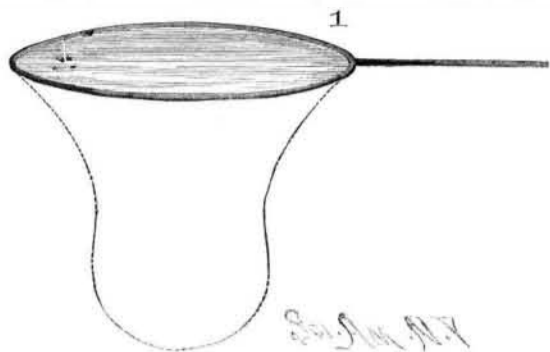


EXPERIMENTS WITH SOAP BUBBLES AND FILMS.\*

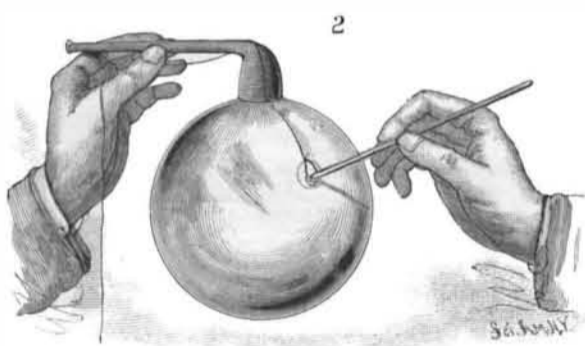
T. O'CONNOR SLOANE, PH.D.

The true nature of a liquid film is comparable to that of a perfectly elastic and tightly stretched membrane. All liquids are bounded and inclosed by such a membrane, composed of the substance of the liquid



itself. The phenomena of films, under the form of soap bubbles, have been known for many generations. They were seriously studied by Sir Isaac Newton, and later by the scientist Dr. Plateau, of Belgium, a curious study for one, like the latter, afflicted with total blindness.

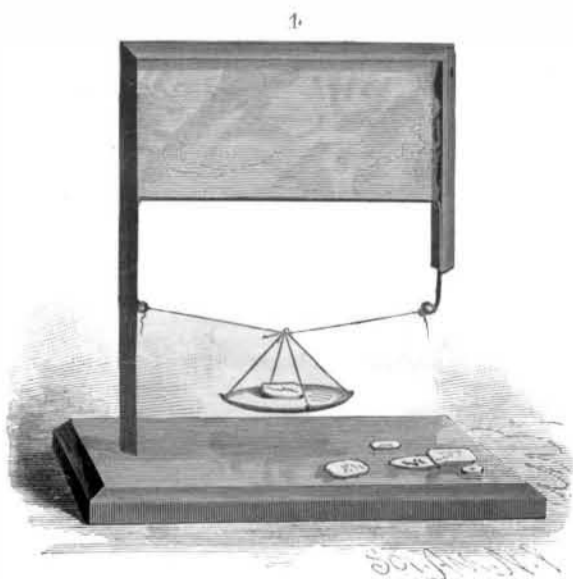
If a ring one or two inches in diameter, and provided with a handle, is dipped into a solution adapted for



forming films, and is withdrawn, it will be found to be filled with a beautiful film, straight and firm, reminding us of the wing of a dragon fly, Fig. 1. If we blow against it, it will be driven out into a purse-like shape of very characteristic outline (see dotted line). If it be held between the mouth and a candle, it will screen the latter from strong blowing until it breaks, when the candle will be extinguished.



By particular management a hole of any desired size can be made in the side of a soap bubble. This is done by tying a small loop, less than the third of an inch, in the end of a silk thread, moistening it thoroughly with the solution, and hanging it over the bowl of a pipe just before blowing a bubble. As the bubble is blown, the end of the thread and the loop will adhere to it.

