

Third, a transparent zone of heat around the outside. The first or inner zone consists of unburned gas given off from the wick of the candle. The melted grease is drawn up by a capillary action into the wick and is there converted into gas by the heat of the flame. With care a portion of this gas can be drawn off through a tube.

Hold one end of the glass tube in the flame and directly over the wick. Hold the tube slanting upwards so that the other end is out at the side and a little above the flame. If held correctly smoke will come from the end of the tube and can be lighted with a match.

That it is relatively cool inside of the flame can be shown by thrusting a match stick into this zone for a few seconds. The portion of the stick which was held in the dark zone will not be burned as soon as that portion passing through the sides of the flame.

EXPERIMENT 302.—The structure of flame.—Manufacturing lamplblack

The second or bright yellow zone of the flame contains particles of carbon heated to a white heat so that they glow brightly. The carbon is formed by the action of the heat on the gas of the inner zone.

The presence of this carbon can be shown by holding a cold spoon or piece of glass tubing in the flame for about a minute. You will notice that when you take it out it is covered with a black deposit of lamplblack or soot which is one form of carbon. The cold spoon chills the flame and prevents the carbon from being completely burned.

Lamplblack is made on a large scale in just this way except that natural gas is burned instead of candles and the cooling is done by means of iron pipes with water circulating through them.

The third or outside zone of the flame consists of the gases formed by the complete burning of the carbon particles. If you will hold the cold spoon in the outer zone you will find that it gets very hot but that no soot or only a very small amount will be deposited. This zone is above the luminous one.

EXPERIMENT 303.—Carbon dioxide in the breath

Make up a solution of lime water as previously directed.

Now take a hollow glass tube, put one end into the test tube containing the lime water and allow your breath to bubble through the lime water. (Figure 35.) Notice that very soon the water becomes turbid and after a short while a white precipitate is formed. This precipitate is calcium carbonate and is formed by the action of carbon dioxide in the breath upon lime water or calcium hydroxide.

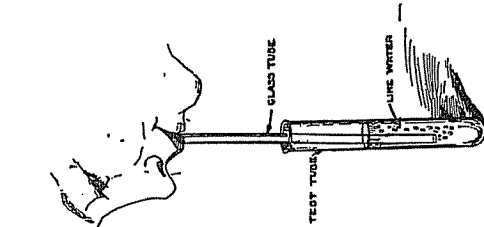


FIG. 35

TANNIN AND ITS APPLICATIONS

The raw skin obtained from an animal must be chemically treated to become useful as leather or fur, otherwise it becomes shrivelled and horny when dry, or, if wet, it is attacked by bacteria which causes putrefaction and decay.

The chemical treatment is called tanning, and the chemical which combines with the raw skin to change it to leather is called a tannin.

There are many tannins from different sources which are alike only in their ability to convert raw skin into leather. Simple treatment with salts like alum and with oils may suffice for furs. Chromium compounds are used in chrome tannage, and complex compounds produced by the action of formaldehyde and sulphuric acid on phenols are known as synthetic tannins or "syntans," but have their use limited by cost. The principal tannins are extracted from trees and plants, sometimes from the bark, sometimes from wood, leaves, or fruit. The bark of oak and hemlock and the wood of the chestnut tree have long been used, but one of our most important sources of tannin is now the wood of the quebracho tree which grows in South America. Your chemical set contains a supply of purified tannin called tannic acid.

Tannin is unpleasant to taste for it puckers the mouth, as anyone knows who has tasted a green persimmon. If you follow the directions given below you can easily test various plant materials to see if they contain tannin. Possibly you may discover a valuable new source of tannin in some ordinary weed.

The tanning of skins to make leather is too long a process to describe here but there are many other applications of tannin which make interesting experiments.

EXPERIMENT 304.—Testing for tannin

Weigh out one spoonful of ordinary gelatin such as is used in the kitchen for making desserts. Also weigh out seven spoonfuls of sodium chloride (common salt) and dissolve them together in 10 test tubes of water. This is your test solution. It spoils quickly, just as moist raw skins do unless you add a drop or two of a suitable antiseptic such as carbolic acid.

Now to see what happens when tannin is present, make up a solution of one measure of tannic acid in one test tube of water. Fill a test tube about one-third full with the gelatin solution and add the tannin solution drop by drop. The cloudiness which develops shows that the tannin has made the gelatin insoluble in water. This is not only a very sensitive test for tannin, but it shows what happens when tannin changes raw skin substances to leather.

Raw skin is chemically very similar to gelatin, so when it is soaked in water containing tannin a similar precipitation takes place within the structures of the piece of skin, converting it from a soft jelly-like consistency to a firm tough texture.

EXPERIMENT 305.—Another test for tannin

Make up a test solution by dissolving one measure of ferric ammonium sulphate in 10 cc. of water. Add a drop of this to a one-quarter test tube of your tannin solution. The black color which forms is an indication that tannin is present. Try it on a more dilute tannin solution. Is the test very sensitive? Some tannins produce a dark green color with iron instead of black.

You will find elsewhere in this book how you can make use of this color change to produce ink and perform various mysterious tricks.

EXPERIMENT 306. Test for tannin in tea

Drop a pinch of dry tea in a test tube, cover it with water, and heat nearly to boiling. Now carefully pour off the clear tea extract from the leaves and add a drop or two to a little of the gelatin test solution. Also add a drop or two of ferric alum solution to some of the tea extract in another test tube. Do you find any tannin in tea?

