convenient size, and laid out to dry. A little of this detergent being scraped off with a knife, made into a paste with water, and applied to the stain, will remove it. Purified ox-gall is to be mixed with its own bulk of water, applied to the spots, rubbed well into them with the hands till they disappear, after which the stuff is to be washed with soft water. It is the best substance for removing stains on woollen clothes. The redistilled oil of turpentine may also be rubbed upon dry clothes with a sponge or a tuft of cotton, till the spot disappears; but it must be immediately afterwards covered with some plastic clay reduced to powder. Without this precaution, a cloud would be formed round the stain as large as the part moistened with the turpentine. Oxalic acid may be applied in powder upon the spot previously moistened with water, well rubbed on, and then washed off with pure water. Sulphurous acid is best generated at the moment of using it. If the clothes be much stained, they should be suspended in an ordinary fumigating chamber. For trifling stains, the sulphur may be burned under the wide end of a small card or paper funnel, whose upper orifice is applied near the cloth.

Manipulations.—These consist, first, in washing the clothes in clean soft water, or in soap-water. The cloth must next be stretched on a sloping board, and rubbed with the appropriate reagent as above described, either by a sponge or a small hard brush. The application of a red-hot iron a little way above a moistened spot often volatilizes the greasy matter out of it. Stains of pitch, varnish, or oil paint, which have become dry, must first be softened with a little fresh butter or lard, and then treated with the powder of the scouring ball. When the gloss has been taken from silk, it may be restored by applying the filtered mucilage of gum tragacanth; stretching it upon a frame to dry. Ribbons are glossed with isinglass. Lemon juice is used to brighten scarlet spots after they have been cleaned.

Scouring Shawls.—Scrape 1 lb. of soap, and boil it down in sufficient water to make it a thin jelly. When cold, beat it with the hand, and add three tablespoonfuls of spirits of turpentine and one of spirits of hartshorn. Wash the shawl thoroughly in this mixture, then rinse in cold water until all the soap is taken off. Next rinse it in salt and water, in order to prevent the colours striking. Wring the water out, fold between two sheets, taking care not to allow two folds of the article washed to lie together; mangle, and iron with a cool iron.

To Scour Point Lace.—Fix the lace in a prepared tent, draw it tight and straight, make a warm lather of Castile soap, and with a fine brush dipped in, rub over the lace gently, and when clean on one side, do the same to the other, then throw some clean water on it, in which a little alum has been dissolved, to take off the suds; and having some thin starch, go over with it on the wrong side, and iron it on the same side when dry, then open with a bodkin, and set it in order. To clean the same, if not very dirty, without washing, fix it as before and go over with fine bread, the crust being pared off, and when done dust out the crumbs.

To Scour Lace of all kinds.—Get anything round, of convenient size, say a wine bottle, as that will not stain. Wind round smoothly and carefully with a piece of soft material; gently sponge the dirt away in tepid soapy water, no soda to be used; and when clean, and before dry, pass through weak gum water. Pick out, and lay in the sun to dry. If it is wished to bleach it, rinse it in some weak chloride of lime water, and expose it to the air. It must be very weak, or it will seriously damage the lace. Starch it and expose it; then boil and starch, and expose again if not white enough.

Reviving Sable and other Furs.—Thoroughly sprinkle every part with hot flour and sand, and well brush with a hard brush. Then beat with a cane, comb it smooth with a wet comb, and press carefully with a warm iron. For ermine use plaster of Paris instead of

flour and sand, and treat in the same way.

Tanning.—The skin of an animal must be carefully cleansed of hair, fat, and dirt, washed with lime water, and then with water containing a small quantity of oil of vitriol; it is then immersed in an infusion of oak bark, or other astringent vegetable matter containing tannic acid. The process is a slow one; thick hides require 12 to 18 months' preparation for the market; whilst thin leather, to be dressed for such purposes as the uppers of boots, take 3 or 4 weeks.

Tanning by the Decoction of Bark.—Fill a boiler of copper, or any other metal that does not stain or colour the liquor, half full with ground oak bark, and pour water upon it, up to the brim. The whole is then to be boiled for 3 hours, till the tanning principle is completely extracted. The liquor is then to run off by a cock into pits, where it stands to cool. The hides are put into the liquor, and handled frequently, by taking them out and putting them in again, because the liquor is too powerful for them to remain long at a time in the first stages of tanning. They are then to be removed to fresh liquors from time to time as the old is weakened, until the operation is complete. If leather is required with a lighter colour or bloom, a small quantity of the dust of bark is mixed with the liquor. Besides bark, oak chips and oak saw-dust may be used; and the barks of most trees that produce hard wood have a tanning principle in them. The young shoots from the roots of oaks, and the superfluous twigs or branches, may be lopped off, so as not to injure the trees. These, when cut in proper season, may be chopped and ground, and boiled with bark, and will produce a strong tanning liquor. The trunk, roots, limbs, branches, and leaves of the oak, whether tree, pollard, coppice, or underwood, possess tanning properties in a sufficient quantity to be employed with advantage for tanning, by reducing them to chips or saw-dust, and then boiling and using them in the following way;—

To Tan Calf or other Thin Skins, put cwt. of the limbs or branches, chopped as above mentioned, into a copper containing about 60 galls. of water, and boil till the water be reduced to from 35 to 40 galls.; draw off the decoction. Now add to the same limbs or branches 40 galls. of water, and again boil till the water be reduced to about 25 galls. The liquor thus produced by the second boiling is used as a weak ooze, in the first process of immersing the calf-skins after they come from the scouring beam. The decoction first produced is next to be used in the same way.

To Tan Hides, take 1 cwt. of the limbs or branches, and ½ of a cwt. of oak saw-dust—the sooner the latter is used after being made the better—and ¼ of a cwt. of the root; boil in 80 galls. of water, till reduced to from 50 to 60 galls. Draw off the decoction, and put it aside for use. To the materials left in the copper add 60 galls. of water, and again boil till reduced to from 30 to 35 galls. The liquor produced by this second boiling is to be employed in the first stage of tanning hides after they come from the beam; and afterwards the decoction first produced is to be employed. The skins and hides having undergone the before-mentioned processes, add as much oak bark or tan liquor, or both, to the respective decoctions as is necessary to complete the tanning. The quantity of each will vary according to the strength of such decoctions; which strength will depend on the age and size of the tr ., and other circumstances.

Sheep-skins. — Sheep-skins used for purposes such as gloves and book-covers, and which, when dyed, are converted into mock-morocco leather, are dressed as follows;—They are first to be soaked in water and handled, to separate all impurities, which may be scraped off by a blunt knife on a beam. They are then to be hung up in a close warm room to putrefy. This putrefaction loosens the wool, and causes the exudation of an oily and slimy matter, all which are to be removed by the knife. The skins are now to be steeped in milk of lime, to harden and thicken; here they remain for a month or six weeks, according to circumstances, and, when taken out,

they are to be smoothed on the fleshy side by a sharp knife. They are now to be steeped in a bath of bran and water, where they undergo a partial fermentation, and become thinner in their substance. The skins, now called pelts, are to be immersed in a solution of alum and common salt in water, in the proportion of 120 skins to 3 lbs. of alum and 5 lbs. of salt. They are to be much agitated in this compound saline bath, in order to become firm and tough. From this bath they are to be removed to another, composed of bran and water, where they remain until they become quite pliant, by a slight fermentation. To give their upper surfaces a gloss, they are to be trodden in a wooden tub, with a solution of yolks of eggs in water, previously well beaten up. When this solution becomes transparent, it is a proof that the skins have absorbed the glazing matter. The pelt may now be said to be converted into leather, which is to be drained from moisture, hung upon hooks in a warm apartment to dry, and smoothed over with warm hand-irons. To prepare sheep leather for various elegant purposes, by drying; the skins, after being taken from the lime bath, are to be immersed in another, composed of dog and pigeon dung dissolved by agitation in water; here they remain until the lime is separated, and until the skins have attained the state of soft pliable pelt. To dye this pelt red, the skins are to be washed and sewed into bags, and stuffed with clippings and shavings of leather, or any other convenient substance, and immersed with the grain side outwards in a bath of alum and cochineal of the temperature of 170° or 180° Fahr., where they are to be agitated until they are sufficiently dyed. Each bag is now to be transferred to a sumach bath, where they receive consistency and tenacity. From this bath it is customary to remove the skins, and to plunge them into a saffron one, to improve their colour. To dye these skins black, the washed pelt is first immersed in the sumach bath, and then to be rubbed over on the grained side by a stiff brush dipped in a solution of acetate, or pyrolignite of iron. To give these skins the grain and polish of morocco leather, they are first oiled and then rubbed on a firm board by a convex piece of solid glass, to which a handle is attached. The leather being now rendered more compact, is rubbed or pressed hard by a sharply-grooved boxwood instrument, shaped like the glass one just described. Lamb and kid skins are dressed, tanned, and dyed in a similar manner.

Morocco Leather. — Goat or sheep skins are to be cleansed, have their hair removed, and to be limed as in the before-mentioned processes. They are then to undergo a partial fermentation by a bath of bran and water, and afterwards to be immersed in another bath of white figs and water, where they are to remain for five or six days. It is now necessary to dip them in a solution of salt and water, to fit them for dyeing. To communicate a red colour, the alum and cochineal bath is to be used for sheep-skins; for black, sumach and iron liquor, as before; and for yellow, the bath is to be composed of alum and the pomegranate bark. The tanning, dressing, and graining are the same as for sheep-skins.

Russia Leather. — Calf-skins being steeped in a weak bath of carbonate of potass and water, are well cleaned and scraped, to have the hair and dirt removed. They are now immersed in another bath, containing dog and pigeon's dung in water. Being thus freed from the alkali, they are thrown into a mixture of oatmeal and water, to undergo a slight fermentation. To tan these hides it is necessary to use birch bark instead of oak bark; and during the operation they are to be frequently handled or agitated. When tanned and perfectly dry, they are made pliable by oil and much friction; they are then rubbed over gently with birch tar, which gives them that agreeable odour peculiar to this kind of leather, and which secures them against the attacks of moths and worms. This odour the leather will preserve for many years; and on account of it Russia leather is much used in binding books. The marks or intersecting lines on this leather are given to it by passing over its grained surface a heavy iron

cylinder, bound round by wires. To dye this leather of a black colour, it is to be rubbed over, after tanning, with a solution of acetate, or pyrolignite of iron; to dye it red, alum and Brazil wood are used.

Another Russia Leather.—Deer and goat skins are cleaned and dressed in the same manner as sheep-skins, and then put into a bath of bran in a state of fermentation with water, for three days. Each skin is then put into a wooden tray, where, being spread out, it receives a portion of a liquor composed of honey and water. When the skin has combined with this liquid, it is immersed in very salt brine for a short time, and is then dried. To dye it red, it is to be made up in bags, and dipped in a bath of cochineal water and alkali; it is now to be immersed in a solution of alum, and then tanned with sumach. To give this leather a brilliant and more lasting red, it is dipped in an infusion or decoction of galls, instead of sumach. When to be dyed yellow, the berries of buckthorn or the flowers of wild camomile are used. The graining of this leather is given by an iron instrument of great weight, having a number of blunt points.

Tanning Nets.—Put 1 cwt. of oak branches, and 1 cwt. of spent bark, from any tannery, into 100 galls. of water, and so in proportion for a greater or less quantity. After boiling the same till reduced to about 80 galls., take the branches and spent bark from the copper, and then immerse as many nets, sails, or other articles, as are required, into the liquor left in the copper, taking care that they are completely covered. Boil the whole together for about three hours, then remove the fire, and allow the liquor to get cool; after which remove the nets, sails, or other articles from the furnace, and hang them to dry.

