces of the liquids in the two flasks are brought to a level by raising or lowering one of them, and while level the pinch-cock on the exit tube is closed. The stopper is now withdrawn from the generating flask and the temperature of the water in it is taken. Also the reading of the barometer is noted. The volume of the water in the receiving flask is carefully measured and from its volume the volume of the acid used is deducted. The remainder is the volume of hydrogen produced during the action. This is corrected to standard conditions, and from the corrected volume and the weight of zinc used

the weight of zinc necessary to produce 11.2 litres of hydrogen is calculated. (11.2 litres of hydrogen weigh one gram).

The accuracy of the method was tested by Mr. Kimerline, a sophomore student in chemistry, who made three determinations each of three metals. The average of the closely agreeing results is as follows: aluminum, 9.02 (theory 9.03); magnesium, 12.08 (theory 12.18); zinc, 32.55 (theory 32.7). In a class of 70 freshmen who had worked in the laboratory only 18 hours, and using horn-pan balances, the average of 37 results picked at random was 31.9.

The apparatus apparently gives good results even in the hands of inexperienced men.