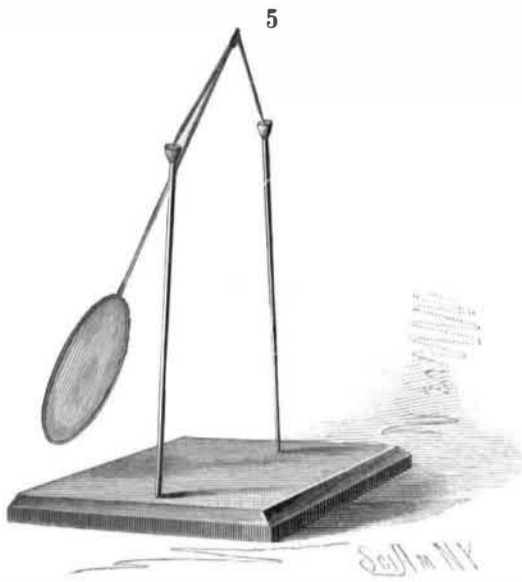


Then by touching the film within the loop, either with a hot wire or with a piece of blotting paper, the film

\* From a lecture on "The Physics of Tenuity," to be given in full, with many additional illustrations, experiments, and formulas, in SUPPLEMENT, No. 495.

will break inside of the loop, which will fly open to its widest extent, Fig. 2. The bubble will immediately collapse, or by vigorous blowing may just be kept inflated. The blast from the hole is sometimes enough to extinguish a candle.

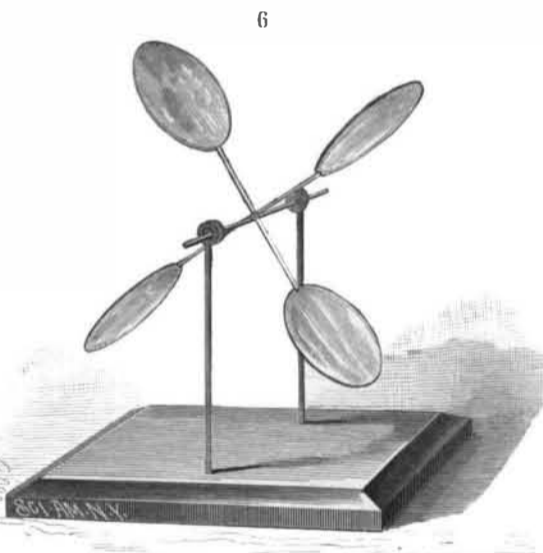
This shows that the film is elastic. To measure di-



rectly the tension exerted by an inflated bubble, a glass tube bent at a right angle may be attached to the end of a pipe stem. After blowing a bubble, the end of the glass tube may be dipped into water, when the depression will show the pressure, Fig. 3. It will be but a small fraction of an inch.

To measure the tension of the film per unit of surface, a little frame with grooved sides is employed. In the grooves a wire carrying a little scale pan slides freely up and down, Fig. 4. The wire is pushed home to the top of the frame and some of the solution introduced, either by dipping the top or by painting it in with a brush. Then by adding weights the film can be pulled down like a delicate curtain until the limit is reached, and it breaks.

By mounting a ring as a pendulum and filling it with

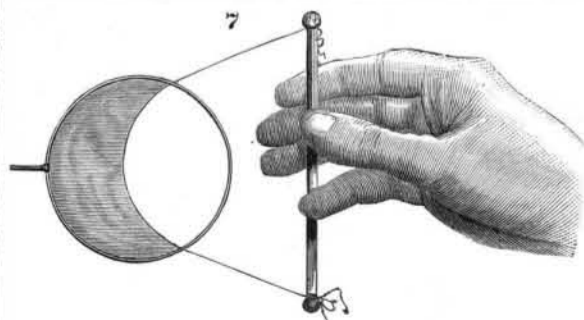


a film, Fig. 5, the retardation the latter exercises on its swing is quite striking.

Four of the rings may be mounted as a windmill, Fig. 6, and be made to turn several times by the breath until their perishable sails break one by one.