Tanning Sheep or other Skins with the Wool on.—All fragments of flesh must be scrupulously removed with a knife, taking care not to cut or bruise the inner skin; then dry with towels, and lay the skin on a flat board or slab. With hot water, soft-soap, and a hard brush, thoroughly scrub the inside of the skin. Crush and mix together 2 oz. of salts of tartar and 1 oz. of ammonia, which sprinkle on the skin while you scrub it. This will free it from grease. After well scrubbing the skin, rub it well with dry saw-dust, and in a few hours it will be ready for the tanning pickle. This preparation consists of 1 lb. of fine oatmeal, 8 oz. of corrosive sublimate, 4 oz. of saltpetre, and 1 gall. of vinegar. Boil the vinegar, and pour it over the solid ingredients, stirring the whole briskly while in the act of pouring. Let the solution get quite cold, and then immerse the skin, which may be allowed to remain and soak for at least two days. Then take it out, and strain it tightly over a stretcher till it is quite dry. During the process of drying, comb and smooth the wool or hair. In the course of a week the skin will be ready for use.

Preserving Small Skins.—They are first cleaned and scraped; they are then rubbed over with arsenical soap, prepared thus;—To 4 lbs. of white curd soap add 1 lb. of arsenic and 1 oz. of camphor; cut the soap into thin slices, and dissolve it in 1 pint of water. When melted, add the arsenic and camphor, stirring them well together, and boil again until a thick paste is attained, and pour it into jars while hot. When cold, tie it up carefully with bladder, and it will retain its qualities for years.

Discolouration of Leather.—In the process of tanning, leather is made to take up tannic and gallic acids; these combine with iron, derived from the metallic surfaces of the press, and form tannate and gallate of iron, both of them black, hence the stained leather. This discolouration may be prevented by not allowing the iron surfaces to come in contact with the wet leather. Brass moulds would not be open to the same objection.

Tanning Sole Leather.—Wash the hide in running water to cleanse from blood and dirt. Then immerse in milk of lime for about a week, removing the hide gradually from a weak to a strong solution. The lime kills the grease, and loosens the hair and epidermis. Place the hide on a convex beam, and scrape off the hair with

a blunt two-handled concave knife. Next remove all flesh that may be left on the hide in flaying, by cutting off with a sharp two-handled convex knife. Wash the hide in clean water, and it is ready for tanning. The bellies and head are mostly trimmed off, and tanned for insole, the butt only being fit for sole leather. The tanning liquor is made by pumping water upon ground bark, in large piles and letting it stand until it has dissolved the tannic acid out of these materials. The hide is then immersed in this liquor, and gradually removed to pits containing stronger and stronger liquors, until the tannic acid has penetrated through it. It is then removed to other pits called layers, where the hides are placed flat on each other, with layers of ground bark between, and the pit filled up with strong liquor. After they have been there some months the process of tanning is finished. It is then struck or smoothed on the grain side with a blunt three-cornered knife, rolled with a heavy roller, and dried.

Preparing Skins.—Any skin can be made white and the coat preserved by taking a blunt knife and scraping the skin on a piece of circular wood, so as to get off as much of the flesh and fat as possible; then make a solution of alum, salt, and water, 4 salt to 1 of alum, as much as the water will contain. Dissolve the alum in hot water, when cold immerse the skin in it, and in about 48 hours the skins will be cured. Wash in a weak solution of soda and water, to carry off any fat that may remain. If for sheep, or other skins that are thicker, a longer time will be required.

DYEING LEATHER.—*Blue.*—1. Steep the leather for a day in urine and indigo, then boil it with alum; or it may be given by tempering the indigo with red wine, and washing the skins therewith. 2. Boil elder-berries, or dwarf elder, then smear and wash the skins therewith, and wring them out; then boil the berries as before in a solution of alum water, and wet the skins in the same manner, once or twice; dry them, and they will be very blue.

Red.—Wash the skins, and lay them 2 hours in galls; then wring them out, and dip them in a liquor made with privet-berries, alum, and verdigris in water; and lastly in a dye made of Brazil wood boiled with ley.

Purple.—Wet the skins with a solution of roche alum in warm water, and when dry again rub them, with the hand, with a decoction of logwood in cold water.

Green.—Smear the skin with sap-green and alum water boiled.

Dark Green.—Steel filings and sal ammoniac, steeped in urine till soft, then smeared over the skin, which is to be dried in the shade.

Yellow.—Smear the skin over with aloes and linseed oil, dissolved and strained, or infuse it in weld.

Light Orange.—Smear with fustic-berries, boiled in alum water; or, for a deep orange, with turmeric.

Sky-colour.—Indigo steeped in boiling water, and the next morning warmed and smeared over the skin.

Chamois Leather.—Generally made from sheep or doe skin. After dressing and liming, oil well on the grain side, beat for several hours in a fulling mill, air, oil, and full twice again, or oftener if necessary. Ferment or heat in a warm room, and scour in a weak alkaline ley to remove superfluous oil. Rinse in clean water, wring, and finish with a stretcher iron.

Tawed Leather.—Soak and scrape the skins, and hang in a warm room until the odour of ammonia is given off, when the air or wool may be readily removed. Soak for several weeks in water and quicklime, which must be changed several times during that period. Beam, smooth, and trim the skins again, wash and soak in a vat containing bran and water, where they must gently ferment for some weeks. Remove, and place in a warm solution of alum and salt, in which they must be well worked about. Again ferment in bran and water, then remove, drain, stretch on hooks, and hang to dry in a warmed room. Place in water to soak again, and then thoroughly work about in a mixture of the yolks of eggs beaten to a froth in

water; stretch and hang to dry, smooth with a warm iron. To shorten this process, after the first soaking in bran and water, the skins may be soaked in part of the following mixture largely diluted with water;—Dissolve 8 lbs. alum, and 3½ lbs. common salt, in sufficient boiling water, add 21 lbs. wheat flour, and yolks of 100 eggs, make the whole into a paste.

Tannic Acid.—Make an infusion of galls, precipitate with a concentrated solution of carbonate of potassa, avoid adding an excess of this solution. Wash the precipitate in very cold water, dissolve it with dilute acetic acid, filter the solution, precipitate with acetate of lead, wash the precipitate with water; suspend it in water, and decompose by a stream of sulphuretted hydrogen; evaporate the filtered liquid in vacuo, or over sulphuric acid.

Dressing Furs and Skins.—If the skin has been already dried, soak it in clean, and if possible running, water for 24 hours, working it with the hands repeatedly during that time, until it becomes quite soft. Remove any small pieces of flesh or fat which may have adhered to the skin, and in the case of full-sized tiger-skins, which are very thick and stiff behind the neck, pare or scrape them down until reasonably thin, but with smaller skins this is unnecessary. If the skin is fresh, and has not been dried, it need only be washed to remove any dust or dirt. Skins which have been tanned without being previously dried always turn out the softest. Now prepare the following mixture, the quantities given are sufficient for a small tiger-skin, and must be proportionately increased or diminished for different sized skins;—Alum, very finely powdered, 5 lbs.; salt, well powdered, 2 lbs.; coarse wheat meal, 2 lbs. Mix the above in a large stoneware basin or wooden bucket, and add gradually sufficient sour milk or sour butter-milk to bring it to the consistency of cream. Having previously allowed the soaked skin to drain until most of the moisture has evaporated, lay it on a firm table, with the hair underneath, and taking some of the above mixture, rub it thoroughly into every part of the flesh side of the skin, using as much force with the hands as possible, so as to drive the mixture into the pores of the skin. Much of the success of the operation depends upon giving the skin as much rubbing and handling as possible. When it will absorb no more, cover it with a layer of the composition about ¼th of an inch thick, fold it up with the flesh surfaces together, and the hair outside, and lay it aside in a cool place. The mixture is only to be put on the flesh side, not on the hair. Next day open out the skin, add more of the mixture, rub thoroughly, and fold up as before. Repeat daily for two days more. Now wash the skin thoroughly in clean water, removing all the composition, hang up to drain, and when half dry rub in a fresh supply of the mixture, and repeat the rubbing daily, adding more of the composition when necessary. In 5 days from the first washing wash again, apply fresh mixture, and rub once daily for 7 or 8 days more, making in all about 17 days. This should be ample for a full-sized tiger-skin, if the rubbing has been well performed, and, indeed, the greater part of the skin would be found to be tanned by the 12th or 14th day, but the skin of the neck and head, even when it has been pared down, is still very hard and tough, and is but slowly acted upon by the tanning mixture. For smaller skins 8 or 10 days will be found sufficient, according to the amount of rubbing. When tanned sufficiently, wash thoroughly in clean water repeatedly changed, or, what is preferable, in a running stream. This washing must be thoroughly done, because if any of the salt of the mixture is left in the skin it will absorb the damp on every gloomy day. Now take a strong solution of plain alum without salt, and after the skin has drained lay it out on a flat surface, exposed to the sun if possible. Apply the alum solution to the flesh side, and let it dry. The skin will now be found as hard as a board. Roll it up into a tight roll, fur outside; take a

mallet and beat it thoroughly until it is less stiff. Open it out, and stretch it as follows;—Get any blunt instrument with a rounded edge, a large shoemaker's rasp does excellently, and, laying the skin on the floor, proceed to work it from the centre to the sides with the blunt end of the tool, steadying the skin by placing the foot on it, using the tool with the right hand, and holding the skin with the left. When ...roughly worked all over, smooth with pumice-stone, and it is finished. The more the skin is worked the softer it will be.

PRESERVATION OF LEATHER.—The extreme heat to which most people expose boots and shoes during winter deprives leather of its vitality, rendering it liable to break and crack. Patent leather particularly is often destroyed in this manner. When leather becomes so warm as to give off the smell of leather, it is singed. Next to the singeing caused by fire heat, is the heat and dampness caused by the covering of rubber. Close rubber shoes destroy the life of leather. The practice of washing harness in warm water and with soap is very damaging. If a coat of oil is put on immediately after washing, the damage is repaired. No harness is ever so soiled that a damp sponge will not remove the dirt; even when the sponge is applied, it is useful to add a slight coat of oil by the use of ...nother sponge. All varnishes and all blacking containing the properties of varnish should be avoided. When harness loses its lustre and turns brown, which almost any leather will do after long exposure to the air, the harness should be given a new coat of grain black. Before using this grain black, the grain surface should be thoroughly washed with potash water until all the grease is killed, and after the application of the grain black, oil and tallow should be applied to the surface. This will not only fasten the colour, but make the leather flexible. Harness which is grained can be cleaned with kerosene or spirits of turpentine, and no harm will result if the parts affected are washed and oiled immediately afterward. Vitriol blacking for boots is generally used until every particle of the oil in the leather is destroyed. To remedy this, the leather should be washed once a month with warm water, and when about half dry, a coat of oil and tallow, or, best of all, castor oil, should be applied, and the boots set aside for a day or two. This will renew the elasticity and life in the leather, and when thus used upper leather will seldom crack or break. When oil is applied to belting dry, it does not spread uniformly, and does not incorporate itself with the fibre, as when partly damped with water. The best way to oil a belt is to take it from the pulleys, and immerse it in a warm solution of tallow and oil. After allowing it to remain a few moments, the belt should be immersed in water heated to 100°, and instantly removed. This will drive the oil and tallow all in, and at the same time properly temper the leather.

Harness Polish.—4 oz. glue, 1½ pint vinegar, 2 oz. gum arabic, ½ pint black ink, 2 drams isinglass. Break the glue in pieces, put it in a basin, and pour over it about a pint of the vinegar; let it stand until it becomes soft. Put the gum in another vessel, with the ink, till it is perfectly dissolved; melt the isinglass in as much water as will cover it, which may be easily done by placing the cup containing it near the fire about an hour before you want to use it. To mix them, pour the remaining vinegar with the softened glue into a saucepan upon a gentle fire, stirring it till it is perfectly dissolved, that it may not burn to the bottom, being careful not to let it reach the boiling point—about 180° Fahr. is the best heat. Next add the gum, let it arrive at about the same heat again; add the isinglass. Take from the fire, and pour it off for use. To use it, put as much as is required in a saucer; heat it sufficiently to make it fluid, and apply a thin coat with a piece of dry sponge; if the article is dried quickly, either in the sun or by the fire, it will have the better polish. This answers equally well for boots or shoes.

