hydrogen, and has an odor like that of rotten fish, will be given off; as it bubbles up through the water (H_2O) and

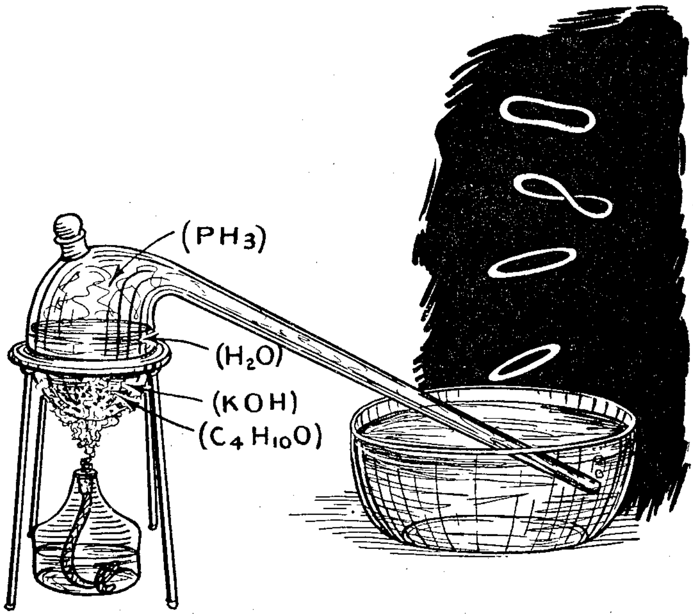

FIG. 171.—Making Phosphine Smoke Rings.

passes into the air, it will catch fire of its own accord and form wonderful rings of smoke.

The purpose of the ether ($C_4H_{10}O$) is to drive the air out of the retort and so prevent the burning of the first bubbles of gas that are formed *inside* of it. The heat must be carefully regulated, so that the bubbles will not follow each other too quickly, and the air must be perfectly still, so that the burning bubbles can form smoke rings.

How to Make Pharaoh's Serpents. This chemical reaction is a never-ending source of wonder, and it has been suggested that the ancient Egyptian conjurors in the time of Moses knew how to produce it or, at least, something very like it — hence the name *Pharaoh's Serpents.* The bald effect is that the lighting of a pill, or egg, the size of a pea, will cause a serpent-like form to wriggle forth from it with a length of several feet. This writhes about in a very life-like manner, as shown in Fig. 172, until the egg is completely consumed.

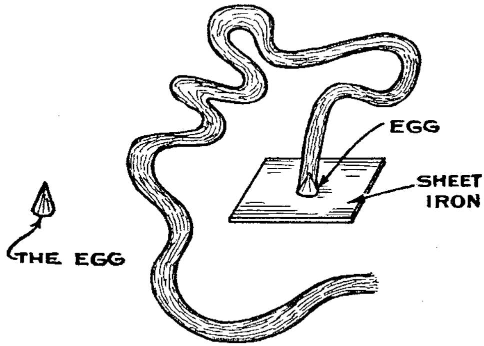

FIG. 172.—Pharaoh's Serpent Cometh Forth.

Put a drop of mercury (Hg) about the size of a pea in a test tube and add 3 or 4 drops of water (H_2O) to it, and a like amount of strong nitric acid (HNO_3). Now hold the tube over the flame of your alcohol lamp and let it heat gently; very soon the mercury (Hg) will dissolve. Then let the solution boil for ½ minute; this done, add 4 times as much water (H_2O) as there is of the solution, which now contains mercuric nitrate ($Hg(NO_3)_2, H_2O$).

Next, dissolve as much potassium thiocyanate ($KNCS$)

as you can get on the head of a lead pencil in ½ teaspoonful of water (H_2O) and add this to the solution of mercuric nitrate ($Hg(NO_3)_2, H_2O$). When this is done, a dirty grey precipitate will be thrown down, but as you keep adding more of the potassium thiocyanate ($KNCS$) to the mercuric nitrate ($Hg(NO_3)_2, H_2O$) solution, the precipitate will become a creamy white.

Now filter the solution and save only the precipitate which remains behind on the filter paper, then wash it by pouring on a little water (H_2O), and let it filter through. Let the latter drain off, then take the paper out of the funnel, unfold it, lay it on a couple of sheets of blotting paper and let it stay there until the precipitate is perfectly dry. scrape the latter off into a small dish and put a drop or two of mucilage on it so that you can mold it with your fingers into little cone-shaped pieces about as large as peas.

Finally, let them dry thoroughly, and you have the eggs of the famous Pharaoh's serpents. Now light one of them with a match, and it will burn with a nearly invisible flame, and at the same time form a brown ash of almost incredible length which curls up and twists round after the manner of a live serpent, whence it gets its name.

NOTE.— As potassium thiocyanate ($KNCS$) is a poison, be sure to wash your hands after you have shaped the compound into eggs. Further, as it gives off poisonous gases when it burns, do not get close enough to inhale them. Either make the experiment out of doors, or in a fireplace.