EXPERIMENT 307.—Tannin from oak bark

Obtain some oak bark and cut it up into fine shavings. Put some of these shavings in a test tube half full of water and boil for two or three minutes. Allow the test tube

to cool and pour the liquid into another test tube. Test as above for tannin in the extract.

EXPERIMENTS 308, 309, 310, 311, 312—Tannin from hemlock bark, chestnut bark, chestnut wood, sumac leaves, acorns

Follow the directions of the previous experiment (307) with these materials. Many other common trees and plants contain tannin in varying amounts. Try extracting tannin from some of your native trees, shrubs, and weeds. The tannin content varies in different parts of the same tree. Usually it is present in higher percentage in the bark, but frequently the leaves, fruits or nuts, and the heartwood are rich in tannin.

Tannin is important in other ways besides its use in making leather. Oak timbers owe much of their resistance to rotting to their tannin content. Many shrubs are not eaten by grazing animals, except as a last resort to keep from starving, because of the taste of the tannin in the leaves. Some tannin is used in the textile industry to assist in dyeing. This use is illustrated by experiments in another part of your handbook.

Tannin has long been used in medicine, and this application is increasing greatly since it has been discovered that it is especially valuable for treating burns.

EXPERIMENT 313—Making a tannic acid solution for burns

Dissolve about 2 measures of tannic acid in four test tubes of water. For small burns, saturate a small pad of cotton or gauze with this solution and hold it in place over the burn with a loose bandage. Very large and severe burns are treated by bathing in the tannin solution or by applying the solution as a spray.

In an emergency if your supply of tannic acid is used up, you can extract enough tannin from tea, as described above in experiment 306. Simply extract the tea leaves with hot water, using plenty of tea, and use the clear water extract to treat the burn.

PAINTS, LACQUERS, AND WATER COLORS

In all of these you will find a solid substance furnishing body and color together with a liquid called the vehicle. It is the nature of the vehicle which makes the chief difference between paints, lacquers, and water colors.

In paints the vehicle is an oil such as linseed oil which is capable of combining with oxygen of the air to become hardened to a tough film. When such an oil has been mixed with a solid such as lead carbonate or zinc oxide it produces a good weather-resisting paint. In this case the paint will be white, but suitable coloring matters called lakes and pigments may be added to give any desired color.

If these solid colors are ground up with water containing a little glue or gum to make them stick, water colors are produced. White wash and calomine are common examples. These are not usually weatherproof enough to be used outdoors, but are popular for inexpensive painting of inside walls.

Lacquers may be considered a kind of varnish, differing from the older types of varnishes and the paints in that the vehicle does not consist of an oil which dries by oxidation, but is some form of gum or resin dissolved in a mixture of solvents which evaporate to deposit the gum, together with any pigments and coloring matter, in a tough film. The lacquers may be made very quick-drying by using solvents which evaporate quickly, but if they dry too quickly the film is brittle and does not hold well to any surface it is to cover. To remedy this, a small proportion of a substance called a plasticizer is added. This is a comparatively non-volatile substance like castor

oil which keeps the lacquer film tough and pliable. Large numbers of new solvents and resins have been synthesized in the last few years, making possible lacquers of almost endless variations in properties.

EXPERIMENT 314—Making a water color medium or vehicle

Cover two measures of gum arabic in a beaker or cup with about five test tubes of water and let it stand about a day. On stirring with a stirring rod you will find that you have a thin gummy liquid or mucilage. This material when mixed with a colored powder makes a very good water color paint and, when dry, after being painted on a surface, adheres to the surface and has a glossy finish. If it is to be kept long, a drop or two of a preservative such as carbolic acid must be added.

EXPERIMENT 315—To make a color lake

Lakes are colored bodies made by precipitating a colloid which is a jelly-like substance in the presence of an organic dye, the dye being absorbed by the colloid and giving it color.

To make a purple lake, put two measures of logwood in a test tube half full of water and boil for several minutes. Add one and a half measures of aluminum sulphate and shake the mixture thoroughly. Allow the test tube to stand for several minutes and pour the clear red liquid into another test tube. Now add to this solution one measure of sodium carbonate and shake the mixture. Notice the formation of a deep purple precipitate. Collect this precipitate in a funnel with filter paper. This purple lake can be mixed with your water color vehicle to make a good water color paint.

EXPERIMENT 316—To make a carmine lake

Follow the directions of the previous experiment, but substitute two measures of cochineal in place of the logwood.

EXPERIMENT 317—To make a black lake

Follow the directions for the purple lake, but in place of aluminum sulphate use one and a half measures of ferrous ammonium sulphate. Collect the black precipitate and mix it with a few drops of the gum arabic solution to make a good black water paint.

Colored organic substances which are not lakes may be useful pigments. The following are examples.

EXPERIMENT 318—A black charcoal paint

Mix together three or four measures of powdered charcoal with two or three drops of gum arabic solution. This gives a black charcoal paint.

EXPERIMENT 319—A black iron paint

Mix together one measure of ferric ammonium sulphate, one measure of tannic acid, and two or three drops of gum arabic solution. The black color is due to black iron tannate.

The most common class of pigments consists of insoluble inorganic substances, generally called mineral pigments.

EXPERIMENT 320—White terra alba paint

Mix well together three or four drops of gum arabic solution and four or five measures of calcium sulphate. This white water color paint is commonly called terra alba or mineral white.

EXPERIMENT 321—Paris white

Substitute calcium carbonate (whiting) in the directions of the previous experiment.

EXPERIMENT 322—To make zinc white

Put four or five measures of powdered zinc in the spoon and oxidize it by heating it carefully over a flame. When the zinc has turned to a white powder, allow it to cool and pulverize it very fine. This pigment may then be moistened with your gum arabic solution to give you a paint.

