The Porosity of Glass.

Some interesting experiments going to show that glass is more porous, under some conditions, than it has hitherto been considered, have been carried out by Messrs. E. Warburg and F. Tegetmeier. These experiments are described by Professor W. Chandler Roberts-Austen as demonstrating the possibility of producing eventually a degree of porosity in vitreous bodies which will admit of the passage of elements having comparatively small atomic volumes; while other elements having larger atomic volumes are strained off; thus occasioning a mechanical sifting of the elements. A receptacle was divided into two compartments by a sheet of glass, which could be several millimeters thick. Sodium amalgam was placed on one side and pure mercury on the other; the whole was then heated to the moderate temperature of 200° C, at which the glass becomes slightly conducting. The positive and negative wires from a Plante battery were then respectively placed in connection with the contents of the two compartments; and it was found at the end of 30 hours that a considerable quantity of sodium had passed into the mercury through the glass, which had nevertheless preserved its original weight and transparency.

A CARBONIC ACID MOTOR.

BY GUSTAVE MICHAUD, SC.D., COSTA RICA.

This little apparatus derives its power from self-compressed carbonic acid. I devised it to illustrate Pascal's principle as well as many other chemical and physical phenomena. It is easily made; some of my pupils constructed it in less than an hour with materials obtained from the apothecary. If made of the dimensions I give below, it will oscillate for three or four hours without being reloaded. Its various parts are as follows: Two 9 or 10 oz. bottles, B, with wide mouth. One glass tube, T, about 26 in. long and ¼ in. bore (cost about three cents). Two glass tubes, E, 6 in. long each; ¼ in. bore (cost about two cents). Two rubber stoppers, K, each with two holes (cost about fifteen cents each). If cork stoppers are used the expense is much reduced, but a set of round files (rat tails) or a cork borer will be necessary to bore holes in the cork. Two rubber tubes, I, about 4 in. long, ¼ in. diameter (cost about ten cents). One rubber tube, R, about 19 in. long, ⅛ in. diameter (cost about ten cents). A piece of wood, A, shaped in the form of a quadratic prism; size 1 × 1 × 2 in. Two pieces of sheet iron, S; size 1½ × 2 in. Two pieces of marble the size of a nut, each wrapped in a piece of linen.

To make the apparatus, take the glass tube, T, introduce each of its extremities through the holes of the two rubber stoppers, K, place the rubber tubes, I, on each of the ends of the tube, T; take a needle with common thread and sew the piece of marble wrapped in its linen to the free end of the rubber tubes, I. Take the piece of wood, A, nail on each side of it a piece of sheet iron, S. Out of the central part of the piece, A, saw a cleft perpendicular to the metallic sheets, S. Press the center of the tube, T, in this cleft, and keep it in place by means of two pieces of wood screwed on the top of the piece. A.

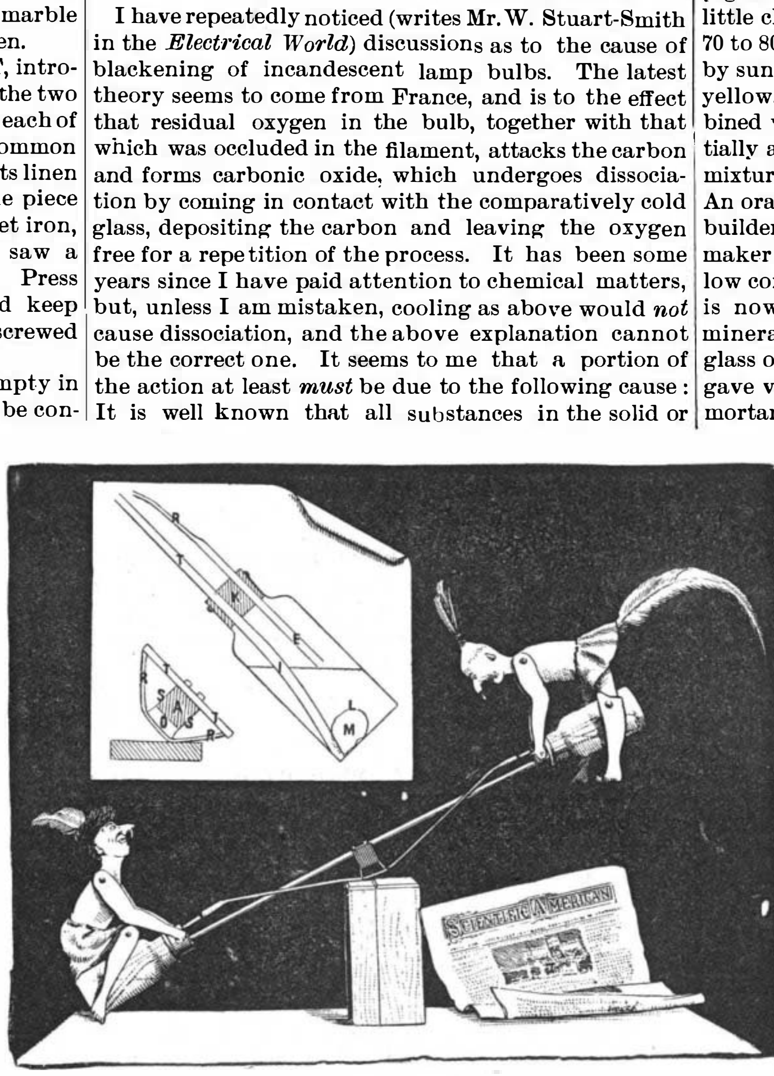
Pass the tubes, E E, through the holes left empty in the stoppers, so that the length of the part to be contained in the bottle be equal to half of the height of the bottle. Connect the tubes, E E, by means of the rubber tube, R. After putting it in place, cut a small hole in its central part, O. Last, stop one bottle with either of the two stoppers.