Waterproof Harness Paste.—Put into a glazed pipkin 2 oz. of black resin;

place it on a gentle fire. When melted, add 3 oz. of beeswax; when this is melted take it from the fire—add ½ oz. of fine lamp black, and ½ a dram of Prussian blue in fine powder. Stir them so as to be perfectly mixed, then add sufficient spirits of turpentine to form a thin paste; let it cool. To use it, apply a coat, with a piece of linen rag, pretty evenly all over the harness; then take a soft polishing brush, and just brush it over, so as to obtain a bright surface.

Boot-top Liquid.—1. Dissolve in a quart of water 1 oz. of oxalic acid, and the same of white vitriol, with which sponge the leather, previously washed with water, then wash off the composition with water, and dry. This is for white tops. For brown mix 1 oz. of oxalic acid, 1 oz. of spirits of salts, a scruple of cochineal bruised, and a pint of boiling water, and use as before. These mixtures should be labelled poison. Also, for brown tops, mix with a pint of skimmed milk, ½ oz. of spirits of salts, ½ oz. spirits of red lavender, 1 oz. of gum arabic dissolved in water, and the juice of two lemons. Keep the mixture closely corked, sponge the tops when dry, and polish with a brush. 2. White—Alum, cream of tartar, magnesia, and oxalic acid, of each 1 oz.; salt of sorrel and sugar of lead, of each ½ oz.; water, 1 quart. Mix. Brown—Alum, annato, and oxalic acid, of each 1 oz.; isinglass and sugar of lead, of each ½ oz.; salt of sorrel, ½ oz.; water, 1 quart. Boil for 10 minutes.

Driving Belts.—Fat should be applied to belts once every three months. They should be first washed with lukewarm water, and then have leather-grease well rubbed in. A good leather-grease may be made from fish-oil, 4 parts; lard or tallow, 1; colophonium, 1; wood-tar, 1.

Varnish for Boots and Shoes.—1. Take a pint of linseed oil, with ½ lb. of mutton suet, the same quantity of beeswax, and a small piece of resin. Boil all this in a pipkin together, and use it when milk-warm with a hair brush; two applications will make the articles waterproof. 2. Common tar made warm, and brushed over the soles of boots or shoes; these are to be put near the fire, that the tar may be absorbed. When this is the case, a second, and afterwards a third may be used with advantage. This is not applicable to the upper leathers, though it makes the soles very much more durable, and impervious to moisture. 3. India-rubber varnish is a valuable article to anoint the upper leather of boots and shoes. It covers them with a resisting varnish; but the lower parts subject to wear from contact with the ground are little benefited by its application.

Cleaning Harness, or Saddles and Bridles.—If harness, wash it perfectly clean with warm water and soft-soap, and when dry, apply neat's-foot oil and black dye, mixed; mix them by adding a small quantity of salts of wormwood, when they will be well blacked and pliable. Then apply on the top of the straps Wrigley's composition. At the same time, by applying the oil and dye to the bottom or under parts of the straps, and composition to the top, they will always be pliable, and have a good polish on the top. If a riding saddle, wash in cold water and soft-soap until free from dirt; then apply soft-soap with a woollen cloth—about two table-spoonfuls would be enough for a saddle—which will dry in. If the saddle is to have a yellow appearance, infuse a penny-worth of hay saffron in about four or five table-spoonfuls of water, and apply before the soft-soap; then rub on to a piece of woollen cloth, or a brush, a piece of beeswax, and finish the saddle off with it, rubbing till a good polish is obtained.

Blacking for Harness.—1. Treacle, ½ lb., lampblack, 1 oz.; yeast, a spoonful; sugar-candy, olive oil, gum tragacanth, and isinglass, each 1 oz.; and a cow's gall. Mix with two pints of stale beer, and let it stand before the fire for an hour. 2. Treacle, 8 parts; lamp-black, 1; sweet oil, 1; gum arabic, 1; isinglass, 1; water, 32. Apply heat to the whole; when cold, add 1 oz. spirits of wine, and apply with sponge. If it should get hard, place the bottle in warm water a short time.

Harness Composition.—Put into a glazed pipkin 2 oz. of black resin; place

it on a gentle fire; when melted, add 3 oz. of beeswax. When this is melted, take it from the fire, add ½ oz. of fine lampblack, and ½ dr. of Prussian blue in fine powder; stir them so as to be perfectly mixed, and add sufficient spirits of turpentine to form a thin paste; let it cool. To use it, apply a coat with a piece of linen rag pretty evenly all over the harness; then take a soft polishing brush and brush it over, so as to obtain a bright surface.

To Preserve Leather Driving-bands and Leather Water-hose.—Old leather can be partially renovated by being impregnated with castor oil, and new leather can be preserved by the same means for a very much longer time than by any process heretofore in use. Old boots can be rendered soft and pliable by its application, and, unlike other oily applications, castor oil does not prevent the polish from blackening. Leather hose and driving belts for machinery treated with castor oil have been found to last years longer than ordinarily. Belts impregnated with castor oil will not slip, and a belt 3 inches wide, treated with castor oil, will perform the part of a belt 4½ inches wide on which the oil has not been used, and where the latter would last only from 3 to 5 years the former would last 10. Old fire-hose may be treated with castor oil, and rendered as soft as new. An additional recommendation to castor oil as a preservative of leather is that rats dislike it exceedingly.

Piecing Leather Straps without Laces.—Dissolve best gutta-percha in bisulphide of carbon till it attains the consistency of thick glue; it will give a cement that will do excellently for straps, provided they are not subjected to such friction as will make them warm. The piecing must be nicely spliced, and made so thin at the ends that it will not catch in working; then spread as much of the cement on as will cover; allow it to stand 2 or 3 minutes, then warm the splicing over a fire, lay them together, and hammer or otherwise press them well. In a few minutes the piecing will be so firm as to withstand the efforts of two or three men to pull it asunder.

Softening Leather.—Mix 1 pint of boiled linseed oil, 2 oz. of beeswax, 1 oz. of Burgundy pitch, 2 oz. of turpentine, and melt them together over a slow fire. The mixture should be well rubbed into the leather on both sides, but principally on the flesh side.

Fastening Emery to Leather.—Boil glue very thin, add a little milk, raise the pile of the leather, and put on the glue with a brush, afterwards sprinkle on the emery, and let it cool.

Cleaning Buff-coloured Leather.—One oz. oxalic acid dissolved in 1 pint water. Wash well, and then rub in a little clean tallow.

Boot and Shoe Making.—First get patterns. Some leather-sellers will cut the shoe or boot out if you take a last; but the surest way is to take an old shoe or boot to pieces. Get one the pattern and size required, put the pieces in water to soften them, open them out, and lay them on thick paper, and cut pieces of paper the size of the leather, tack these pieces of leather together with small steel tacks, or fasten them with paste, that made with rye flour is best; then close or stitch them together, holding them between the knees with clamps. Next get the last the size of the shoe. Procure some insole leather, soak in water, place the last on the smooth side, mark the leather round the size of the last; then cut the pieces off exactly by the mark, place the smooth side on the last, tack on with 3 or 4 tacks, press it close to the last, and while wet trim the insole close to the last all round. The shape of the shoe depends on this. Trim the rough off the bottom of the insole. Some shoemakers make two slight nicks round the insole, one about ¼ of an inch from the edge, the other about ½ an inch. Putting the awl in at one and out at the other of these nicks, it will sew more level, and the stitches are not so liable to break their hold of the leather. Next place the top level and straight on the last, get the pliers, and pull tight over the toe; drive a tack in the centre of the toe,

and one in the heel. Shoemakers generally push some bits of leather betwixt the last and the top leather on the instep, according to the size of the foot round the instep. Next, tack the top all round, then get a piece of top leather about an inch broad that will reach round the heel. Then place the heel of the shoe towards you, holding it on the knee with a strap, which goes under your foot and over the shoe. Sew round the heel first, put the awl in at the insole, but not too deep; sew the narrow piece round the heel, leaving enough to turn over; this done, take a bit off the edge of the welt, and sew round the shoe, putting from 4 to 5 stitches to the inch; keep the welt level while sewing. Get a stick, make it flat at one end, work it round the shoe between the top and the welt; trim the welt round level, cut the leather level round the heel, turn the narrow piece of top leather over, and fasten down with a few stitches. Place the shoe on the rough side of the bottom leather, mark round, and cut off. Then put a piece of inferior leather to finish up the heel, hammer the bottom soles, fill up the middle with small bits, put on the sole, and tack down. Next stitch the sole on; place the awl through the welt, holding the shoe so as to stitch towards you; place the heel on, put the awl between the top and the narrow piece that is turned over and through the heel pieces; these being sewn on, get the sharp end of the hammer, and hammer round the edge of the sole, and welt while they are wet; this will make the edge better to finish. Trim the edges round when dry, being careful not to cut the top leather; scrape round and put ink on, let the ink dry, put the heel-ball on, and heat the iron hot enough to melt the ball, but not to burn the leather; rub up with a bit of old cloth. If required to make the bottom smooth, and put a polish on, cut a nick in the bottom sole to let the stitches in, then scrape the bottom, and file it and rub with sand-paper.

To Skin and Stuff Birds.—1. Suspend the body by a hook, so that both hands are at liberty. For small kinds a common fish-hook will answer, with the barb broken off, and a cord attached a foot or two in length. This may be inserted among the bones near the tail after the skin has been partly detached. Other implements required are the following;—A sharp knife, or almost any shape; but a surgeon's scalpel without a jointed handle is the best for small kinds, and the common butcher's knife which is of similar shape, for large ones. Strong, sharp-pointed scissors, and for large skins a pair of shears is often useful. Triangular glovers' needles for sewing up skins; two or three sizes. A pair of spring forceps, such as are used by surgeons, though not essential, are very useful. A tape measure, 3 to 6 feet long. A fine saw, or coarse flat file, to notch small bones before breaking them, so as to make them break evenly, or sharp-edged nippers. Large bones may be broken roughly, and the ends smoothed off. When a bird is shot all large holes must be plugged with cotton or paper, and this also inserted in the mouth and throat, so as to prevent the flow of blood or other fluids. Blood on the feathers may be absorbed by sprinkling with plaster of Paris, ashes, dust, or sand, shaking off all that does not stick; then make a cone of paper, large enough to put the bird in, head down, and to twist up the other end over it, taking care not to injure the tail feathers. This will secure smoothness of the feathers when the body stiffens. In cool weather it is best to postpone skinning for 12 to 24 hours, in order to allow the blood to coagulate, so that it will not flow so freely, and the fat hardening also gives less trouble. Obtain its exact girth, so that it can be stuffed out to the same dimensions afterwards. Before skinning, put fresh plugs in the mouth, nostrils, and large shot-holes. Take the measurements and notes required. Then make an incision from the breast-bone down to the tail, not so deep as to open the intestinal cavity, and carefully separate the skin on each side, plugging or sewing up any holes accidentally cut too deep. If blood or fluids