EXPERIMENT 323—To make Prussian blue

First dissolve three measures of sodium ferrocyanide in a test tube $\frac{1}{3}$ full of water. In another test tube $\frac{1}{3}$ full of water dissolve three measures of ferric ammonium sulphate. Mix these solutions, and collect the deep blue precipitate on a filter. By mixing it with gum arabic solution you obtain Prussian blue paint.

EXPERIMENT 324—A brown iron paint

Dissolve one measure of sodium carbonate in a test tube $\frac{1}{4}$ full of water. In the same quantity of water in another tube dissolve one measure of ferric ammonium sulphate. The red-brown precipitate which forms is ferric hydroxide and may be filtered out and used as a pigment in gum arabic solution.

EXPERIMENT 325—A black manganese paint

Moisten three or four measures of manganese dioxide with gum arabic solution.

EXPERIMENT 326—A white wash

Mix four or five measures of calcium oxide with five or six drops of water until a smooth paste is obtained. It may be used in this form as a cheap whitewash, but it is improved by addition of a binder such as gum arabic or glue solution.

EXPERIMENT 327—Making a lacquer vehicle

Obtain some waste celluloid, such as used photograph films. Fill a bottle $\frac{1}{4}$ full of scrap celluloid and fill nearly full with acetone and put in a stopper. Let stand for a time and shake occasionally until celluloid is entirely dissolved. If you use photograph films you can make them dissolve more quickly if you first remove the coating of gelatin by a wash with hot water containing a little sodium carbonate. When the celluloid has gone into solution in the acetone, pour the clear solution into another bottle, leaving behind any undissolved sediment. Add as a plasticizer a few drops of castor oil. You now have a very useful clear lacquer which you can use to protect bottle labels, to coat polished metals to keep them bright, etc. But it may also be mixed with colored powders to produce very useful colored lacquers.

EXPERIMENT 328—An aluminum lacquer

Moisten a few measures of fine aluminum powder with this lacquer vehicle. You will obtain a water-proof aluminum lacquer.

EXPERIMENT 329—A black lacquer

Pulverize a few measures of charcoal to a very fine powder, or obtain some in the form of lampblack. Before trying to mix it with the clear lacquer, it will help if you stir in a drop or two of acetone—just enough to barely moisten it. Now stir it up with enough clear lacquer to make it thin enough to spread with a brush.

The procedure of the two experiments above may be followed with any of the dry pigments you have used for water paints. However, if the pigment is wet, as was

the case with several that you prepared from water solution by precipitation, you must first remove the water before using the pigment in a lacquer. The following experiments illustrate two general methods.

EXPERIMENT 330—To prepare a wet pigment for use in a lacquer

Drain off free water on a filter paper, and leave the precipitate on the paper until it dries by evaporation. Brush it from the filter into the mortar and grind it to a fine powder, adding a few drops of acetone toward the last. It can now be mixed with the lacquer.

EXPERIMENT 331—Another way to prepare a wet pigment for use in a lacquer

Sometimes the pigment dries to a hard mass which is not easily pulverized. If so, do not let the precipitate dry by evaporation, but pour over it while on the filter some acetone, a few drops at a time, continuing until the acetone solution which has passed through the filter is at least twice the volume of the original precipitate. The acetone washes the water out and leaves the pigment wet with acetone ready to mix with the lacquer.

EXPERIMENT 332—Testing white paint for lead

Substitutes are often used for the white lead (basic lead carbonate) used as pigment in paint. To test whether lead is present in paint, spread a little of the paint on a board with a brush. Now put five measures of sodium bisulphate in your gas generating flask with about half a test tube of water. Add about three measures of powdered iron sulphide and fit the stopper with the gas delivery tube to the flask. Warm the contents of the flask to start gas evolution, then hold the board so that the paint is exposed to the hydrogen sulphide gas coming from the delivery tube. If lead is present, lead sulphide will form and the paint will be blackened. Paint containing lead compounds should be avoided in laboratories where fumes would darken it. Even the smoke in cities contains enough hydrogen sulphide to darken lead paint. Since zinc sulphide is white, zinc pigments are more satisfactory under these conditions.

EXPERIMENT 333—Testing water color paints for carbonates

Evaporate some of the paint dry in a spoon, heating until the residue is white. Allow the residue to cool, then add a few drops of tartaric acid solution or vinegar and notice whether the residue gives off bubbles of gas. If it does, the paint contains a carbonate.

CHEMISTRY IN THE HOME

How many boys and girls have ever been instructed regarding the applications of chemistry in the home. In fact, how few of us there are who really realize what an important part chemistry plays in many of the natural processes taking place in the home. Most of us are inclined to work mechanically, and do this or that according to specific directions, and how seldom do we stop to consider what is taking place chemically in the environment of home surroundings. A household kitchen is a good example of a practical chemical laboratory. It is very important today that we all realize the relationship of this household unit to our everyday life, especially simple applications of chemistry when dealing with the necessities of life, such as pure food and water, proper sanitation and clothing.