Here is a way to make Pharaoh's serpents which are not poisonous, neither are they anywhere nearly so effective as the foregoing. Mix, but *do not rub or grind*, ½ teaspoonful each of powdered potassium nitrate (KNO_3) and sugar ($C_{12}H_{22}O_{11}$) and 1 teaspoonful of powdered potassium dichromate (K_2CrO_7). Now add just enough mucilage to make a paste of the mixture and then shape them into little cones. When you light these, or the kind described above, always do so at the top of the cone.

CHAPTER XV

USEFUL HOUSEHOLD RECIPES

IN this chapter it is my intention to tell you how to make some interesting experiments that have to do with things in and around the house, and the family living in it. These experiments include the making of soap, water-softeners, cleansing compounds, disinfectants, dyes and inks, together with a number of miscellaneous recipes.

How to Make Soaps. In Chapter VIII I told you how to make hard and soft soaps simply as experiments in chemistry, and here I shall give you some additional easy formulas for making other kinds of soap, but also on a very small scale.

Toilet Soap. Put a tablespoonful of olive oil ($C_3H_5(CO_2C_{17}H_{33})_3$)[1] into a small porcelain evaporating-dish and then pour the same amount of alcohol (CH_4O) over it; next, put a teaspoonful of sodium hydroxide ($NaOH$), that is, caustic soda, in a test tube and pour a like amount of water (H_2O) over it. Now put 20 drops of this solution in the dish with the other two compounds.

This done, heat the dish gently until the solution boils and all the alcohol (CH_4O) has evaporated, which you will know when you can no longer smell the odor from it; evaporate the solution slowly until the remaining mass is quite

[1] This is the formula for *olein*, and olive oil contains 75 per cent of it.

dry, and this is, or at least it should be, *soap*. If it has not *saponified*, that is, changed into soap, put a little more alcohol (CH_4O) and sodium hydroxide ($NaOH$) in the dish and boil it again.

Perfumed Soap. Take a piece of good hard soap the size of a walnut and melt it in a test tube, or the tin cover of a baking-powder can, and while it is in a liquid state add a few drops of perfume of any kind to it and stir it in thoroughly. When it is cold you can easily detect the odor by smelling of it, and it will be very much in evidence when you wash with it.

Colored Soap. Follow the same directions as for making the perfumed soap given above, except that you add a harmless coloring matter to it while it is in a melted state. To give the soap a red color, put ¼ teaspoonful of cochineal[1] in a test tube one-fourth full of water (H_2O) and boil it until the solution is a bright red. Now put enough of this into the melted soap to give it the tint you want. Other colors can be had by using vegetable dyes of various kinds.

Floating Soap. Put enough good hard soap into a test tube to fill it half full and then melt it. Stick a straw or glass tube into the solution and just before it gets hard, blow a blast of air through it and stir it at the same time; this will fill it with air bubbles, and it will then be lighter than water (H_2O) and, consequently, the soap will float.

Glycerine Soap. Cut up a lump of good soap the size of a walnut and put it in a test tube and melt it. Then add ½ teaspoonful of glycerine ($C_3H_5(OH)_3$) and stir them

[1] This is a brilliant scarlet dye stuff made by killing female cochineal insects and drying them.

until they are thoroughly mixed. When this is cold you will have glycerine soap.

Sapolio. Cut up a piece of soap the size of a walnut and melt it; then add 5 or 6 times the amount of very fine sand (SiO_2),[1] together with a bit of glue, and mix them thoroughly; while the mixture is still hot put it into a little mould made of wood, or a tin box will do, lay a piece of wood on top of it and set a flat-iron or other weight on that. This done, let it dry thoroughly and you will have a cake of *sapolio*, or a close approximation to it.

How to Make a Safe Dry-Cleansing Compound. The process of cleaning goods with solvents other than water (H_2O) is called *dry cleansing*. Gasoline (C_7H_{16}) and benzine (C_8H_{18}), which are *hydrocarbons* obtained from *petroleum*, are very good solvents for oil, grease, tar, and other like organic matter, and they are largely used for removing them from clothing, but they are dangerous because they are easily ignited and explosive.

You can make a cleansing solution which will not burn, by adding 1 ounce of carbon tetrachloride (CCl_4), which is a liquid compound made by passing dry chlorine (Cl) into carbon disulphide (CS_2), to 5 ounces of benzine (C_8H_{18}). Or you can use carbon tetrachloride (CCl_4) alone, for while it is not quite as cheap, it is even safer and it evaporates about as quickly.

How to Take Out Spots and Stains.—A Fresh Grease Spot. Lay a piece of blotting paper over the grease spot and press on it with a hot flat-iron; the heat will melt the

[1]This is the formula for *silicon dioxide*, or *silica*, as it is called, and *sand* is composed chiefly of it.

grease and the blotting paper will absorb it. Hence this is not a chemical experiment but one that has to do with physics. As long as the spot is gone, it really doesn't matter.