run too freely, absorb them by some dry ashes, plaster, or paper, and use them so as to protect the feathers; if necessary keep the fingers well powdered. Separating the skin from one side, the leg is soon reached; this must be drawn out by the knee-joint as far as it can be, and the tendons cut where they go towards the foot. Break off the bone within the skin, and having freed that leg treat the other in the same way. It is most convenient in small birds to break these bones, and also those of the upper wing-joint, before beginning to skin, thus having the limbs less in the way. After the legs are freed, cut down to the tail, and separate from the body, leaving some of the vertebræ attached to support the feathers. Remove the oil-glands above the tail carefully from the skin, then insert the hook in the body and hang it up, head downwards. The skin is then easily peeled off until the wings are reached, when it must be drawn to one side until the broken end of the shoulder-bones are reached, which may be slipped through the muscles, and pulled out as far as possible. The muscles must then be cut off, and this wing being freed, the same process is used for the other. The skin then slips off easily so far as the head, which if large must be supported, so that its weight may not stretch the neck. In drawing the skin over the head be careful not to tear it, and use the finger-nails more than the knife. The ear membranes are easily drawn out with it, and on reaching the eyes the attachment of the lids must be carefully separated from the eyeball, cutting so as to injure neither the lids nor the eyeball, as the fluids escaping give trouble. Then cut off the back part of the skull, remove the brains and the eyes, clean away all remains from the skull, and sprinkle or smear the skin with arsenic, fill the eye-sockets and other cavities about the head with cotton or other stuffing, and draw the skin back to its original shape. If the neck has dried during the operation, it will need moistening before retraction. The second joints of the wings now require cleaning. This may be done in small birds by carefully drawing the skin down over the bones, loosening it with the finger-nails. Large birds, however, need an incision under the wing, reaching the whole length of the joint, which may be sewed up afterwards by a few stitches. Arsenic must be applied freely to all these parts. The wing-bones must now be connected by a string passed through the space between the bones, or a thread sewed through the ligaments so that it cannot slip. Do not draw the wings too close together, but leave as nearly the natural distance between them as is practicable. Cotton or tow may be now wound round the broken ends of the wing and leg bones, a roll of it inserted in the neck, and enough put in the body to fill it out to its natural shape. When the legs are tied together no stitches are generally necessary to sew up the cut. If there are large holes in the skin they should be sewed up from the inside before putting in the stuffing. In large birds it is well to sew on wide strips of rag along the inner edges of the cut made in the skin, to protect the feathers during the operation of skinning, removing the rags afterwards. Very badly-soiled skins can, however, be cleaned, and, provided they have not lost any feathers, are still useful. The bill should generally be tied shut by a string passed through the nostrils, and the label may be put there or on the legs. Very long necks are best stuffed by rolling up a long cylinder of paper and passing it down the throat or from the inside. The neck may then be bent down along the side of the body, and the legs bent up so as to make as compact a specimen as possible. Having smoothed down the feathers, the bird must now be pushed carefully inside a cylinder of stiff paper of the proper size, and laid on its back to dry. Hanging it up by the bill or feet stretches it too much. If carefully dried it retains a good shape, and may be freely handled afterwards. Some birds, especially ducks and woodpeckers, have the neck so slender that the head cannot be drawn through it by skinning in the usual manner. In these an incision must be made on the most injured side, from the ear down far enough to allow the head to be cleaned through it. The

body may then be skinned as usual, or the incision may be continued down the neck to the bare space under the wing, and the skin taken off without cutting it elsewhere. To sew this up requires care in order to adjust the feathers nicely, and the stitches must be taken from within outwards. There is much difference in the ease with which a bird may be skinned, according to the relative toughness of skin, and adhesion of feathers. A humming-bird is more easily skinned than a pigeon, and those of the size of a robin take much less time than an eagle. To practise on, the best are blackbirds and jays, those not too fat being preferable.

2. A very small proportion of the skull-bone, say from the fore part of the eye to the bill, is to be left in, as well as part of the wing-bones, the jaw-bones, and half of the thigh-bones. Everything else, flesh, fat, eyes, bones, brains, and tendons, are all to be taken away. In taking off the skin from the body it will be well to try to shove in lieu of pulling it, to avoid stretching it. Throughout the whole operation, as fast as you detach the skin from the body, put cotton immediately betwixt the body and it; this will prevent the plumage getting dirty. Have close by a little bottle of corrosive sublimate, also a little stick and a handful or two of cotton. Now fill the mouth and nostrils with cotton, and place it on your knee on its back, with its head pointed to your left shoulder. Take hold of the knife with the two first fingers and thumb, the edge upward; do not keep the point of the knife perpendicular to the body of the bird, because it would cut the inner skin of the belly, and let the bowels out. To avoid this let the knife be parallel to the body. Begin on the belly below the breast-bone and cut down the middle, quite to the vent. This done, put the bird in any convenient position, and separate the skin from the body, till you get at the middle joint of the thigh. Cut it through, and introduce cotton all the way on that side, from the vent to the breast-bone. Do exactly the same on the opposite side. Now place the bird perpendicular, its breast resting on your knee, with its back towards you. Separate the skin from the body on each side of the vent, and never mind at present the part at the vent to the root of the tail. Bend the tail gently down to the back, and while your finger and thumb are keeping down the detached parts of the skin on each side of the vent, cut quite across and deep, until you see the back bone near the oil-gland at the root of the tail. Sever the back-bone at the joint, and then you have all the root of the tail, together with the oil-gland, dissected from the body. Apply plenty of cotton. Get the skin pushed up until you come to where the wing-joints join the body. Apply cotton, and then cut this joint through, and do the same at the other wing; add cotton, and gently push the skin over the head, cut out the roots of the ears, and continue skinning till you reach the middle of the eye; cut the membrane quite through, otherwise you would tear the orbit of the eye. After this nothing difficult intervenes before arriving at the root of the bill; when this is effected cut away the body, leaving just a little bit of the skull; clean well the jaw-bones, and touch the skull and corresponding parts with the solution. Now all that remains to be removed is the flesh on the middle joints of the wings, one bone of the thighs, and the fleshy root of the tail. Fasten thread to the joints of each wing, and then tie them together, leaving exactly the same space betwixt them as existed there when the bird was entire; hold the skin open with your finger and thumb, and apply the solution to every part of the inside. Neglect the head and neck at present. Fill the body moderately with wool to prevent the feathers on the belly from being injured. Half of the thigh, or in other words one joint of the thigh-bone, has been cut away. As this bone never moved perpendicularly to the body, but in an oblique direction, of course as soon as it is cut off, the remaining parts of the thigh and leg, having nothing to support them obliquely, must naturally fall to their perpendicular. Hence the legs

appear considerably too long. To correct this take a needle and thread, fasten the ends round the bone inside, push the skin just opposite to it, and then tack up the thigh under the wings with several strong stitches. This will shorten the thigh, and render it quite capable of supporting the body without the aid of wire. Now put in the cotton for an artificial body, by means of the little stick, and then sew up the orifice you originally made in the belly, beginning at the vent. Lastly, dip your stick into the solution, and put it down the throat three or four times, in order that every part may receive it. When the head and neck are filled with cotton close the bill as in nature. Bring the feet together by a pin, and then run a thread through the knees, by which draw them to each other as near as may be thought proper. Add the eyes; adjust the orbit to them as in nature, and that requires no other fastener. After this, touch the bill, orbit, feet, and former oil-gland at the root of the tail, with the solution. Procure a common box, fill one end of it, about three-fourths up to the top, with cotton, forming a sloping plane. Make a moderate hollow, and place the bird in its right position. If it is wished to elevate the wings, do so, and support them with cotton. If desired to have the tail expanded, reverse the order of the feathers, beginning from the two middle ones, and when dry place them in their true order, and the tail will preserve the expansion given to it. In three or four days the feet lose their natural elasticity, and the knees begin to stiffen. This is the time to give the legs any desired angle, and to arrange the toes. When the bird is quite dry, pull the thread out of the knees, and take away the needle, and all is done.

3. Previous to skinning take a piece of wire of suitable thickness, and measure from the centre of bill to tip of toes; have the wire twice that length, and double it in two, and point the double end with a hammer; do not separate them; point the other ends with a file. Having put in the eyes, and twisted some cotton on leg-bones, and filled up the aperture in skull with a piece of cork, thrust the double end of the wire through the cork, and let it enter the base of the beak; twist some cotton or tow round the wire to the same thickness and length as neck; then separate and form a shoulder on each wire, roll up some tow same size and shape as the bird's body, and twist some thread round it; thrust the wires through the tow body, one at each side; carefully turn the skin over your artificial body, in doing so place the wing-bones in their right place; pass the wires through the back of the legs, but inside the skin, add a little tow if required, sew up the aperture, and fix on stand by the wires; form a piece of wire into same shape as a hairpin, and pass under and through tail into the body to keep tail up; tie the bill with a piece of thread till it sets; give the bird the natural set, fix the wings in the right position, and pass a thread with a long needle through the body and last joints of wings and tie, not too tight, and tie tips of same at tail. Pay particular attention to the eyes, replace stray feathers with a needle, and brush down with a camel-hair brush.

Preservative for Bird-skins.—Ground alum, 4 parts; pepper and saltpetre, 1.

Lubricants.—The friction of the parts in machinery frequently absorbs a large percentage of the power employed. Various lubricating materials are used to reduce this source of waste. When polished steel moves on steel, or pewter properly oiled, the friction is about one-fourth of its weight; on copper or lead, one-fifth; on brass, one-sixth. Metals have more friction when they move on metals of the same kind than when on different metals. In wood rubbing upon wood, oil, grease, or black-lead, properly applied, reduces the friction two-thirds. Lard, oil, tallow, soap, black-lead, French chalk, and combinations of these substances, are used in different trades.

Antifriction Grease.—1. One part of fine black-lead, ground perfectly smooth, with 4 parts of lard. 2. Dissolve about

50 lbs. of soda in 3 or 4 gallons of boiling water, then melt in a copper about 1¼ cwt. of tallow or palm oil; after it has cooled a little pour in gradually the soda, stirring it all the while till it cools. 3. For cooling necks of shafts, which may occasionally be found useful where the shafts are not of a proper length, or the bearings faulty; 16 lbs. tallow, dissolved in a vessel; 2¼ lbs. white sugar of lead. When the tallow is melted, but not boiling, put in the sugar of lead and let it dissolve. Then put in 3 lbs. of black antimony. Keep stirring the whole mass till cold.

Lubricating Composition for Railway Axles.—In a small boiler dissolve from 56 lbs. to 60 lbs. of soda in about 3 galls. of water. In a 60-gallon boiler, melt tallow, and to it add palm oil, each in quantity, according to season. In summer weather, tallow 1 cwt. 3 qrs.; palm oil, 1 cwt. 1 qr. In winter, tallow 1 cwt. 1 qr.; palm oil, 1 cwt. 3 qrs. In spring or autumn, tallow, 1 cwt. 2 qrs.; palm oil, 1 cwt. 2 qrs. As soon as the mixture boils, put out the fire, and let the mixture cool down gradually, frequently stirring it while cooling. When reduced to blood heat, run it off through a sieve into the solution of soda, stirring it well, to ensure a perfect mixture of the ingredients.

Anti-attrition Paste.—Lard, 2½ lbs.; camphor, 1 oz.; black-lead, ½ lb.; rub the camphor in a mortar down into a paste, with a little of the lard; then add the rest of the lard, and the black-lead, and mix thoroughly.

A good Lubricating Oil that will not thicken.—Take olive oil, and dissolve it in boiling alcohol, add it drop by drop to the hot alcohol, until it is no longer taken into solution. Upon cooling, it will let fall crystals, and leave a considerable portion still fluid; the fluid part is to be poured off, filtered through a piece of white blotting paper, and either used in this form, or the alcohol may be distilled off for fresh processes, and the pure lubricating oil which will remain can be obtained for oiling watches and delicate machinery. This will not oxidize or gum up, and will remain perfectly fluid even when exposed to great cold.

Watchmakers' Oil.—1. Take neat's-foot oil, and put into it some lead shavings in order to neutralize the acid contained in the oil; let this stand for a considerable time, the longer the better. Oil thus prepared never corrodes, or thickens. 2. Get the best olive oil, stir it up for some time with water kept at the boil, then, after separation, shake it up in a bottle with a little fresh lime, and allow them to stand for some weeks in a bottle exposed to the sunlight and air, but protected from wet and dirt. When filtered off it will be nearly colourless, perfectly limpid, and will never thicken or become rancid. 3. Procure 1 quart of olive oil, put it into a cast-iron vessel capable of holding 2 quarts, place it over a slow, clear fire, keeping a thermometer suspended in it, and when the temperature rises to 220°, check the heat, never allowing it to exceed 230°, nor descend below 212° for one hour, by which time the whole of the water and acetic acid will be evaporated; the oil is then exposed to a temperature of 30° to 36° for 2 or 3 days; then pour the oil on a muslin filter to allow the fluid portion to run through; lastly, the fluid portion must be filtered once or more through newly-prepared animal charcoal, coarsely powdered, and placed on bibulous paper in a wire frame within a funnel, by which operation rancidity is entirely removed, and the oil is rendered perfectly bright and colourless.

