[CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CINCINNATI.]

XLVIII.—ON SOME NEW FORMS OF GAS GENERATORS.[1]

BY THOMAS H. NORTON.

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IMPROVEMENTS in the construction of the automatic generators, for the gases most frequently used in our laboratories, are always welcome. The following three types, which I devised some time since, have been subjected to prolonged trial in the laboratory of the University, and have given such satisfactory results, that a detailed description would seem worthy of publication.

In Fig. 1 is represented a gas generator for hydrogen, hydrogen sulphide, etc., which differs in several details from well known types of the same general outline. It is constructed of glazed earthenware, and is easily made in our ordinary potteries. *A*, the outside container, is provided with handles on the outside, and is ordinarily sixty cm. in height. Its chief peculiarity is the presence on opposite sides of the inner wall, of the shoulders *DD*, each about four cm. wide and slightly concave on the lower surface. *B*, the gas reservoir, is of the ordinary bell-jar construction, with orifice at the top for the introduction of a perforated stopper and outlet tube. It is provided with projecting shoulders three cm. wide, corresponding to *DD*, and at such a height that they barely slip beneath the latter. At the bottom are frequent circular perforations, one centimeter in diameter, to allow of the easy passage of the acid charge. The recipient *C*, designed to hold zinc or any solid charge, is provided with a loose disk perforated with many fine openings and resting upon the shoulder of the constriction. Beneath the constriction are perforations corresponding to those in *B*. A strong copper wire or rod, passing through the perforations of both parts of the apparatus, holds *B* and *C* in their mutual position to each other.

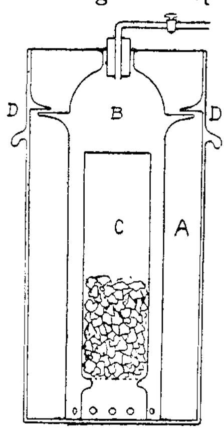

FIG. 1.

[1] Read before the American Association for the Advancement of Science at the Buffalo Meeting.

The working of the generator is exceedingly simple. *C* receives its charge of zinc, marble or ferrous sulphide. *B* is placed over it. The copper rod is passed through the perforations at the bottom. *B* with *C* is then introduced into *A*, and turned until the shoulders of *B* are beneath *DD*. *A* is then filled with the acid charge. The buoyancy of *B* is partly overcome by the rigid attachment of *C*, and entirely prevented by *DD*. Gas can be drawn off as desired, by opening the tap at the outlet tube. When, as naturally occurs, the acid in the lower portion of the generator becomes weak and the evolution of gas sluggish, the exit tap is closed, *B* is turned slightly so as to be free from *DD*, and is then lifted, by grasping the neck, along with the holder *C*, until entirely above the surface of the acid. Both are then plunged to the bottom of *A*, and a few repetitions of this churning movement renders the acid charge of uniform strength.

This style of generator has rendered excellent service. For example, one sixty centimeters in height easily supplies all the hydrogen sulphide required by a class of thirty in qualitative analysis. The special advantages of this generator are to be found in the ease and simplicity with which the buoyancy of the gas reservoir is overcome and the acid charge is maintained at a uniform strength until practically exhausted.

In Fig. 2 we have a less compact and less transportable form, but one which maintains the uniform strength of the acid charge until it is exhausted, without the need of special manipulation, as described above. It is particularly designed for use where small amounts of hydrogen sulphide are in constant requisition, as in the laboratory for qualitative analysis, and it has the advantage of being capable of easy construction from the glassware found in any well equipped laboratory. *A* is a capacious tubulated bell-jar inverted and resting upon

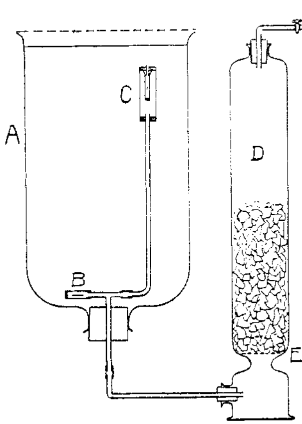

FIG. 2.

either a tripod or the ring of an ordinary support. The perforated stopper in the neck is traversed by a T tube. One terminal of this tube is connected with a simple Bunsen valve, *B*, *i. e.*, a piece of rubber tubing, closed at one end and provided with a clean cut slit in the rubber some two cm. in length. The other terminal of the T tube is connected with *C* in the upper portion of *A*. The attachment *C* is similar to that frequently introduced between suction pumps and filtering flasks. It is the reverse of *B* in its construction, allowing a current of liquid to enter from the outside through the rubber valve. *A* serves as a reservoir for the acid charge. The third external terminal of the T tube is connected with the tubulus of the lower portion of an ordinary lime drying tower, *D*, preferably of the largest size constructed. *D* serves as the recipient for the ferrous sulphide, etc., which may be used, and is provided with a perforated disk at *E* and the outlet tube *F*, the latter on a level with the top of *A*. The working of the generator is exceedingly simple. *A* is charged with acid and *D* with, say, ferrous sulphide. When *F* is opened the acid flows through *C* into *D*. When *F* is closed the pressure of the gas evolved forces the acid back into *A* through *B*. The result is that the supply of acid furnished *D* is always from the top of the reservoir *A*, and hence stronger than that found in the lower strata, which are successively of greater specific gravity, weaker in acid and richer in saline matter, as the bottom is approached. The arrangement permits of a very complete utilization of the acid. When the current of gas is in continuous demand, and evolution becomes sluggish, it is necessary to close the tap at *F* for a short time until the liquid in *D* is driven back into *A*.