THE TRADE NAMES AND CHEMICAL NAMES OF 76 CHEMICALS ABOUT THE HOUSE

Trade Name	Chemical Name	Trade Name	Chemical Name
Alum	potassium aluminum sulphate	Litharge	lead monoxide
Aspirin	acetyl-salicylic-acid	Lunar caustic	silver nitrate
Bakelite	formaldehyde-phenol (resin)	Lysol	creol soap solution
Baking Soda	sodium bicarbonate	Magnesia	magnesium oxide
Beet sugar	sucrose	Marble	calcium carbonate
Benzene	gasoline or petrol	Marsh gas	methane
Benzol	benzene	Milk sugar	lactose
Bleaching powder	calcium chloro-hypochlorite	Muriatic acid	hydrochloric acid
Blue vitriol	copper sulphate	Niter	potassium nitrate
Bone black	animal charcoal	Paris green	copper aceto-arsenite
Boric acid	boric acid	Plaster Paris	calcium sulphate
Borax	sodium tetraborate	Precipitated chalk	calcium carbonate
Brimstone	sulphur	Quick-lime	calcium oxide
Calomel	mercurous chloride	Quicksilver	mercury
Camphor	pinene hydrochloride	Red lead	lead tetraoxide
Carbolic acid	phenol	Rochelle salt	pot. sodium tartrate
Carborundum	silicon carbide	Rock salt	sodium chloride
Chalk	calcium carbonate	Saccharin	benzoic sulphimide
China Clay	aluminum silicate	Sal Ammoniac	ammonium chloride
Common salt	sodium chloride	Saltpeter	potassium nitrate
Corn sugar	glucose	Silica	silicon dioxide
Corundum	aluminum oxide	Slaked lime	calcium hydroxide
Cream Tartar	potassium hydrogen tartrate	Soda (washing)	sodium carbonate
Dextrose	glucose (corn sugar)	Soft soap	potash soap
Epsom salts	magnesium sulphate	Soluble glass	sodium silicate
Formalin	40% solution formaldehyde	Spirits of Hartshorn	ammonia solution
Fruit sugar	fructose	Sugar of lead	lead acetate
Fusel oil	mixed amyl alcohols	Sugar of milk	lactose
Gasoline	benzene or petrol	Table salt	sodium chloride
Galena	natural lead sulphide	Talc	hy-magnesium latrate
Glauber salts	sodium sulphate	Turnbull's blue	ferrous ferricyanide
Glycerine	glycerol	Venetian red	ferric oxide
Grain alcohol	ethyl alcohol	Water glass	sodium silicate
Grape sugar	glucose	White lead	basic lead carbonate
Gypsum	calcium sulphate	Whiting	calcium carbonate
Hypo-	sodium thiosulphate	Wood alcohol	methyl alcohol
Lamp-black	impure carbon		
Lanolin	cholesterol		
Lime	calcium oxide		

THE FAMILY DOCTOR

How many boys and girls realize the important part that the family doctor plays in the daily life of a community? He must always be ready to respond to calls during day or night when he is needed to relieve suffering and human pain.

There is no need greater, no need more urgent than that of the man or woman or the child in illness or in pain; there is no need so great to the individual who is suffering as the need of that moment for one who can soothe or save. To the sufferer the whole world is in the physician who comes at his call. To that sufferer the physician represents life or life's going. That service for which the patient waits hopefully, painfully or desperately is the sort of service that every physician must have at hand at every hour and every day of the three hundred and sixty-five days of the year. It may be a stomach ache or it may be the misery and torture of a sudden or chronic illness. The physician must be ready for whatever it is. What a welcome friend he is at the bedside in the time of sickness.

It becomes the duty of the physician not only to soothe, relieve or cure, but in order to do that he must instill confidence in his patient and then justify this confidence. That is no small task for any man or woman. To accomplish this he must give the very best of all that he has of knowledge, of technical skill and in addition he must give something and sometimes a great deal of himself. This giving is not of just one hour nor of just one day, but of every hour and every day. His own business, his own family, his own pleasures, his own leisure must be sacrificed, suspended or dropped in order that he may serve those who need him.

CHEMISTRY AND PUBLIC HEALTH

Chemistry has done much to help the family doctor in his work. Today he is dependent on drugs manufactured and synthesized by chemists for the successful practice of his profession. This relationship of the doctor and the chemist is illustrated in the following table or chart.

Natural Drugs

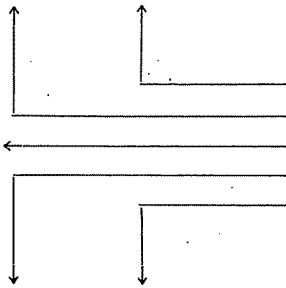
The chemist has improved on the methods of isolating drugs from plants, thereby providing drugs of greater purity for the physician to use.

Bacteria and Microbes

The chemist has added to our knowledge of the life processes of these lower organisms. The physician has been taught how to prevent the destructive diseases caused by these lower organisms.

Synthetic Drugs

The chemist has duplicated and in many cases has improved upon drugs found in nature.



RELATION

OF

CHEMISTRY

TO

DISEASE

Anesthetics and Soporifics

The chemist has enabled the surgeon and dentist to perform painless operations by providing many new organic combinations possessing anesthetic properties.

Light Radiation

The chemist has cooperated in making effective the application of artificial radiation. As a result the physician is enabled to control the ravages of specific diseases and regulate proper nutrition for growing children.

Metallurgy of Iron and Steel

The chemist has provided better instruments to be used by the surgeon by making new alloys of iron and developing improved methods for tempering steel.

X-Ray and Fluoroscope

The chemist has synthesized several new chemicals for X-ray plates and fluoroscope screens. These enable physicians to make more accurate diagnosis.

Radium Extraction

The chemist has worked out practical methods for extraction of radium from ores, thereby providing an effective method of treating cancer.