Belgian Antifriction Metal. — For parts exposed to much friction, 20 parts copper, 4 of tin, 0·5 of antimony, 0·25 lead. For parts subjected to great concussions, 20 parts copper, 6 zinc, 1 tin. For surfaces exposed to heat, 17 parts copper, 1 zinc, 0·5 tin, 0·25 lead. In making these alloys, mix all the other ingredients before adding the copper.

Lard Oil Refining.—Agitate the lard oil with a ley of caustic potash of specific gravity 1·2. A sufficient quantity is known to have been added when, after repose, a portion begins to settle down clear at the bottom; about 4 to 8 per cent. is usually required. After 24 hours' repose, the clear supernatant oil

is decanted from the soapy sediment and filtered; it may be thoroughly bleached by a mixture of bichromate of potassa, and sufficient hydrochloric acid to seize on all the alkali and liberate the chromic acid.

Galvanizing Iron.—Sheet iron, iron castings, and the like, are first cleaned and scoured by immersion in a bath of water, acidulated with sulphuric acid, heated in a leaden vessel, or used cold in a wooden one, to remove the oxide. The pieces are then thrown into cold water, and taken out one at a time to be scoured with sand and water with a piece of cork or the husk of the cocoa-nut, the ends of the fibres serving as a brush. The pieces are then returned to cold water. Pure zinc, covered with a thick layer of sal ammoniac is then melted in a bath, and the iron, if in sheets, is dipped several sheets at a time in a cradle or grating. The sheets are raised slowly to allow of draining, are then immediately thrown into cold water; on removal, the work is finished by wiping dry. Thick pieces are heated in a reverberatory furnace before being placed in the bath, to prevent cooling the zinc. Chains are similarly treated, and on removal from the zinc are shaken until cold to avoid soldering of the links together. Nails and small articles are dipped in muriatic acid, and dried in a reverberatory furnace; next, thrown into zinc covered with sal ammoniac, left for a minute, and taken out slowly with an iron skimmer; they come out in a mass soldered together, and to separate them are placed in a crucible surrounded with charcoal powder, then heated to redness and shaken about until cold for separation. Wire is reeled through the zinc, into which it is forced to dip by a fork or other contrivance. The zinc is melted in a crucible just a little beyond the point of fusion, and is always covered with a thick coat of sal ammoniac, for the purposes of preventing waste of zinc and preparing the metal to be covered. Wrought-iron baths welded at the angles succeed much better than cast-iron, lined with clay. By another system the sheets of iron are pickled, scoured, and cleaned just as for ordinary tinning. A large wooden bath is then half filled with a dilute solution of muriate of tin, prepared by dissolving metallic tin in concentrated muriatic acid, which takes 2 or 3 days, and 2 quarts of the saturated solution are added to 300 or 400 gallons of the water contained in the bath. Over the bottom of the bath is spread a thin layer of finely-granulated zinc, then a cleaned iron plate, and so on—a layer of finely-granulated zinc and a cleaned iron plate alternately, until the bath is full; the zinc and iron, together with the fluid, constitute a weak galvanic battery, and the tin is deposited from the solution, so as to coat the iron with a dull uniform layer of metallic tin in about 2 hours. Whilst this is being done, a wrought-iron bath, containing fluid zinc, is being prepared, the melted metal is covered with sal ammoniac, mixed with earthy matter, to lessen the volatilization of the sal ammoniac, which becomes as fluid as treacle. Two iron rollers, immersed below the surface of the zinc, are fixed to the bath, and are driven by machinery to carry the plates through the fluid metal at a determined velocity. The plates are now received one by one from the tinning bath, drained for a short time, and passed at once, still wet, through the zinc, by means of rollers; the plates thus take a regular and smooth layer of zinc, which, owing to the presence of tin beneath, assumes the natural crystalline character, giving the plates the well-known moire appearance.

Cleaning Galvanized Vessels.—The simplest plan is to scour them with a strong solution of hot water and common washing soda; but if used for hot water and soap, use best tinned vessels, or have them painted, as galvanized iron attracts soap in such a manner as to cause a deposit which is disagreeable and unsightly.

Silvering and Tinning.—*To Silver by Heat.*—1. Dissolve 1 oz. of pure silver in aquafortis, and precipitate it with common salt; to which add ½ lb. of

sal ammoniac, the same of white vitriol, and ½ oz. of corrosive sublimate. 2. Dissolve 1 oz. of pure silver in aquafortis; precipitate it with common salt, and add, after washing, 6 oz. of common salt, 3 oz. each of sandiver and white vitriol, and ½ oz. of sublimate. These are to be ground into a paste upon a fine stone with a muller; the substance to be silvered must be rubbed over with a sufficient quantity of the paste, and heated. When the silver runs, it is taken from the fire, and dipped into weak spirit of salt to clean it.

To Silver in the Cold Way.—1. 2 dr. tartar, 2 dr. common salt, ½ dr. of alum, and 20 grs. of silver, precipitated from the nitrous acid by copper. Make into a paste with a little water. This is to be rubbed on the surface to be silvered with a cork. 2. Dissolve pure silver in aquafortis, and precipitate the silver with common salt; make this precipitate into a paste by adding a little more salt and cream of tartar. It is applied as in the former method.

To Silver Copper Ingots.—The principal difficulties in plating copper ingots are, to bring the surfaces of the copper and silver into fusion at the same time, and to prevent the copper from scaling; for which purposes fluxes are used. The surface of the copper on which the silver is to be fixed must be made flat by filing, and should be left rough. The silver is first annealed, and afterwards pickled in weak spirit of salt; it is planished, and then scraped on the surface to be fitted on the copper. These prepared surfaces are anointed with a solution of borax, or strewed with fine powdered borax itself, and then confined in contact with each other by binding wire. When they are exposed to a sufficient degree of heat, the flux causes the surfaces to fuse at the same time, and when cold they are firmly united. Copper may likewise be plated by heating it, and burnishing leaf-silver upon it; so may iron and brass.

To Plate Iron.—1. Polish the surface very clean and level with a burnisher; then expose it to a blueing heat; a leaf of silver is to be properly placed and carefully burnished down. This is repeated until sufficient leaves are applied to give the silver a proper body. 2. By solder; slips of thin solder are placed between the iron and silver, with a little flux, and secured together by binding wire. Then place in a clear fire until the solder melts; when it is taken out, on cooling, it will adhere firmly. 3. By tinning the iron first, and uniting the silver by means of slips of rolled tin, brought into fusion in a gentle heat.

To Tin Copper and Brass.—Boil 6 lbs. of cream of tartar, 4 galls. of water, and 8 lbs. of grain tin or tin shavings. After the materials have boiled a sufficient time, the substance to be tinned is put therein, and the boiling continued, when the tin is precipitated in its metallic form.

To Tin Iron and Copper Vessels.—Iron which is to be tinned must be previously steeped in acid materials, such as sour whey or distillers' wash; then scoured and dipped in melted tin, having been first rubbed over with a solution of sal ammoniac. The surface of the tin is prevented from calcining by covering it with a coat of fat. Copper vessels must be well cleansed; and then a sufficient quantity of tin with sal ammoniac is put therein and brought into fusion, and the copper vessel moved about. A little resin is sometimes added. The sal ammoniac prevents the copper from scaling, and causes the tin to be fixed wh[illegible] it touches.

To Tin Brass or Copper.—1. Plates or vessels of brass or copper, boiled with a solution of stannate of potassa mixed with turnings of tin, become, in the course of a few minutes, covered with a firmly-attached layer of pure tin. 2. A similar effect is produced by boiling the articles with tin filings and caustic alkali, or cream of tartar. In the above way chemical vessels made of copper or brass may be easily and perfectly tinned.

Tinning Iron Saucepans.—If the saucepan is an old one it must be put on the fire and allowed to get nearly red hot, which will get rid of all the grease; then make a pickle of the following proportions;—Oil of vitriol, ½ lb.; muriatic acid, ¼ lb.; water, 1 gall. If the sauce-

pan can be filled so much the better, if not keep the pickle flowing over it for say 5 minutes, pour out, rinse with water, and scour well with sand or coke dust with a wisp of tow, rinse well with water; if the pan is clean it will be of an uniform grey colour, but if there are any red or black spots it must be pickled and scoured again till thoroughly clean. Have ready chloride of zinc, that is, muriatic acid in which some sheet zinc has been dissolved, some powdered sal ammoniac, some tow, about 18 inches of iron rod of about $\frac{1}{4}$ or $\frac{3}{8}$ inch thick, one end flattened out and bent up a little and filed clean, and some bar tin; dip a wisp of tow in the chloride of zinc, then into the powdered sal ammoniac, taking up a good quantity, and rub well all over the inside. This must be done directly after the scouring, for if allowed to stand it will oxidize; put on the fire till hot enough to melt the tin, the end of the bar of tin being brushed over the heated part till melted; run down about half the bar, and with the flattened end of the iron rod rub the tin well over the surface, taking care not to heat too large a surface at once, nor to let it get too hot, which may be known by the tin getting discoloured, when some dry sal ammoniac must be thrown in. Having gone all over it, wipe lightly with a wisp of tow, just made warm enough that the tin does not stick to it; when cold scour well with sand and tow, rinsing with plenty of water.

Tinning Brass Wire.—Have two baths, one containing the molten tin, kept at a proper temperature, the other a saturated solution of chloride of zinc. Immerse the coil of brass wire in a boiling solution of caustic potash, and remove it to a bobbin, having a fixed spindle and one movable end. Pass the wire by means of suitable hard wood or brass deeply-grooved pulleys, so that it shall pass through the chloride of zinc bath into the molten tin, and after immersion cause it to pass between the grooves of two pulleys, revolving in contact with each other, so that the grooves form a hole equal in size to the tinned wire; these will squeeze off any superfluous metal that may be carried up from the bath; carry forward the end and attach to it a fresh bobbin, and wind off at a speed that must be regulated by experience. The wire must be raised sufficiently in temperature before it will take the tin, and it must be properly cooled again before it reaches the final bobbin, which can be effected by placing it at a proper distance from the tin bath.

Cold Tinning.—Block tin dissolved in muriatic acid with a little mercury forms a very good amalgam for cold tinning; or, 1 part of tin, 2 of zinc, 6 of quicksilver. Mix tin and mercury together until they form a soft paste. Clean the metal to be tinned, taking care to free it from greasiness; then rub it with a piece of cloth moistened with muriatic acid, and immediately apply a little of the amalgam to the surface, rubbing it in with the same rag. The amalgam will adhere to the surface and thoroughly tin it. Cast iron, wrought iron, steel, and copper may be tinned this way. Those who find it difficult to make soft solder adhere to iron with sal ammoniac, will find no difficulty if they first tin the surfaces in this manner, and then proceed as with ordinary tin plate.

Tinning Cast and Wrought Iron Pipes.—File bright the piece of iron required to be tinned, and mix up the following solution;—In a pennyworth of spirits of salts, put a piece of zinc the size of a shilling, the spirits of salts will eat it away; wet the places required to be tinned with the solution, then while wet use a copper-bit with fine solder, and it will immediately tin.