If a thread, well moistened with the solution, is laid across a ring containing a film, and the film is broken on one side of it, the thread will be suddenly snatched across the ring and be drawn up tightly against the opposite side. To facilitate manipulation, the ends of the thread may be fastened to the ends of a wire, or thin slip of wood. On drawing out the thread it will draw with it a curtain of film, and will assume the curve of the arc of a circle, Fig. 7. In this way the ring may be again filled with film and the thread be entirely removed.

A bubble may be blown, a moistened ring touched to

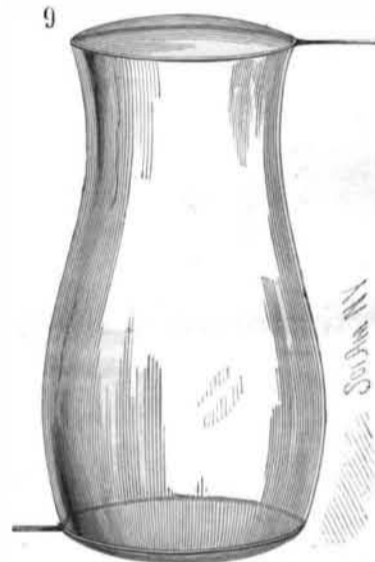


it, and the pipe pulled away, leaving the bubble adhering to the ring. The pipe may be again dipped, passed through the upper part of the bubble into its interior, and a second bubble may be blown thus in the interior of the first, Fig. 8.

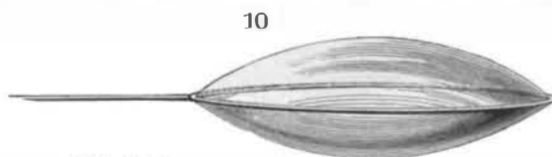
By catching a bubble on a ring, as described above, and touching it with a second ring, previously moistened, it will adhere to both, so that it can be drawn out into the most elegant shapes, Fig. 9, reminding us of the iridescent glass vases so popular a few years ago.



Again attaching a bubble to a ring, the air in it can be drawn out by inverting the mouth of the pipe until, on pulling away the pipe, a lenticular bubble will remain, Fig. 10.



The well known diffusion experiment with a porous jar can be very nicely shown with a film. The mouth of the jar, a porous cup of a Bunsen or Daniell battery,



is dipped into the solution. A glass vessel full of hydrogen, or street gas, is inverted over it, Fig. 11. The lighter gas diffusing into the porous vessel blows a



bubble from the film. On removing the outer jar the reverse action takes place, and the bubble collapses.

Very pretty effects can be produced by blowing bubbles full of tobacco smoke. By attaching the pipe stem by a rubber tube to the gas fixture, they may be in-

flated with gas, when they will rise like balloons. Many formulas have been published for making a good mixture. Plateau's mixture is thus prepared: 1 part of Marseilles soap is dissolved in 40 parts of water, at a moderate heat. It is filtered through very porous filter paper, after cooling, and 15 parts of the solution are mixed with 11 of Price's glycerine. The mixture is thoroughly shaken, and is allowed to stand for seven days in a room that is not too cold (over 67° Fah.). On the eighth day it is cooled for six hours to a temperature of 37° Fah., and filtered. A bottle of ice should be kept in the funnel. The first portions may need refiltering. Very porous paper must be used. Halbrook's brown oil silk soap or his Gallipoli soap, and Scheering & Glatz's glycerine work very well. The second filtration may be omitted—long standing and decantation from the sediment being used. After all the trouble the mixture may not give very good results.

To succeed in these experiments a little practice and niceness of manipulation is required, together with a good soap solution.