To set the apparatus in motion, fill half of the unstoppered bottle with a mixture of one volume of hydrochloric acid with one of water. Stop it, keeping meanwhile the whole apparatus in a vertical position, and place it at once on a box or any other stand, five to eight inches high.

The occlusion of the rubber tube, R, by the pressure of one of the pieces of sheet iron, S, will prevent the escaping of the carbonic acid, and the pressure of this gas will drive the liquid from the lower to the upper bottle through the glass tube, T. Meanwhile, the gas contained in the upper bottle will escape through the hole, O, made in the center of the rubber tube, R. If the center of gravity of the apparatus is not much above its oscillating axis, the upper bottle will fall after receiving little more than half of the liquid contained in the lower one. Then the change that takes place in the occlusion of the rubber tube, R, by the pieces, S S, will cause a repetition of the same phenomena in opposite direction.

If you wish the apparatus to cease its motion for a while, without waste of chemicals, place any heavy body on the lower bottle, which will then completely empty itself into the upper bottle and all chemical action will cease, as the marble is never in contact with the liquid in the upper bottle.

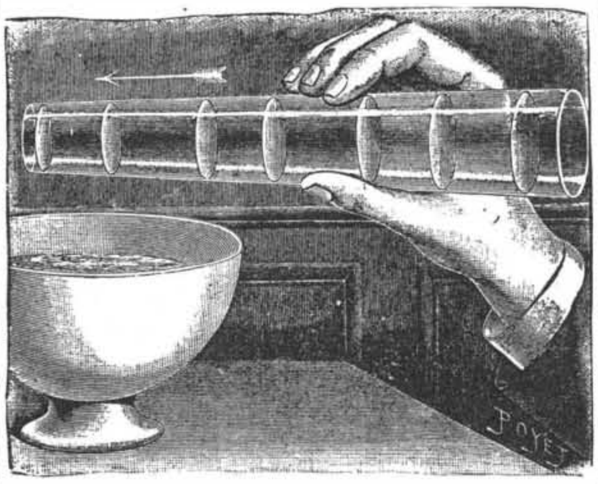
When made of the dimensions which we give above, its working expenses will be about one-eighth of a cent per hour, cost of the hydrochloric acid consumed.



A CARBONIC ACID MOTOR.

EXPERIMENT ON THE TENSION OF LIQUID FILMS.

Take a lamp chimney of conical form, that is to say, wider at the bottom than at the top, wet the interior with soapsuds, and then drain in order to get rid of the liquid in excess. Then, holding the chimney upright, dip the wide end in the soapsuds. Upon removing it, it will be found that, toward this extremity, a film of soapsuds has formed in the interior. Now place the chimney horizontally, and the liquid film will be observed to set itself in motion, and in a moment reach the narrow extremity of the glass. This phenomenon is due to the elastic tension of the film, which might be compared to a distended membrane



EXPERIMENT ON THE TENSION OF LIQUID FILMS.

of rubber, which contracts as soon as the traction upon its edges diminishes. Now here the traction becomes feebler and feebler in proportion as the diameter of the glass diminishes. Instead of a single film, a second may be formed as soon as the first has moved a slight distance from the wide end of the chimney. and then, successively as many films as may be desired. All will be observed to set themselves in motion and travel toward the narrow end, as if they were chasing one another.—*L'Illustration.*

Blackening of Incandescent Lamp Bulbs.