Crystallized Tin-Plate is a variegated primrose appearance, produced upon the surface of tin-plate, by applying to it in a heated state some dilute nitro-muriatic acid for a few seconds, then washing it with water, drying, and coating it with lacquer. The figures are more or less diversified, according to the degree of heat, and relative dilution of the acid. Place the tin-plate, slightly heated, over a tub of water, and rub its surface with a sponge dipped in a liquor composed of 4 parts of aquafortis, and 2 of distilled

water, holding 1 part of common salt or sal ammoniac in solution. When the crystalline spangles seem to be thoroughly brought out, the plate must be immersed in water, washed either with a feather or a little cotton, taking care not to rub off the film of tin that forms the feathering, forthwith dried with a low heat, and coated with a lacquer varnish, otherwise it loses its lustre in the air. If the whole surface is not plunged at once in cold water, but is partially cooled by sprinkling water on it, the crystallization will be finely variegated with large and small figures. Similar results will be obtained by blowing cold air through a pipe on the tinned surface, while it is just passing from the fused to the solid state.

Cleaning Tinware.—Acids should never be employed to clean tinware, because they attack the metal, and remove it from the iron of which it forms a thin coat. We refer to articles made of tinplate, which consists of iron covered with tin. Rub the article first with rottenstone and sweet oil, the same as recommended for brass, then finish with whitening and a piece of soft leather. Articles made wholly of tin should be cleaned in the same manner. In a dry atmosphere planished tinware will remain bright for a long period, but it soon becomes tarnished in moist air.

Tinning Small Articles.—Place them in warm water, with a little sulphuric acid added to it, which will clean them; then powder some sal ammoniac and mix it in the water, stirring well until all is dissolved. After washing the articles in clean water, place them in the solution for a few minutes; then lay them by the fire to dry. Procure a pan resembling a frying pan in shape, the bottom of which must be full of small holes. The pot for melting the tin must be large enough to admit the pan for holding the articles. Cover the bottom of the pan with the articles to be tinned, and, after sprinkling a little powdered sal ammoniac over the surface of the molten tin to clear it from dross, dip the pan containing the goods into it; after all smoke has disappeared, lift it out and shake well over the pot, sprinkling a little sal ammoniac over the goods to prevent them from having too thick a coat, then cool quickly in cold water to keep them bright.

Annealing Steel.—Make the steel red hot, then put it in a heap of dry saw-dust till cold, when it will be found to be quite soft.

Mother-of-Pearl. — Mother-of-pearl is the inner coat of several kinds of oyster-shells, some of which secrete this layer of sufficient thickness to render the shell an object of manufacture. The beautiful tints of the layer depend upon its structure, the surface being covered with a multitude of minute grooves, which decompose and reflect the light. The structure of the pearl shell admits of its being split into laminæ, and it can then be used for the handles of knives, for inlaying, or in the manufacture of buttons; but as splitting is liable to injure or spoil the shell, this method of dividing it is seldom resorted to. In manufacture the different parts are selected of a thickness as nearly as possible to suit the required purpose; excess of thickness is got rid of by means of saws, filing, or by grinding upon the common grindstone. In preparing the rough shell, if square or angular pieces are needed, they are cut with saws, as the circular saw or the ordinary back saw; in the one case, the shell is fed up as the saw divides it, and in the other the shell is held in a vice, and the saw operated by hand. If circular pieces of the shell are wanted, such as those for buttons, they are cut with an annular or crown saw, which is fixed upon a mandrel. It is necessary in sawing that water is plentifully supplied to the instrument, or the heat generated by dividing the shell will heat the saw, and its temper will be destroyed. The pieces of shell are next ground flat upon a grindstone, the edge of which is turned with a number of grooves or ridges, as being less liable to become clogged than the entire surface, and hence grind more quickly. It is necessary to supply water, or soap and water, to the stone, as it is then less liable to become clogged. The flat side of the stone, similarly prepared with ridges, may be used instead of the face, if it is desired to

have the pieces of shell ground flat, and when of the requisite thinness they are ready for operation in the lathe, or for inlaying. After the pieces of pearl shell are cut, ground, or turned to the proper form, they are finished with pumice-stone and water; this may be done with pieces of the stone properly shaped, and rubbed over the work as it is held fast in some form of clamp, or held upon the work as it is revolved in the lathe. This process may be followed by an application of ground pumice-stone, which has been carefully sifted to extract all except the minutely powdered portion, and applied with a piece of cork or a cloth moistened with water. The polishing is accomplished with rotten-stone, moistened with dilute sulphuric acid, which may be applied upon a piece of cork or a bit of soft wood. In some turned works fine emery paper may be used, and followed with rotten-stone moistened with the acid or oil. The pearl handles used for razors or knives are first roughed out, then drilled where the rivets are to be inserted, and lightly riveted together in pairs. They are ground to the proper size and thickness, and finished by the means mentioned, the last finishing touch, to produce a fine polish, often being done by the friction of the hand of the workman. Sometimes it is advantageous to apply the polishing ma- [illegible] to the surface of a wheel, and this wheel may be covered with cloth and moistened with water, which will cause enough of the powder to adhere. Separate wheels may be used for the pumice-stone and the rotten-stone. Sometimes dry powdered chalk or Spanish whiting is used in place of the rotten-stone. One process of working pearl is by the aid of corrosive acids and the etching point. The shell is first divided as may be necessary, and the designs or patterns drawn upon it with an opaque varnish; strong nitric acid is then brushed over the plates repeatedly, until the parts undefended by the varnish are sufficiently corroded or eaten away by the acid. The varnish now being washed off, the device, which the acid had not touched, is found to be nicely executed. If the design is to be after the manner of common etching on copper, the process upon the shell is precisely the same as that process upon metal. When a considerable number of pieces of thin shell are required to be of the same size and pattern, the requisite number of plates are cemented together with glue, and the device or figure drawn upon the outer plate. They may then be held in a vice or clamp, and cut out as one plate with a fine saw, or wrought into the desired form with files; drilling tools may be employed to assist in the operation. To separate the pieces, the cemented shells are thrown into warm water, which softens the glue and separates the pieces.

Artificial Mother-of-Pearl Buttons.—White horn buttons may be made to imitate mother-of-pearl by being boiled in a saturated solution of sugar of lead, and then laid in very dilute hydrochloric acid. Combs, to which the boiling process is not applicable, as it distorts the teeth, may be treated by being kept overnight in a moderately concentrated cold solution of nitrate of lead, then laid for a quarter to half an hour in a bath containing 3 per cent. of nitric acid, and finally being rinsed in water. The use of sugar of lead is, however, prejudicial, and should be avoided.

Inlaying with Mother-of-Pearl. — 1. Tortoiseshell is softened by soaking it in hot water—the design arranged, and placed between flat dies, under a heavy press, to remain till the shell is cold and dry. It is thus embedded in the shell. Those vivid colours on paper trays are fragments of the Aurora shell, pressed in the same way, while the paper is damp; when dry the design is painted, varnished, baked, and polished.

2. Thin scales of the shell are to be selected for their colour, or shade, and cemented to the surface of the material. The rest of the surface is covered with successive coats of japan varnish, generally black, being subjected to a baking process after each application. When the varnish is as thick as the shell it is polished, the gilding and painting added, and a flowing coat of varnish put over the whole.

To Imitate Tortoiseshell with Horn.—1. Mix up an equal quantity of quick lime and red lead with soap lees; lay it on the horn with a small brush, in imitation of the mottle of tortoiseshell; when it is dry, repeat it two or three times. 2. Grind 1 oz. of litharge and ½ oz. of quick lime, together with a sufficient quantity of liquid salts of tartar to make it of the consistence of paint. Put it on the horn with a brush, in imitation of tortoiseshell, and in three or four hours it will have produced the desired effect; it may then be washed off with clean water; if not deep enough it may be repeated. 3. Take a piece of lunar caustic about the size of a pea; grind with it water on a stone, and mix with it a sufficient portion of gum arabic to make it of a proper consistence; then apply it with a brush to the horn in imitation of the veins of tortoiseshell. A little red lead, or some other powder mixed with it, to give it a body, is of advantage. It will then stain the horn quite through, without hurting its texture and quality. In this case, however, you must be careful, when the horn is sufficiently stained, to let it be soaked for some hours in plain water, previous to finishing and polishing it. Pieces of horn are united together to form one large piece by being softened at the edge by boiling water, and then pressing them together powerfully while surrounded by boiling water.

Preparation of Horn.—The horn is first roasted over a fire made of the stalks of furze. When rendered soft, it is slit on one side, and kept expanded flat between a pair of tongs; it is then placed in a press between iron plates which are greased. The horns are suffered to remain till they are cooled; they are then soaked in water till soft enough to be pared down to the required thinness, with a large knife worked horizontally on a block. Their transparency is thus acquired; and after being immersed in ley, they are polished with whitening and the coal of burnt willow.

Gum.—*Mucilage for Labels.*—Macerate 5 parts of good glue in 20 parts of water for 24 hours, adding 20 parts of rock candy, and 3 parts of gum arabic.

To Preserve Gum-Arabic Solutions.—A few drops of oil of cloves, or of alcohol, or any essential oil, will preserve a quart of the mucilage of gum arabic or gum tragacanth from turning sour. A small quantity of dissolved alum will preserve flour paste.

Artificial or British Gum.—Malt, crushed small, 1 lb.; warm water, 2 galls. Mix; heat the whole to 145° Fahr.; add potato starch 5 lbs.; raise the heat to 160° Fahr., and mash for about 25 minutes, or until the liquid becomes thin and clear; it must then be instantly run off, and raised to the boiling point to prevent the formation of sugar; after boiling for 3 or 4 minutes, the whole must be filtered and evaporated to dryness by a steam heat.

Wax Impressions from Seals.—Warm the seal a little, and rub over it the end of a wax candle; then sprinkle it with the best vermilion. Melt the sealing wax by holding it over a candle, so that it does not catch fire—suffering it to drop upon the paper; impress the prepared seal upon it, and if done carefully a fine impression will be made. If several seals are to be made at once, or even one of a large size, it is customary to melt the sealing wax in a small ladle or crucible, from which it may be poured as wanted. Seals of different colours are made by dusting the seal with a powder of one colour, and stamping it upon wax of another; thus dust the seal with lamp-black, and impress it upon red wax—the impression will have a black centre and red edge.

To make Glass Seals.—First, procure a mould made of plaster of Paris, the counterpart of the seal wished for, and this may be made by pouring a mixture of plaster of Paris and water, of the consistency of cream, upon any engraved seal, previously slightly oiled; when set, remove the cast and let it thoroughly dry, when it will be fit for use; then place in the centre of a clear fire a piece of flint glass, holding it with a pair of iron pincers, being careful to hold it so as not to touch any of the black coals.

When of a red, or still better of a white heat, take it from the fire, lay it upon the mould, and press upon the back of it so as to force it into all the depressions. To finish it, it requires to be ground round the edge into shape. If it be desired to imitate a sealing-wax impression, it is necessary to oil it, pour common wax upon it, and take the plaster cast from this. The makers of composition seals usually melt the glass in a crucible, taking out a sufficient quantity with an iron rod. Their moulds have a ridge or frame of plaster round them, to ensure the proper shape at once, without after grinding.

Gum Seals are made by pouring a little strong gum water over the impression, after being oiled slightly, and keep adding more as it dries. When about the consistence of india-rubber, it can be taken off with an open penknife.