Old Grease Spots. You can remove an old grease spot from clothing by dissolving it out with alcohol (CH_4O), benzine (C_8H_{18}), carbon tetrachloride (CCl_4), or the solution described above. In taking out a grease spot, start at the edge of it with the cloth saturated with the solvent, and then keep on working toward the center of it.

Paint Spots. The first thing to do is to soften the paint, and this can be done by pouring on a little carbon tetrachloride (CCl_4); after it has soaked for a while, moisten a bit of clean muslin with turpentine ($C_{10}H_{16}$) and rub the spot until all traces of the paint have disappeared.

Ink Spots. To take out an ink spot on woolen clothing, rub it lightly with a bleaching solution made by dissolving 1 teaspoonful of calcium hypochlorite ($Ca(OCl)_2$), that is *chloride of lime*, in 2 tablespoonfuls of water (H_2O). This will bleach out the black spot and leave a yellow spot, and this you can remove by soaking a pellet of cotton in hydrogen dioxide (H_2O_2) and with it gently rubbing the spot, which in turn will disappear.

Where fresh ink is spilled on bright-colored goods, or on a carpet, it can generally be removed by repeatedly washing the stain with fresh, sweet milk.[1]

To remove ink from paper, dissolve ½ teaspoonful each of tartaric acid ($C_4H_6O_6$) and calcium hypochlorite (Ca

[1] Milk is an emulsion formed of 80 to 90 per cent of water in which there is dissolved 2 to 6 per cent of *casein*, ⅕ to 9 per cent of *milk-sugar*, 1 to 2 per cent of *mineral salts*, and 2½ to 6 per cent of *fat;* and it swarms with bacteria.

$(OCl)_2$), in 2 tablespoonfuls of water (H_2O). Now take a pointed glass rod, or a wood toothpick will do, dip it into the solution and rub with it the ink that you want to remove, and it will fade away. The tartaric acid ($C_4H_6O_6$) and the calcium hypochlorite ($Ca(OCl)_2$) react on each other and set the chlorine (Cl) free. This with the water (H_2O) makes hypochlorous acid ($HClO$), which, as you know, is a bleaching agent. There are some kinds of ink that cannot be bleached out with this solution.

Iron-Rust Stains. Rub the stain with a solution made of 1 teaspoonful of oxalic acid ($C_2H_2O_4$) dissolved in 3 tablespoonfuls of water (H_2O). When the stain has been removed, wash out the acid solution with a plentiful supply of water (H_2O).

Alkali Spots. Where an alkali, such as sodium hydroxide ($NaOH$), that is, caustic soda gets on a piece of goods you can take it out by rubbing it gently with a piece of clean muslin dipped in the oxalic-acid solution, made as described above. After the acid has neutralized the alkali, causing the spot to disappear, wash it out with plenty of water (H_2O).

Mildew Stains. You can remove mildew stains by rubbing them gently with a solution made by dissolving 1 teaspoonful of calcium hypochlorite ($Ca(OCl)_2$) in a test tube half full of water (H_2O). It will then bleach out the stains; after which the goods should be washed in a plentiful supply of water (H_2O).

HOW TO MAKE BLEACHING COMPOUNDS.

For Cotton and Linen Goods. Hypochlorous acid ($HClO$) is the universal bleaching compound for cotton and linen goods. You can make it by dissolving a teaspoonful of calcium hypochlorite ($Ca(OCl)_2$), which is chloride of lime, or bleaching powder, as it is called when used for this purpose, in ½ pint of water (H_2O).

For Wool and Silk. Never try to bleach wool or silk with bleaching powder, or any compound that makes hypochlorous acid ($HClO$), for this destroys these kinds of goods because they contain complex organic compounds called *proteins*. To bleach wool and silk, use sulphurous acid (H_2SO_3), which you must not confound with sulphuric acid (H_2SO_4). Sulphurous acid (H_2SO_3) is formed by dissolving sulphur dioxide (SO_2) in water (H_2O) thus:

$$\underset{\text{Sulphur dioxide}}{SO_2} + \underset{\text{Water}}{H_2O} = \underset{\text{Sulphurous acid}}{H_2SO_3}$$

While sulphurous acid (H_2SO_3) is like sulphuric acid (H_2SO_4) except that it contains one less molecule of oxygen (O), it differs from it in that it is a very weak acid. It bleaches by virtue of the fact that it combines with various coloring substances and makes other compounds, which process leaves the goods white.

For Hair and Wool. For bleaching hair and wool, use hydrogen peroxide (H_2O_2), which, as its formula shows, is very like water (H_2O), except that it has 2 atoms of oxygen (O) where the latter has only 1 of oxygen (O). This difference is enough to make it heavier than water (H_2O), give it a syrupy consistency, and it makes hydrogen perox-