FIRST AID DON'TS

- Don't touch a wound with your fingers or any instrument.
- Don't put an unclean dressing or cloth over a wound.
- Don't allow bleeding to go unchecked.
- Don't move a patient unnecessarily.
- Don't allow a patient with a fracture or suspected fracture to be moved until splints have been applied.
- Don't neglect shock.
- Don't burn a patient with an unwrapped hot-water bottle or other heated object.
- Don't fail to give artificial respiration when needed.
- Don't fail to remove false teeth, tobacco, and chewing gum from the mouth of an unconscious person.
- Don't permit air to reach a burned surface.
- Don't wash wounds.
- Don't reduce dislocations, except of the finger and lower jaw.
- Don't put a quid of tobacco on a wound.
- Don't leave a tourniquet on over 20 minutes without loosening.
- Don't forget to send immediately for a physician.

FIRST AID CHEMICALS

Some common drugs and chemicals which are safe to apply externally for local treatment to the skin and wounds in case of minor injuries:

Caustics

Silver nitrate solution
Tincture of iodine
Carbolic acid solution (phenol)
Potassium carbonate solution
Sodium carbonate solution
Zinc chloride solution
Sodium hydroxide solution

Antiseptics and Disinfectants

Boric acid
Salicylic acid
Cresol solution
Phenol or carbolic acid solution
Formaldehyde
Hexylresorcinol in form of ST. 37
Hydrogen peroxide
Potassium permanganate
Thymol
Chlorinated lime
Iodoform
Sulphur

Astringents

Tannic acid
Alcohol
Alum
Silver nitrate
Bismuth subgallate
Ferric sulphate

Styptics

Ferric chloride
Alum (ammonium or potassium aluminum sulphate)

Protectives (surface treatment)

Zinc oxide
Talcum powder
Collodion
Magnesium carbonate
Bismuth subnitrate

Emollients

Paraffin
Petrolatum
Fixed oils and fats
Lanolin

Local analgesics for pain and itching

Aqueous ammonia
Carbolic acid solution
Sodium bicarbonate

Emergency Medicines

Ammonia vapor: Inhaled through the nostrils is a stimulant and delays fainting. Do not breathe strong ammonia vapor.

Tincture of arnica: Useful as a liniment and valuable as a liniment for treatment of sprains and bruises. Almost always found in mother's medicine cabinet.

Bicarbonate of soda: Known as baking soda. Used in treatment of burns.

Camphor: Comes in gum form and also as spirits of camphor. Camphor should not be applied directly to open wounds.

Ginger: Tincture of ginger is useful for bowel complaints. Trust to your mother to properly apply this remedy.

Glycerine: Recommended for burns. Mixed with rose water it makes a practical lotion.

Peppermint: Tincture of peppermint is a well-known home remedy oftentimes used by your mother.

Witch hazel: Extract of the plant witch hazel. A remedy for sprains, contusions, wounds and swellings. Also good for chapped hands, burns, scalds and abrasions.

Vaseline: Recommended for burns and scalds.

Carron oil: For burns and scalds, formula: Mix equal parts lime water and raw linseed oil and shake thoroughly. This forms a creamy emulsion and can be used freely without harm. Olive oil or cotton seed oil may be substituted for linseed oil.

Lime water: Always available at a drug store for both internal and external use.

Help in Case of Accidents

Burns and scalds: Cover the surface of the wound with bicarbonate of soda and lay over it a wet cloth. Olive oil and linseed oil alone or mixed with lime water are useful.

Snake bite: Suck the blood from the wound and cauterize with a caustic as tincture of iodine, silver nitrate solution or sodium hydroxide.

Dog bite: Treat the same as in the case of snake bites.

Bee stings: Apply diluted ammonia solution, salt water solution, or tincture of iodine.

Fainting: Lay patient on the back. Furnish with plenty of fresh air and moisten face with cold water. Keep head lower than rest of body.

Foreign substance in eye: Pull the upper lid downward away from the eyeball over the lower lid and then release.

Pharmaceutical Preparations

Capsules: Are made of gelatin oftentimes mixed with a little glycerine. These are used for oils and solutions of drugs in oils. Hard gelatin capsules are used for dispensing powders.

EXPERIMENT 334

Take a gelatin capsule and apply your test recommended for protein.

EXPERIMENT 335

Take a gelatin capsule and apply your test recommended for sulphur in protein.

Colloids: Solutions of pyroxilin (gun cotton) in mixtures of ether and alcohol or acetone. They are used for external applications.

EXPERIMENT 336—Preservation of animal matter

Place a small piece of beefsteak in a salt mouth bottle and add one spoonful of formaldehyde solution, which can be obtained in any drug store. Cork quickly and seal the bottle with a coating of collodion.

EXPERIMENT 337—Putrefaction of meat

Repeat the previous experiment, using only meat, and do not seal the bottle with collodion. Let both bottles stand around at ordinary temperature. Which sample will first show evidence of putrefaction?

Decoctions: These are aqueous preparations made by boiling vegetable substances in water.

EXPERIMENT 338—Decoction of bayberry leaves

Collect some bayberry leaves, dry them, and prepare a strong decoction. Filter and allow to stand. Notice the odor of the solution.

EXPERIMENT 339—Balsam

Repeat previous experiment, using balsam twigs.

Emulsions: Are aqueous preparations in which oils or resins are suspended by means of colloidal substances. Fresh milk is an emulsion.

Extracts: Are preparations made by evaporating solutions of the soluble constituents of vegetable or animal matter.

EXPERIMENT 340—Bayberry extract

Select 50 grams of bayberries and mix with five test tubes full of carbon tetrachloride. Cool and filter; then let the carbon tetrachloride evaporate and bayberry wax will be left behind. This is an extract of crude bayberry wax.