#### How Window Glass is Made.

The workmen were engaged in making window glass, and proceeded in a way that seemed very simple. A young man would take one of the long hollow iron pipes we saw the gaunt man juggling with, and approaching one of the mouths of the great furnace with the indifference of a salamander—first, however, protecting his face with a leather screen—would proceed by a series of wave-like movements of the pipe to gather at the end a ball of liquid glass, getting his supply from a fire clay pot. These pots contained a mixture of soda, lime, and sand, which had been reduced by firing for two days. After gathering a waad the size of a coconut, the young man would turn and cool it upon an iron plate, still keeping up the wave-like rotary motion. Then he would return to the pot and begin fishing again, then back to the iron plate for cooling, and then more angling. By this time he has gathered a ball of about sixteen pounds weight and of intense heat. Now cooling the pipe with water, he carries his burden over and deposits it on a larger iron plate—this one floating in a tub of water—gives the pipe to a glass blower, and seizing another iron, goes back to the furnace to perform his part once again.

The glass blower rolls the ball upon the plate until he has made the glass assume a pear shape, when he applies the pipe to his lips and blows till his cheeks stand out like red apples, blows till he is red behind the ears; blows until he becomes of a complexion as blooming as the glass. All this while he imparts a rotary motion to the pipe, and does not cease either the blowing or the rotating until the pear shaped glass has expanded into the rude semblance to a bottle with no neck and a very thick bottom. Now over he goes to one of the mouths of the side furnace, into which he thrusts the pipe to warm the mean looking bottle at the end. At his feet is the grave-like pit.

Now watch him. He takes the pipe from the furnace, blows in it, and lets it swing before in the pit. The glass begins to lengthen out, stove pipe fashion; into the furnace again; now out, and up over his head. Agitate the pipe. Blow. Now a big sweep from mid-air through the pit and up again. Blow. Now a pendulum-like movement—up—down—way cross—back! The glass is become a cylinder four feet long. Heat again and withdraw. Blow. Rotate. A little more jugglery—here—there—right side—left—a beautiful swing below! The cylinder is over five feet long now! The work is done!

These cylinders are placed still glowing on a stand. A tap with a piece of steel releases the blow pipe, the blower makes a measurement with a stick, wraps a string of hot glass about the cylinder, the superfluous part falls off as though cut with a diamond, and the completed cylinder—about five feet long and eighteen inches in diameter—is carried away to a place of safety. To-morrow a hot steel rod will cut each of the cylinders through one side, thus leaving it like a sheet of paper twisted until its upper and lower edges meet. This roll will be subjected to another gentle baking, when it will flatten out into a large sheet of glass. This will be cut into sheets of the proper size, and the work is done.—*M. Quad, in Detroit Free Press.*

#### The Medical Electric Lamp.

The electric lamp used for examining General Grant's throat is manufactured by agents of the Edison Light Company. It is mounted on a hard rubber holder, about seven inches long, having a reflector at the lamp end, by which the light can be thrown to any desired angle. The holder is connected by two silk-covered wires to a small storage battery carried in the pocket of the physician. The light is turned on by simply pressing a small button on the rubber holder, and the quantity is governed by another button convenient to the operator. The lamp is inserted in the mouth almost to the palate, with the reflector above the lamp, which throws the light down the throat. The lamp has no unpleasant heat, and gives a light equal to half a sperm candle. The extreme simplicity of the whole appliance makes it very valuable to the physician and dentist.

#### A New Japanese War Ship.

On the afternoon of March 17, a cruiser built by Sir William G. Armstrong, Mitchell & Co., being one of two begun less than twelve months ago to the order of the Japanese Government, was successfully launched from the shipbuilding yard of the company at Walker, in the presence of a large concourse of spectators.

The Naniwa-Kan is the first of two powerfully protected cruisers which were begun at the Walker yard, about ten or eleven months ago. They were designed by Mr. W. H. White, intended for the swiftest and most heavily armed cruisers at present in existence. They are also the largest war vessels that have been hitherto built by the firm. During the last few years considerable activity has been displayed by the Japanese Government in connection with the development of their naval forces and the extension of their mercantile marine, a close connection existing between the two, and the merchantmen having been built so that some of the finest of them could be used as armed transports in case of war.