Manufacture of Glue; *from Bones.*—The first process is to cleanse the bones by immersing them in a pit or cistern of water, where they remain about 12 hours; the water is then to be drawn off, and fresh water added to them; this operation is sometimes repeated to remove any dirt. The water being withdrawn from the bones, a solution of lime, in the proportion of 1 bushel of lime to 500 gallons of water, is to be poured into the cistern for the more perfect cleansing of the bones and the removal of any superfluous matter. After 3 or 4 days' saturation the lime solution should be drawn off and fresh water added to get rid of the lime. Thus prepared, the bones are placed in a hollow globular vessel of wrought iron, called an extractor, which is filled with them by removing the interior plate which covers the manhole; this aperture is of an elliptical form, and allows the plate to be slipped round and refixed in its place by turning a nut, which draws it up tight against the interior surface of the extractor, and the junctures are made air-tight by luting. The extractor turns upon a horizontal cylindrical shaft; one half of this shaft is made hollow, or consists of a strong tube, which tube also proceeds downwards towards the centre of the vessel to conduct the steam beneath the grating upon which the bones are laid. The steam, of about 15 lbs. pressure, is admitted by the cylindrical shaft, proceeds first to the bottom of the extractor, then rises up through the grating and amongst the bones, until the vessel is completely charged; previous to this, however, the air in the extractor is got rid of by opening a cock at the top of the extractor, and closing it after the admission of steam. While the steam is acting upon the bones the extractor is occasionally turned round by means of a hand-winch. When at rest, a quantity of fluid gelatine is collected at the bottom of the extractor, from whence it is discharged by means of a cock into a tub beneath, after opening the air-cock to enable it to run off. This done, steam is again admitted from the boiler into the extractor to act upon the bones for another hour, when the second portion of condensed liquor is drawn off. When the products thus obtained have become cold, the fat which has formed upon the surface is to be carefully removed by skimming, and the gelatinous portion only is to be returned into the extractor by means of a funnel through the cock on the top. The steam is then admitted to the extractor for an hour, after which it is finally drawn off into another vessel to undergo a simple evaporating process until it arrives at a proper consistency to solidify when cold, previous to which some alum is added to clarify it. When cold this gelatinous mass is cut out into square cakes, and dried as usual in the open air.

Common Glue.—1. Common glue is extracted from hoofs, horns, and cuttings of the hides of various animals. For this process the materials are first steeped in water for 2 or 3 days, well washed, and afterwards boiled to the consistency of a thick jelly, which is passed while hot through osier baskets to separate the grosser particles of dirt or bones from it, and allowed to stand some time to purify further. When the remaining impurities have settled to the bottom, it is melted

and boiled a second time. It is next poured into flat frames or moulds, from which it is taken out hard and solid, and cut into square pieces or cakes, and afterwards dried in the wind in a coarse kind of net. 2. Substances intended for the glue-maker are macerated with milk of lime for 14 days, and dried by exposure to the air; they can then be transported to any distance without undergoing decomposition. The manufacturer generally treats the materials again with dilute milk of lime; afterwards they are carefully washed and exposed to the air for about 20 or 30 hours. They are then placed in a copper boiler having a perforated false bottom, which supports the materials and prevents their being burnt; the boiler is filled about two-thirds with water, and is piled up with the animal substances until they are level with the brim; a gentle but steady boil should be maintained, and the substances should be stirred from time to time. When the liquor on cooling forms a firm gelatinous mass, the clear portion is run off into another vessel, and a small quantity of dissolved alum is added. It is kept warm by means of hot water, and allowed to remain undisturbed for some hours to deposit its impurities; it is next run into the congealing boxes, and left to cool. When cold the masses are turned out upon boards wetted with water, cut into small cakes, and these cakes are placed upon nettings to dry. The dry cakes are then dipped into hot water, and lightly rubbed with a brush to give them a gloss, and lastly stove-dried for sale. This furnishes the best and palest glue. After the first liquor is drawn from the copper, the remnants left in the boiler are treated with fresh water, again and again, until no gelatinous matter can be extracted.

Gelatine.—Gelatine is made by steeping the stomach and intestines of fish in cold water, and then gently boiling them into a jelly; this is spread into sheets and allowed to dry. The air-bladder of the sturgeon makes the true isinglass.

Bleaching Wax.—The process of bleaching wax consists in first melting it at a low temperature in a caldron, from whence it is allowed to run out by a pipe at the bottom into a capacious vessel filled with cold water, in which is fitted a large wooden cylinder that is made to turn on its axis, upon which the melted wax falls. The surface of the cylinder being constantly wet, the wax does not adhere to it, but lays solid in the form of ribbons as fast as they are formed, and distributed through the tub. The wax is then put upon large frames covered with linen cloth, which are supported about 18 in. above the ground, in a situation exposed to the air, dew, and sun. The thickness of the several ribbons thus placed on the frame should not exceed 1½ in., and they ought to be moved from time to time that each part may be equally exposed to the action of the air. If the weather is favourable it will become white in a few days. It is then re-melted, formed into ribbons, and exposed to the air as before. These operations are repeated until the wax is rendered perfectly white; after which it can be melted and run into cakes. Sometimes it is bleached by the following chemical process;—The wax is heated to about 212° Fahr. in an iron vessel lined with lead, when either chloride of lime or magnesia is added, either in solution with water or in a dry state, and then intimately mixed and stirred up with a wooden spatula. When these materials have acted on each other for a sufficient length of time to discharge the colour from the wax, the lime or magnesia is removed by the addition of dilute sulphuric acid, which possesses a greater affinity for those alkalies than chlorine. The whole is then to be boiled until all the alkalies employed are separated. The solution of the chloride is to be in the proportion of from 14 lbs. to 28 lbs. of the salt to 112 lbs. of water, and an equal quantity by weight of the melted wax. The sulphuric acid should be of the specific gravity 1·8, and be diluted with twenty times its weight of water.

Inks.—The composition of ink varies according to the purposes for which it is intended, and the large number of uses to which it is now applied, such as for writing, printing, lithography, and engraving, necessitate very great nicety in its proportions, and care in its preparation. A good ink ought to be so thin as to flow freely from the pen; it should be so thick as not to spread or blur on the paper, and it should possess sufficient depth of colour to retain its blackness for many years. Much of the permanency of ink depends on the material upon which it is written, for if we write on paper which has been bleached with chlorine, and the gas has been imperfectly removed, it has a deleterious effect on the beauty and durability of the writing. Concerning the composition of ink, galls are used in the process, not because they are rich in gallic acid, but because they contain a high percentage of tannic acid.

Black Writing Inks.—The proportions which appear most suitable, and upon which most dependence can be placed, are—1. bruised galls, 1 lb.; to this add 1 gallon of boiling water, and one-third of the weight of the galls, namely, 5½ oz. of sulphate of iron in solution; also 3 oz. of gum arabic previously dissolved, and a few bruised cloves or a few drops of creosote or carbolic acid dissolved in methylated spirit. It is better to allow the galls to macerate for 24 hours, then strain the infusion, and add the other ingredients. 2. Take of bruised galls 12 oz., macerate for a week in 1 gallon of cold water, then add 6 oz. of sulphate of iron in solution, also 6 oz. of mucilage of gum arabic, and 5 or 6 drops of creosote. 3. 12 lbs. Aleppo galls bruised, boiled in 6 gallons soft water for an hour, adding water to replace that evaporated; strain, and again boil the galls in 4 gallons more water for about half an hour; strain and boil with 2½ gallons more water; strain, and mix the liquors. Add 4½ lbs. coarsely-powdered green copperas, 4 lbs. gum arabic in small pieces, agitate until the ingredients are dissolved, filter through a hair sieve. This will yield about 12 gallons of very fine durable ink.

Copying Ink.—1. Add 1 oz. of lump sugar, or of sugar-candy, to 1½ pint good black ink, dissolve. The following requires no press, but may be copied by placing a damp sheet of copying paper on the writing intended to be copied; above this sheet of copying paper a sheet of ordinary writing paper must be placed, and then rubbed over with a paper knife. 2. Mix 30 grains of extract of logwood; 7 grains of crystal soda; ½ oz. of water. Boil till dissolved; then, while stirring well, add 30 grains of glycerine, 1 grain of chromate of potash, previously dissolved, and 4 grains of powdered gum arabic. 3. A transfer ink, for copying without any press, and without previously moistening the copying paper, consists of a decoction of Brazil wood and glycerine. When paper is written upon with the ink, and laid on tissue paper, rubbing with the finger transfers it.

Blue-black Writing and Copying Ink.—Blue Aleppo galls, free from insect perforation, 4½ oz.; bruised cloves, 1 dram; cold water, 40 oz.; purified sulphate of iron, 1½ oz.; pure sulphuric acid, by measure, 35 minims; sulphate of indigo, in the form of a thin paste, and which should be neutral, or nearly so, ½ oz. Place the galls, when bruised, with the cloves, in a 50-oz. bottle, pour upon them the water, and digest, shaking daily for a fortnight. Then filter through paper into another 50-oz. bottle. Get out the refuse of the galls, and wring out of it the remaining liquor through a strong clean linen or cotton cloth into the filter, in order that as little as possible may be lost. Next put in the iron, dissolve completely, and filter through paper. Then the acid, and agitate briskly. Lastly, the indigo, and thoroughly mix by shaking. Pass the whole through paper. Filter out of one bottle into the other till the operation has been completed. When intended for copying, 5½ oz. galls is the quantity. The water should be as soft as possible—that is, it should contain

no lime or other earthy matter; rain water, or distilled water, should be used in making ink.

Black Ink, Non-corrosive.—Digest in an open vessel, 42 oz. of coarsely-powdered nut-galls, 15 oz. of gum senegal, 18 oz. of sulphate of iron, free from copper; 3 drams of aqua ammonia; 24 oz. of alcohol; and 18 quarts of distilled or rain water. Continue the digestion until the fluid has assumed a deep black colour. For cheap inks other ingredients may be substituted instead of part of the galls; logwood, catechu, sumach, and oak bark may be used for the same purpose. Many other substances, such as elm wood, elder, chestnut, beech, willow, plum, cherry, and poplar, all contain a certain amount of astringent properties, but none of them are to be compared to galls, and are not likely to supersede them in the manufacture of ink so long as galls can be had for a fair price. The cheapest ink is one composed of a saturated solution of logwood obtained by boiling 22 lbs. of logwood in sufficient water to produce, after being strained, 14 gallons of liquor; to this decoction add 1 lb., avoirdupois, of yellow chromate of potash, not bichromate, in solution; the proportions are one thousand parts of solution to one of chromate; the change of colour is not immediate, but it gradually becomes darker. This can be made on a small scale, by using logwood, a quarter of a pound boiled in water to produce two pints, to which, when strained, add 20 grains of chromate of potash in solution.

To prevent Mouldiness in Ink.—Add a few bruised cloves, a little oil of cloves, or a few drops of creosote. If either of the latter is used, first mix with a small quantity of strong vinegar.

Substitute for a Copying Machine.—Write with common writing ink in which lump sugar has been dissolved, in the proportion of 4 scruples, or 1½ dram, of sugar to 1 oz. of ink. Moisten copying paper. Put the paper so moistened upon the writing, and cover with a soft pad of blotting paper, place the whole on the carpet or hearth-rug, one end of which is to be folded over. By treading upon this, an impression will be taken, equal to what would have been taken by a copying machine.

Indestructible Inks.—1. Dissolve 25 grains of powder gum copal in 200 grains of lavender oil, by the aid of a gentle heat; then add 2½ grains of lamp-black, and ½ grain of powdered indigo. 2. In 18 oz. of water, boil shellac, 2 oz., and borax, 1 oz.; when cold, filter and mix with 1 oz. of gum arabic dissolved in 2 oz. of water, to which add powdered indigo and lampblack as much as may be required. 3. Two solutions are necessary.—No. 1 consisting of crystallized chloride of copper, 8·5 parts; chloride of soda, 10·6 parts; and sal ammoniac, 5·3 parts, to be together dissolved in 60 parts of distilled water. No. 2 solution, consisting of 20 parts of hydrochlorate of aniline, to be dissolved in 30 parts of water, to which has to be added 20 parts of a solution of gum made by dissolving 1 part, by weight, of gum in 2 parts of water; and lastly, 10 parts of glycerine. These solutions are kept in separate bottles. When it is required to write anything with the fluids, 1 part, by bulk, of solution No. 1 is mixed with 4 parts, by bulk, of No. 2. The ink must be applied to paper, linen, cotton, wool, or silk, with a quill pen or small hair brush; at first the writing appears greenish; but it soon becomes black, especially if it is exposed to a higher temperature. 4. 20 grains of sugar dissolved in 30 grains of water, and the addition to the solution of a few drops of concentrated sulphuric acid; the mixture is then heated, when the sugar is carbonized by the action of the acid.