Infusions: These are aqueous preparations made by pouring hot water over a vegetable drug. The best illustration is the preparation of ordinary tea or coffee in a percolator.

Mucilages: These are aqueous solutions of gums or the mucilaginous principles of many plant substances.

Fixed oils: These are neutral glycerine esters of vegetable and animal fatty acids. The acids present are generally oleic, palmitic and stearic acid.

Essential oils: These are oily liquids derived from plants. Oil of wintergreen is an example.

Spirits: These are alcoholic solutions of volatile substances. Alcoholic ammonia is an example of a spirit.

Syrups: Are concentrated solutions of sugars and water. Honey is a natural syrup.

Tinctures: Are alcoholic extractive preparations of vegetable drugs. Tincture of iodine is a specific case of a tincture preparation of an inorganic element.

Ointments: Soft, fatty solids of such a consistency that they may be spread over the skin. They are generally used as simple protectives.

CHRISTMAS EXPERIMENTS

"A bayberry candle burned to the socket brings health to the home and wealth to the pocket."

EXPERIMENT 341—Preparation of bayberry wax

Collect in the Fall of the year about one pound of bayberries and place them in a large bottle. The bottle should be about one-half filled. Then pour over the berries a mixture made up of six parts of gasoline and one part of wood alcohol. Let stand at ordinary temperature and agitate frequently. After standing for two or three days, then drain off the gasoline mixture into a round bottom flask, connect with a Liebig condenser and distill off the solvent at the lowest possible temperature by heating the flask in a steam or hot water bath and condensing the distillate with an efficient condenser. This distillate can be used for further extractions. After removal of the solvent the dissolved bayberry wax will be left behind as a dark colored oil. On cooling it will solidify to a greenish colored wax. If exposed to the air for several hours this wax can be practically freed of all traces of solvent. The wax can be preserved in the form of moulded cakes of any shape desired if you have the proper mould.

EXPERIMENT 342—Making a bayberry candle

Select a piece of glass tubing of proper diameter and length for moulding a candle. Insert in one end of the tube a cork through which is drawn a string to serve as a wick. Hold the wick string taut, fill the tube with melted wax, and let cool. After complete solidification then remove the cork and gently warm the tube. The candle will easily slip from the tube after heating.

EXPERIMENT 343—Balsam pillows

The balsam tree is well known for its fragrant aroma. Secure some green boughs of a balsam tree and chop the twigs into small pieces. Balsam twigs in this form are very fragrant and are an excellent material for filling pillows at Christmas time.

EXPERIMENT 344—Making a partridgeberry bowl

If you are a wild flower lover and are interested in making a unique home decoration at Christmas time, construct a partridgeberry bowl. The leaf of the partridgeberry is evergreen and the berries a brilliant red. Select a round, glass bowl about four inches in diameter, fitted with a tight glass or metal cover. Select uniform sprays of the plant and arrange in the bowl so that both leaves and berries are visible.

If properly packed the sprays will continue to grow. The partridgeberry bowl requires no attention except a few drops of water once a month. Keep tightly covered to conserve water.

EXPERIMENT 345—Evergreen trees

Every boy and girl should be familiar with our native evergreen trees. Collect sprays of the following: Arbor vitae, American yew, balsam fir, hemlock, juniper, red cedar, white spruce, American arbor vitae, white pine, red spruce and Norway spruce. Compare the foliage of these species and note any characteristic differences. Which species are commonly used for Christmas trees?

EXPERIMENT 346—Around the fireplace at Christmas

The fireplace is the center of family life at Christmas time, as well as in the long winter evenings. What can you suggest in the way of a Christmas decoration to make it more attractive? Make the proper selection of evergreen, etc., for roping, sprays and provide balsam needles and selected cones for burning in the fireplace.

COLORLED FLAMES FOR FIREPLACES AND OPEN FIRES

Material for preparing interesting Christmas gifts for your friends can easily be made by chemically treating wood and other combustible material which when thrown on burning fires will produce colored flames. Small pieces of well dried wood, pine cones, corn cobs, charcoal, knots and rolls of old newspapers are all suitable materials for use in making colored fires.

GENERAL DIRECTIONS FOR CHEMICAL TREATMENT

To apply the chemicals, take a small wooden pail, a tub or an old earthen crock. Do not use a metal container because the chemicals will destroy the metal. Dissolve the chemical to be used in the proportion of one pound to a gallon of water. In some cases it will not be necessary to use so strong a solution. After the chemical solution is ready, then take your material to be soaked (pieces of wood or cones) and suspend them in a porous bag, a wire basket or some similar container, and dip them into the chemical solution. Let them soak for two or three hours so that the solution will completely penetrate the combustible material. Then remove from the solution and allow to drain, finally spreading on paper for complete drying. **CAUTION!** When preparing the chemical solutions and also when soaking wood and cones do not put your hands in the solutions as they are corrosive and will injure the skin.

EXPERIMENT 347—A blue fireplace flame

Use blue vitriol or copper sulphate as your chemical and dissolve as directed in water. This chemical is not expensive and can be purchased at a wholesale drug house. Wood shavings, cones, coarse charcoal, and dried branches of evergreen trees make suitable material for soaking.

EXPERIMENT 348—A purple fireplace flame

Potassium permanganate is a practical reagent for cone or wood soaking. A beautiful purple color characteristic of potassium will be produced.

EXPERIMENT 349—A green fireplace flame

For producing this color use a solution of boric acid.

EXPERIMENT 350—A red fireplace flame

Two chemicals can be utilized for producing a red flame: lithium chloride or strontium nitrate. It will not be necessary to use more than one-quarter to one-half of the quantities of chemicals recommended in the general directions. The red colors are more intense and therefore less chemicals are required to produce the desired results.