As regards the distribution of the armament and their external appearance, the two new cruisers will bear a considerable resemblance to the famous Esmeralda. In fact, they may be briefly described as enlarged Esmeraldas, with substantial improvements in defense, structural arrangements, protection armaments, and speed, these improvements having become possible in consequence of the increase in size. In dimensions the new cruisers are almost identical with the Iris and Mercury, dispatch vessels of the Royal Navy, and the Leander class of partially protected cruisers. They are 300 ft. in length, 46 ft. in breadth, draw 18½ ft. of water, and are of about 3,600 tons displacement. They have twin screw engines, which are to develop 7,500 H. P. at least, and their estimated speed is from 18 to 18½ knots. The armament includes two 28 ton 26 centimeter guns, mounted on center pivot automatic carriages as bow and stern chasers. These heavy guns are worked and loaded by means of hydraulic mechanism, which is an improvement on that fitted in the Esmeralda. On each broadside there are three 15 centimeter guns of five tons each, also on center pivot automatic carriages of Elswick design, and along the broadsides there are also placed no less than ten 1 in. machine guns and two rapid fire guns. There are two military masts, in the tops of which four of the improved Gatling guns made at Elswick will be mounted. All the guns, except those in the tops, are carried on the upper deck, and all of them have strong steel shields protecting the gun and crews from rifle and machine gun fire. Besides the gun armament, each vessel will have a complete armament of locomotive torpedoes, ejected from four stations, two on each broadside, situated at a small height above water.

Her powers of offense are further assisted by the presence of a most powerful ram bow, formed of an immensely strong steel casting, which projects forward under water, and would deliver a terrific blow upon the under water portion of any of the ships attacked. The powers of defense are also remarkably developed. Throughout the length, and covering the spaces occupied by machinery, boilers, magazines, and steering gear, there is a strong protective deck, the central portion of which rises a little above water, while the sides slope down to some depth under water. This deck is of steel, and has a thickness varying from two to three inches; the total weight of the material used in this protection amounting to something over 450 tons. The few openings in this deck are protected by strong armored covers, or armored gratings, and when the ship is ready for action, and these openings are closed, the chance of shell fire reaching the vitals of the ship is extremely small. In addition to the steel deck, the defense is assisted by means of minute cellular subdivisions of the space lying above the protective deck and below the main deck, which is about six feet above water. In these cellular subdivisions very large quantities of coal can be stowed, and when the coal is in the ship it will greatly add to the defense. Below the protective deck in the hold there are also very large coal bunkers, from which can be drawn the supply of coal necessary for working the ship for a considerable time when she is in action. Watertight subdivision is also carried out very minutely in the hold space proper below the protective deck. There are two separate engine rooms and two separate stokeholes. The magazines are all duplicated and formed into separate watertight compartments, and there is a cellular double bottom running through a very large part of the length of the ship.

This double bottom is fitted to be used for the stowage of water ballast, and in this manner the draught and trim of the ship can be controlled as she consumes her coals, or ammunition and stores, so that whenever she has to fight, her protective deck can be brought into proper relation to the water line. Moreover, the cellular bottom and the subdivision of the hold space will add greatly to the powers of the ship in resisting under water attacks by rain or torpedoes, or in preventing any serious consequences should the outer skin be damaged by grounding or other accidents. One very notable feature in the vessels is the extremely

rapid rate at which they have been built and their advanced state of completion at the time of launching. The openings in the funnel, hatches, and engine hatches have been so arranged that the machinery and boilers can be passed on into the vessels without disturbing the decks in the least, and consequently it has been possible to push on with the internal fittings of cabins, mess rooms, store rooms, etc., previously to the launch. The magazines, shell rooms, gun supports, and armament fittings generally are also in an exceptionally forward state, and the interval between the launch and final completion of the ships will be proportionally shortened by the amount of work done while the vessel remains on the stocks. It may be questioned whether any war vessel of the size, and with the complicated fittings which are embodied in the design of the Naniwa-Kan, has been built in so short a time.