I have repeatedly noticed (writes Mr. W. Stuart-Smith in the *Electrical World*) discussions as to the cause of blackening of incandescent lamp bulbs. The latest theory seems to come from France, and is to the effect that residual oxygen in the bulb, together with that which was occluded in the filament, attacks the carbon and forms carbonic oxide, which undergoes dissociation by coming in contact with the comparatively cold glass, depositing the carbon and leaving the oxygen free for a repetition of the process. It has been some years since I have paid attention to chemical matters, but, unless I am mistaken, cooling as above would *not* cause dissociation, and the above explanation cannot be the correct one. It seems to me that a portion of the action at least *must* be due to the following cause: It is well known that all substances in the solid or liquid form give off vapor, in fact, are surrounded by an atmosphere of their own vapor.

If the substance is confined in an airtight space the vapor density is definite for every substance and for every temperature, but varies greatly with the temperature, being much greater for high temperatures. For a given substance and a given temperature the vapor density will be the same, no matter what other gases may be present; but if other gases are present in considerable quantities, considerably more time will be required for the density to reach its maximum value. In a vacuum, on the contrary, the action is comparatively rapid. Carbon, when cold, is a very stable substance, and its vapor density very low; but at the high temperature of the white-hot filament vaporization must be comparatively rapid and the vapor density relatively great. As the hot vapor comes in contact with the cooler glass it will deposit, and thus vaporization, instead of stopping, as would be the case if the glass were the same temperature as the filament, continues while the lamp is burning. When the lamp is extinguished the vapor in the globe must deposit on the glass until the definite density of the vapor of the cold carbon is attained. The more rapid blackening when the lamp is new may be due in part to the better condensing action of the clean glass, and it may be due in a greater part to the fact that some portions of the filament are more easily volatilized than others, and the action consequently more rapid while these are being thrown off.

A New Fertilizer.

In tallow melting establishments—and there are a score of them in the city of New York—a large amount of refuse, so-called "tank water," is thrown away. It contains a valuable element, gelatine. A patent has lately been granted to Michael A. Golseieff, of this city, for a method of utilizing the above waste product. It consists in partially evaporating the tank water and then combining it with quicklime in the proportion of one and one-half parts of lime to each part of water remaining in the refuse after the evaporation. The mixture is then allowed to expand and dry, when it is reduced to a powdered state, and is useful as a fertilizer, containing, as the patentee claims, from seven to twelve per cent of ammonia and from forty to sixty per cent of lime. If the new process should be found practicable for adoption by the various tallow melting manufactories, then a waste refuse of to-day will be made useful, and what is now a nuisance to public health will be abated.

Colors of Ancient Egypt.

The pigments used by the ancient Egyptians 4,000 to 6,000 years ago were few and almost all represented what have been called primary colors. Red seems to have been most used in the outside decoration of buildings. Giving results of an investigation of Mr. Flinders Petrie's specimens, Mr. W. J. Russell states that the red pigment was a ferric oxide, an oolitic hematite, with a little clay, the proportion of ferric oxide varying from 70 to 80 per cent. It was a natural pigment, unaffected by sunlight, heat or acids. Another color was a dull yellow, and this also consisted of oxide of iron, combined with alumina, lime and some water—being essentially a kind of colored clay. A reproduction of the mixture was fadeless in light, but was changed by heat. An orange about 4,000 B. C., by one of the first pyramid builders, was a mixture of the red and yellow. The maker mixed his colors with gum. A very bright yellow contained arsenic, and was in fact orpiment, which is now produced artificially. Beaten gold was the mineral called chrysolite; but in later times a kind of glass or frit colored with oxide of copper was used, and gave various shades. It could be rubbed down in a mortar, and was probably applied with gum. The white pigment used was sulphate of lime, known also as gypsum and alabaster. A pale pink color contained 99 per cent of sulphate of lime, the rest being an organic compound believed to be madder.

Transportation of Liquid Air.

In connection with the forthcoming lectures at the Royal Institution on "Air, Gaseous and Liquid," it may be mentioned that Prof. Dewar has successfully conveyed a considerable quantity of liquid air from London to Cambridge. The liquid air was carried in one of the double glass, vacuum jacketed flasks, the space between the inner and outer flask containing nothing but extremely attenuated mercurial vapor, together with a little liquid mercury. On pouring liquid air into the inner flask its outer surface is rapidly covered with a mercurial film of extreme thinness, forming a reflecting surface highly impervious to radiant heat. As soon as this is formed the whole apparatus is packed in solid carbonic acid, which at once freezes the liquid mercury, arrests the deposit upon the mirror, reduces the mercurial vapor to an infinitesimal quantity, forms an almost perfect vacuum, and supplies an envelope 80 degrees below zero. Thus protected, the liquid air reached Cambridge. The protective power of the high vacuum and the mercurial mirror will be better appreciated if it be borne in mind that the difference of temperature between liquid air and solid carbonic acid is the same as between ice and boiling water.

THREE routes for a cable line to the Sandwich Islands have been surveyed, and each is said to be practicable.