EXPERIMENT 351—An orange fireplace flame

For producing an orange fire, calcium chloride is recommended. This is a very cheap salt.

EXPERIMENT 352—Christmas souvenirs

Prepare small bags of netting and then place some dried wood shavings or small cones in each of them and tie with bright red ribbons or cord. These bags make excellent gifts at Christmas time and give much pleasure when burned in fireplaces or open hearth fires.

EXPERIMENT 353—A Merry Christmas greeting

Make a strong water solution of potassium nitrate. Using this solution as an invisible ink, write on a sheet of white paper the following: "Merry Xmas." Make the lines heavy and writing continuous without any breaks. Allow the paper to dry and then touch the beginning of the writing at the letter "M" with a red hot wire. A spark will develop and run over the paper tracing out the words "Merry Xmas." This is an example of fire writing.

EXPERIMENT 354—Happy New Year

Repeat the above experiment using the greeting "Happy New Year." Make writing continuous.

EXPERIMENT 355—April Fool

Repeat the above experiment, using the words "April Fool."

EXPERIMENT 356—Believe it or not

Repeat the above experiment using the well-known Ripley remark "Believe It or Not."

THE CHEMISTRY OF FOODS

While there is quite a variety of foods and the compounds present in foods are very numerous and often very complex, yet they may all be included in a few general classes. The edible portion of our foods consists essentially of proteins, fats, carbohydrates, mineral matter and water.

Proteins, which occur to a larger extent in animal foods, serve to replace the worn-out tissues of our bodies and to supply material for growth. The carbohydrates and fats are both oxidized in the body to carbon dioxide and water and consequently serve as a source of heat and muscular energy. If carbohydrates or fats are lacking in the foods we eat, the protein material in them furnish the necessary heat and energy. The mineral matter supplies the necessary material for building up the solid tissues of the body besides taking other complex parts.

Proteins occur in both animal and vegetable foods and are composed of the elements carbon, hydrogen, oxygen, nitrogen and small amounts of sulphur and phosphorus. Carbohydrates are chiefly found in vegetable foods in the form of starch and sugars and are composed of the elements, carbon, hydrogen and oxygen. Fats occur in both classes of foods, but occur in much larger quantities in animal foods. They are

compounds of glycerine with organic acids and are composed of the elements carbon, hydrogen and oxygen.

It is important, since the various constituents of our foods serve different purposes, that we use the proper proportion of these materials in order to keep up a healthy body. For example, during the winter months we should eat a larger amount of animal foods since they contain a larger proportion of fats necessary to keep the body warm. During the warm weather we should eat less meats or animal foods and more vegetables or fruits. They contain carbohydrates which serve to keep up the necessary body heat and energy. How often people are made very uncomfortable and sometimes sick by their ignorance of the amounts and kinds of foods that the body requires during the different periods of the year. Did you ever realize that sometimes a heavy cold is brought about by over-eating. This happens quite often when we are not exercising the body enough; the foods are not oxidized or burned up, the blood becomes stagnant and we are sick. The body is a very intricate form of machinery, each part performing its own particular function the same as the different parts of a watch. If we abuse any one of these parts by eating too much with an insufficient amount of exercise or by not eating the right kinds of foods, something goes wrong and we are sick.

Throughout the country there are chemical laboratories which are conducted by the Government and local public health boards for the purpose of analyzing and testing foods as to their purity. A few years ago the Government enacted the Pure Food Law, which requires that foods which are bought by the public should be free of impurities or adulterants as they are called. Adulterants are materials sometimes mixed with foods to make them cheap. For example, oleomargarine was quite often used to take the place of good butter, whereas, it was a very poor substitute. In other foods harmful chemicals were often used to preserve them. Quite often foods were adulterated to give them weight, bulk or proper color. For example, coffee was often weighted with chicory. Today things are quite different; most of the foods on the market are pure or nearly so.

The square meal today has come to have six sides, all of which are necessary for human beings, if they wish to enjoy good health. First, water is the most important of these sides. Proteins: bones require proteins and minerals. If human beings do not get a proper amount of proteins and mineral substances, for bone growth, they suffer from rickets and other bone disorders. Calcium and phosphorus are the two chief mineral elements needed for bone growth. It is very important to realize the importance of calcium as one of the essential elements in the metabolism of human beings. In the growth and repair of the bony frame-work and teeth of the body it is very necessary. Calcium plays a very distinct role in the tuberculosis patients' bid for the return of good health. A careful study of all available data indicates that about 95% of school children suffer from tooth decay. The prevention of tooth decay would be an untold boon to the public. A lack of vitamin C in the diet leads to an increase in tooth decay. The lack of this vitamin produces a degeneration and retards the nutrition of the teeth. Vitamin D is a potent substance and also a regulator of tooth decay. Blood serum high in phosphorus is essential to tooth immunity. The chief fuels used by the body are known as carbohydrates. Two forms of carbohydrates which man uses as food are starches and sugars. Foods rich in these substances are important energy-giving foods. Fats: These are important constituents of such foods as butter, cream, bacon. Fats serve two purposes in the body: They serve to keep the body warm by supplying a padding around the muscles; they also serve as a reserve fuel supply, and are drawn upon by the body as a source of energy. Materials which regulate body processes: common salt, iron, mineral substances, and the naturally occurring principles known as vitamins.