The accommodations and fittings of the interior of the vessel are of an exceptionally good and finished character, and, besides having four powerful electric search lights, carried in commanding positions at bow and stern, each of the cruisers will also have internal electric lighting of the more important hold spaces. In every particular these vessels will embody the latest improvements in armament and equipment, and although they have been so rapidly constructed, it is but right to state that, in quality of workmanship and material, they will bear comparison with any war ships built in the royal dockyards.

#### How to Make Cucumber Pickles.

In the SCIENTIFIC AMERICAN of March 28, 1885, Answers to Correspondents, No. 22, E. B. D. asks how cucumber pickles for the market are put up. Then follows a most extraordinary recipe, which, if followed would make each cucumber cost as much as Horace Greeley's turnips on his experimental farm—twenty-five cents apiece.

For those who care to know how to prepare pickles (cucumbers) for the market or for home use, I give a couple of as good recipes as ever were practiced, and better than most that have been published. I know about what I talk on this subject from eleven years of practice. No. 1. Cucumbers for immediate use may be pickled by making a brine—a saturated solution of salt, all the salt the water will take up; cover the cucumbers with it, adding water if necessary. The brine will act sufficiently in one night if poured on hot; if cold, give it twenty-four hours. Drain, and pack in a jar and stand, vinegar with cloves, cinnamon, and a lump of alum big as a marble for two gallons of cucumbers. Pour the spiced vinegar hot on the cucumbers and add a piece of horseradish root large as a human finger, and if desired two or three green peppers. These pickles are ready in three days, and with the horseradish will keep indefinitely. If the whole root of horse radish is not at hand, use some of the grated horseradish for the table.

No. 2. For family use or the market, as occasion requires; pack the cucumbers in salt, "the coarse fine salt," is best, covering them properly. When needed for pickling, freshen them in water three days, changing the water twice, or four days if they are desired fresh, and add cold vinegar, spice if wanted, and the piece of horseradish.

J. H. L.

#### The Cotton Industries.

The total number of spindles at the two different periods of 1870 and 1883 in operation in the great cotton manufacturing countries of the world is as follows:

	Great Britain.	Continent.	United States.
	Spindles.	Spindles.	Spindles.
1870.....	34,000,000	18,300,000	7,100,000
1883.....	42,000,000	21,215,000	12,660,000

The amount of cotton consumed by these countries from 1880 to 1883 is as follows:

	Great Britain	Continent	United States.
	Bales.	Bales.	Bales.
1880.....	3,018,000	2,618,000	1,774,000
1881.....	3,202,000	2,883,000	1,993,000
1882.....	3,439,000	2,910,000	1,989,000
1883.....	3,426,000	3,447,000	2,231,000
Total.....	13,085,000	11,858,000	7,987,000
Average per year.....	3,271,250	2,964,500	1,996,750

#### How Shall the Physician Cleanse His Hands?

Dr. Forster, of Amsterdam, contributes an article on this subject to the *Centralblatt für Klinische Medicin*. He calls attention to the great importance of physicians thoroughly disinfecting their hands before leaving a case of infectious disease (especially any of the exanthemata), and at the same time he asserts that few of the disinfectants now in use really have the power of destroying those microspores which are recognized as so dangerous an element in modern medicine. After a series of careful experiments in the hygienic institute at Amsterdam, in which every precaution was taken to avoid error, the author decided that a solution of carbolic acid of the strength of two and a half per cent was not capable of "sterilizing" the finger, but that a solution of corrosive sublimate of the strength of one to two thousand formed a reliable antiseptic wash. He urges that the latter be adopted by all physicians as well as surgeons.—*N. Y. Med. Jour.*