Care must be exercised in constructing the valve at *C*, so that it will yield to a very slight pressure. To effect this the slit in the rubber should be at least two cm. in length. When the apparatus is used exclusively for the evolution of hydrogen sulphide to be employed in qualitative analysis, it is desirable to have beyond *F* some device which regulates uniformly the strength of the current of gas and keeps it within the limits of easy absorption. In practice this has been accomplished most simply by introducing into the rubber tube attached to *F* a short piece of glass tubing, one end of which is drawn out so as to form a very narrow opening.

Essentially the same principle for the control of the strength of the acid charge is to be found in the generator devised recently by Professor Harris. In consequence of the costly character of the latter, due largely to the use of valves of elaborate construction, the form of generator just described may be welcome to many on account of its simplicity and inexpensiveness.

An automatic chlorine generator based upon the use of manganese dioxide, has long been desired. In Fig. 3 is shown such a generator which for six years has rendered satisfactory service, both on the lecture table and in the laboratory. The essential parts only are outlined without the accompanying supports. *A* is a copper funnel, provided with a hollow projection *C*, on one side, perfectly similar in make to the funnels used for hot water filtration. It can be advantageously replaced by the more graceful and modern type of aluminum funnel, resting in a ring burner. The reservoir *B* is of glass, and is an article of current manufacture, obtainable from all dealers in chemical glassware. The long, tapering neck is tightly fastened in the neck of the funnel by means of a section of rubber tubing. A large opening at the top, closed by a rubber stopper, serves for the admission of the charge. In a smaller tubulure on the side is a perforated rubber stopper with outlet tube and tap. The funnel with its reservoir is held firmly in a support, so that the end of *C* is about two cm. above the top of an ordinary burner. A perforated plate is introduced into *B* so as to prevent solid matter from falling into the narrow neck. The latter is connected at *D* with a large tubulated bottle *E*, which serves as a reservoir for hydrochloric acid, and is attached to a support so that it can be raised

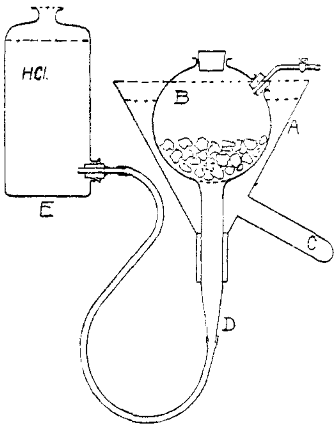

FIG. 3.

or lowered at will. When in use B is filled to two-thirds of its capacity with manganese dioxide, large lumps alone being used, as powdered mineral may easily cause a stoppage of the connections. E is filled with hydrochloric acid and raised to a level slightly above the top of B. Water is poured into the funnel A until it is nearly full, and a lamp is placed under C. As soon as the temperature has reached about 80°, a very small flame suffices to maintain the activity of the generator. When the exit from B is open, the acid enters and the evolution of chlorine continues until checked by closing the tap, when the acid is driven back into E. A slight agitation of the latter before opening the tap serves to prevent the accumulation of a stratum of weak acid at the bottom. It is advisable to lower the reservoir E when a current is not required, so as to avoid pressure and any possible escape through minute leaks. In practice it is also found desirable to connect the opening of E by a flexible tube with a bottle of caustic soda solution, the tube terminating at the surface of the solution. This prevents any escape into the surrounding air of chlorine, with which the contents of E are soon saturated. When thus arranged a current of the gas can be taken at will from the generator, the sole condition being the maintenance of a small flame beneath C. The manifold advantages of such a device, especially for the lecture table, will be appreciated by all who attempt an extended series of experiments with chlorine. As described above the generator can be readily constructed from pieces of apparatus ordinarily found in a well equipped laboratory. I have found a generator in which the reservoir B contains 1500 cc., a very convenient size for use in the lecture room.

MINERAL CONSTITUENTS OF THE WATERMELON.

By George F. Payne.

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THE watermelon is not a crop that is widely grown even in this country with great success. It is this very reason which makes it a desirable crop to handle in Georgia, as the watermelons in this state attain finer flavor, crispness, juiciness and sweetness than anywhere else in the world.