HOME KITCHEN CHEMISTRY

EXPERIMENT 357—The use and care of aluminum ware

Obtain an old aluminum pan and put some vinegar in it. Warm slightly and notice the corrosive action which the vinegar has on aluminum. Add a small quantity of salt to the vinegar and notice that the corrosive action is increased. Put a small quantity of lye in the aluminum pan, dissolve it in water, and notice that this also corrodes the aluminum.

This experiment shows that neither strong acids or alkalies should be used in cleaning aluminum ware. Instead lemon juice in water boiled in the vessel to be cleaned will impart a beautiful luster to the surface. This should be in the proportion of two teaspoons lemon juice to each cup of water. Boil for 10 to 12 minutes.

EXPERIMENT 358—Why zinc vessels are not used for foods

Test the solubility of zinc in acids, for example, warm vinegar. Also test the solubility of zinc in a strong lye solution. You will see that zinc is attacked by acids and alkalies; therefore, foods should not be kept or prepared in zinc vessels. Sodium chloride solution also attacks zinc readily, and as the soluble compounds of zinc are poisonous, it would be very dangerous to use zinc vessels in preparing foods.

EXPERIMENT 359—Cooking in copper vessels

Test a strip of copper in acids; for example, two measures of sodium bisulphate in a test tube one-quarter full of water, strong vinegar, etc. Notice that especially when the solution is heated the copper dissolves in the acids. Add a few drops of household ammonia to an acid solution which has acted on copper. We find, therefore, that copper vessels are not good for cooking foods as the copper will dissolve in acids and the soluble salts of copper are poisonous.

EXPERIMENT 360—Testing silver plate

To find out whether an article is plated with nickel or with silver prepare a solution of four measures of sodium bisulphate in a test tube half full of water. Put the article which you wish to test in this solution and warm it for a few minutes. If a greenish solution is formed, the article contains nickel. Test the solution by adding sodium carbonate until it no longer effervesces and then generate hydrogen sulphide gas, and pass the gas through your delivery tube into the solution. A black precipitate indicates nickel.

EXPERIMENT 361—Cleaning silverware

Sodium thiosulphate dissolves silver sulphide. Prepare a solution of two measures of this salt in a test tube three-quarters full of water. Moisten a soft cloth in this solution and rub a piece of silverware, which is tarnished with silver sulphide.

EXPERIMENT 362—Removing iodine stains

The blue color formed with iodine and starch or the brown iodine stains can be removed from flesh or from fabrics by means of sodium thiosulphate solution.

EXPERIMENT 363—A test for soil in the flower pot

Remove a sample of soil from your mother's flower pot and mix with sufficient clear water to make a thin paste. Insert a strip of blue litmus paper in the mixture and allow it to remain for half an hour. Withdraw the paper and wash with water. If the paper has turned pink the soil is acid.

EXPERIMENT 364—A fragrant paste wax

One part of carnauba wax and one part of bayberry wax are mixed with sufficient turpentine to form a thick paste. Be sure to mix thoroughly in order to obtain a uniform paste. Apply this mixture to a piece of furniture that your mother would like renovated. Rub briskly when dry to obtain a good polish.

EXPERIMENT 365—Keeping the surface of window panes clear

In cold weather one often desires to keep a window pane in the kitchen free from ice in order to see out of doors. Also, when driving a car in rain, snow, sleet, fog or frost, it is very difficult to keep the windshield so that you can see through it. A very simple compound can be made of soap and glycerine which will prevent the window panes from becoming fogged or streaked with rain or ice. The same compound can also be used on eye glasses to keep them clear in bad weather.

Shave some white soap by scraping with a knife and put 25 measures of the soap shavings and four or five drops of glycerine in a glass or cup. Add a few drops of water and stir thoroughly with a stirring rod until a smooth stiff paste is formed. Keep this paste in a tight container, and when needed take a little on your fingers and rub over the outside surface of the glass to be kept clear.

EXPERIMENT 366—Colored soap

Put a heaping spoonful of shaved soap in a mortar or cup and add two or three drops of cochineal solution. Grind the mixture thoroughly, and when the whole mass is a uniform color, work it up into a cake with your fingers. By using different dyes almost any desired color of soap can be made.

EXPERIMENT 367—Perfumed soap

Put a heaping spoonful of soap shavings into your mortar and add four or five drops of a selected perfume. Grind the mixture up thoroughly and then form it into a cake by pressing it into a smooth mould. Various perfumes can be used to make soap any odor desired.

EXPERIMENT 368—Liquid soap

Put a spoonful of soap shavings into your mortar and add water, a few drops at a time, stirring the mixture continually with the pestle. When the proper consistency has been reached pour the liquid soap into a bottle if you wish to keep it.

EXPERIMENT 369—Transparent soap

Take a piece of Ivory soap about the size of a marble and put it in the bowl of a spoon together with four or five drops of glycerine. Now heat the spoon over the flame for a few minutes until the soap has melted and mixed with the glycerine. Upon cooling you will find that the mass is now transparent. Transparent soaps are also made by mixing alcohol or sugar with ordinary soaps.

EXPERIMENT 370—How soap cleanses

Have you ever thought why it is that soap will immediately remove dirt from your hands; while if you try to wash them without soap it takes very much harder rubbing? Soap cleanses by emulsifying or holding the dirt in suspension and then by rinsing the soap away with water, the dirt goes away with it. On the other hand, if you wash with water which does not contain soap, the water will loosen the dirt, but in order to remove the dirt it must be rubbed away. Try this experiment.

Obtain a small amount of grease or oil and fill a test tube about one-quarter full with it. Now add water until the tube is half full and shake the tube for a few minutes until the oil and water are thoroughly mixed. When you stop shaking, the oil and water