Ink Powder.—1. Mix powdered galls, 4 oz.; powdered sulphate of iron, 1 oz.; powdered gum arabic, 1 oz.; powdered white sugar, ½ oz.; powdered cloves, 1 dram. To these add 1 quart of water, and macerate for an hour or two. 2. Aleppo galls, 3 lbs.; copperas, 1 lb.; gum arabic, ½ lb.; white sugar, ½ lb.; powder and mix. 2 oz. of this powder dissolved in 1 pint boiling water gives a very good ink.

INVISIBLE INKS.—1. Write with dilute nitrate of silver, which, when dry, will be entirely invisible; hold the paper over a vessel containing sulphate of ammonia, and the writing will appear very distinct. The letters will shine with the metallic brilliancy of silver. 2. Write with a solution of muriate of cobalt, and the writing, while dry, will not be perceptible, but if held towards the fire, it will then gradually become visible, and if the muriate of cobalt be made in the usual way, the letters will appear of an elegant green colour. 3. Write with acetate of cobalt previously purified from the iron which it generally contains. When the writing is dry, these letters will be invisible. Warm the paper a little, and the writing will be restored to a beautiful blue. 4. Equal parts sulphate of copper and sal ammoniac dissolved in water. Writing colourless until warmed, then turns yellow. 5. Onion juice, same colour. 6. Solution of chloride, or nitro-muriate of cobalt; writing turns green when heated, but disappears again on cooling. 7. A weak solution of the mixed chlorides of cobalt and nickel. This writing also turns green when heated.

A Cheap Invisible Ink.—Dissolve 1 fluid oz. of common oil of vitriol in a pint of soft water. Stir well and allow it to cool. Write with a clean pen. When dry it will be invisible, held to the fire it turns an indelible black.

COLOURED INKS.—*Red Ink.*—1. Take 4 oz. of ground Brazil wood and 3 pints of vinegar. Boil till reduced to a pint and a half, and add 3 oz. of powdered rock alum. 2. Tincture of red sanders, with a solution of rock alum. 3. Take a ¼ lb. of raspings of Brazil wood, and infuse it 2 or 3 days in vinegar. Boil the infusion for 1 hour over a gentle fire, and filter while hot. Put it again over the fire, and dissolve in it, first, ½ oz. of gum arabic, and then of alum and white sugar ½ oz. 4. Boil 2 oz. Brazil wood in 32 oz. of water, to which add, after the decoction has been strained, ½ oz. of chloride of tin, and 1 dram of powdered gum arabic; then evaporate to 16 fluid oz. 5. Dissolve carmine, 1 dram in ½ dram of strong liquid ammonia, sp. gr. 880, then dissolve 20 grains of powdered gum arabic in 3 oz. of water, which add to the dissolved carmine. 6. Brazil wood, 200 parts; salt of tin, 3; gum, 6; water, 3200. Reduce to one-half by boiling. Filter 7. Brazil wood, 2 parts; alum, ½; cream of tartar, ½; water, 16. Boil down to half, and filter; add ½ part of gum. 8. Add to an ammoniacal solution of cochineal a mixture of alum and cream of tartar, till the required tint is obtained. 9. When a very fine colour is desired, digest 1 oz. powdered cochineal in ½ pint hot water; when it is quite cold, add ½ pint spirit of hartshorn, macerate for a few days, then decant the clear portion. Or dissolve 20 grains pure carmine in 3 fluid ounces of liquid ammonia; add 18 grains powdered gum.

Green-Black Ink.—Take 15 parts bruised gall-nuts, and 200 parts of water, boil for about an hour, strain, and then add to the liquor 5 parts sulphate of iron, 4 parts fine iron shavings, and a solution of ½ pint of powdered indigo in 3 parts of sulphuric acid. This ink writes green, but turns black after a few days; it flows very well from the pen.

Green Ink.—1. Calcine aceto-nitrate of chrome; dilute the green powder with sufficient water. 2. Mix good clear blue and yellow inks in the proportions necessary to give the desired tint. 3. Sap green dissolved in very weak alum water. 4. Verdigris, 2 oz.; cream of tartar, 1 oz.; water, ½ pint; reduce one-half by boiling, and filter.

Blue Ink.—1. Dissolve 2 or 3 oz. of sulphate of indigo in a gallon of water; or by rubbing together 1 oz. of oxalic acid and 2 oz. of fine Prussian blue, to which add 1 quart of boiling water. The excess of iron in the Prussian blue must be first removed by a strong mineral acid, then wash in rain water. 2. Chinese blue, 2 oz.; boiling water, 1 quart; oxalic acid, 1 oz. Dissolve the blue in the water, then add the acid, and it is ready at once.

Purple Ink.—1. Add to a decoction of 12 parts Campeachy wood in 120 parts

of water, 1 part subacetate of copper, 14 parts alum, and 4 parts gum arabic. Let stand for 4 or 5 days. 2. Add a little alum, or chloride of tin, to a strong decoction of logwood.

Violet Ink.—1. Boil 8 oz. of logwood in 3 pints of water till reduced to 1½ pint. Strain, and add 1½ oz. of gum, and 2½ oz. of alum. 2. Cudbear, 1 oz.; pearlash, 1½ oz.; hot water, 1 pint. Allow to stand for 12 hours; strain, and add about 2 oz. gum. If required to keep, add 1 oz. spirits of wine.

MARKING INKS.—1. Twenty-two parts of carbonate of soda are dissolved in 25 parts of distilled water; also 17 parts of crystal nitrate of silver in 24 parts of ammonia; 20 parts of gum are then liquified in 60 parts of water, and mixed with the soda solution; afterwards with the nitrate of silver, and, lastly, 33 parts of sulphate of copper are added. This writes a rich blue. 2. Dissolve 1 dram of nitrate of silver, or lunar caustic, in ¾ oz. of water. Add to the solution as much liquid ammonia as will redissolve the precipitated oxide, with sap green to colour it, and gum water to make the volume amount to 1 oz. Marks written with this liquid should be first heated before the fire, and then exposed in the sun to blacken. The linen marked on requires no previous preparation. 3. Damp the linen first with a solution of carbonate of soda. Dry the spot, and write upon it with a solution of the nitrate of silver thickened with gum, and tinted with sap green. 4. Dissolve separately, nitrate of silver, 1 oz.; crystal carbonate of soda, 1½ oz.; mix the solution, and collect the precipitate on a filter; wash well, then introduce the moist precipitate into a mortar, and add 8 scruples of tartaric acid; triturate till effervescence ceases; then add strong liquor ammonia a sufficient quantity to dissolve the tartrate of silver, to which add 4 fluid drams of archil, 4 drams of powdered white sugar, and 12 drams of powdered gum arabic, and make up to 6 fluid ounces, if required, with distilled water.

Crimson Marking Ink is prepared by adding 6 grains of carmine to the liquor ammonia of the above receipt, but it soon loses its crimson colour, and becomes, like other marking inks, a black colour.

INDIAN INK.—Dissolve horn strip with caustic kali root till it is melted. The brown liquid is to be boiled in an iron kettle until it is thick. Then pour on it boiling water, double its weight, and precipitate it with dissolved alum. Dry, grind, and mix it with gum water, and pour it in a mould. A few drops of essence of musk, or of ambergris, may be added as perfume. 2. Horse-beans or the kernels of the stones of apricots. Must be burnt in an oven till perfectly black, ground to a fine powder, and made into a paste with a solution of gum arabic, and then formed into cakes. 3. Mix the finest lampblack with a solution of 100 grains of lac, with 20 grains of borax, and 4 oz. of water. 4. Pure lampblack, mixed with asses' skin glue, and scented with musk.

PRINTING INK.—*Linseed Oil.*—The linseed oil, however long boiled, unless set fire to, cannot be brought into a proper state for forming printing ink; the flame may be most readily extinguished by the application of a pretty tight cover to the top of the boiler, which should never be more than half full. The French prefer nut oil to linseed; but if the latter is old, it is fully as good.

Black Rosin is an important article in the composition of good ink; as by melting it in the oil, when that ingredient is sufficiently boiled and burnt, the two combine, and form a compound approximating to a natural balsam, like that of Canada, which is one of the best varnishes that can be used for printing ink.

Soap.—This is a most important ingredient in printers' ink, for the want of which ink accumulates upon the face of the types, so as completely to clog them up after comparatively few impressions have been taken; it will not wash off without alkaline leys, and it skins over very soon in the pot. Yellow rosin soap is the best for black inks; for those of light and delicate shades,

white curd soap is preferable. Too much soap is apt to render the impression irregular, and to prevent the ink from drying quickly. The proper proportion is when the ink works clean, without clogging the surface of the types.

Lampblack. — The vegetable lampblack, sold in firkins, takes the most varnish, and answers for making the best ink.

Ivory Black is too heavy to be used alone as a pigment for printing ink; but it may be added with advantage by grinding a little of it upon a muller with the lampblack, for certain purposes; for instance, if an engraving on wood is required to be printed so as to produce the best possible effect.

Indigo alone, or with an equal weight of Prussian blue, added in small proportion, takes off the brown tone of certain lampblack inks, or a little Indian red may be ground in with the indigo and Prussian blue, to give a rich tone to the black ink.

Balsam of Capivi, mixed, by a stone and a muller, with a due proportion of soap and pigment, forms an extemporaneous ink, which the printer may employ when he wishes to execute a piece of work in a peculiarly neat manner. Canada balsam does not answer quite so well. After the smoke begins to rise from the boiling oil, a bit of burning paper stuck in the cleft end of a long stick, should be applied to the surface, to set it on fire, as soon as the vapour will burn; and the flame should be allowed to continue, the pot being meanwhile removed from over the fire, or the fire taken from under the pot, till a sample of the varnish, cooled upon a palette knife, draws out into strings of about half an inch long between the fingers. It is necessary to have two kinds of this varnish—a thicker and a thinner, from the greater or less boiling—which are mixed together to suit different purposes; that which answers well in hot weather becomes too thick in cold, and large characters or type do not require such stiff ink as the small. To six quarts of linseed oil thus treated, 6 lbs. of rosin should be gradually added, as soon as the froth of the boiling has subsided. As soon as the rosin is dissolved, 1¾ lb. of dry brown soap, of the best quality, cut into slices, is to be introduced cautiously, for its water of combination causes a violent commotion. Both the rosin and soap should be well stirred with the spatula. The pot is to be now set upon the fire, in order to complete the combination of all the constituents. Put next of well-ground indigo and Prussian blue, each 2¼ oz. into an earthen pan, sufficiently large to hold all the ink, along with 4 lbs. of the best mineral lampblack, and 3½ lbs. of good vegetable lampblack; then add the warm varnish by slow degrees, carefully stirring, to produce a perfect incorporation of all the ingredients. This mixture is next to be subjected to a mill, or slab and muller, till it is levigated into a smooth uniform paste. 1 lb. of superfine printing ink may be made by the following recipe:—Balsam of capivi, 9 ; lampblack, 3 oz.; indigo and Prussian blue, together, 1¼ oz.; Indian red, ¾ oz.; yellow turpentine soap, dry, 3 oz. This mixture is to be ground upon a slab, with a muller, to an impalpable smoothness. Red or other coloured printing inks are made from linseed oil, boiled as described above, with the addition of dry pigment of the required colour, which is ground up with the varnish with a stone and muller. The pigments used for coloured printing inks are carmine, lakes, vermilion, red-lead, Indian red, Venetian red, chrome yellow, chrome red or orange, burnt sienna, gall-stone, Roman ochre, yellow ochre, verdigris, blues and yellows mixed for greens, indigo, Prussian blue, Antwerp blue, lustre, umber, sepia, and browns mixed with Venetian red.

TRANSFER INK.—For the manufacture of the following inks an iron pot and lid must be procured. Then take as follows:—

Stone Writing Ink.—Virgin wax, 4 parts; tallow, 3; soap, 13; shellac, 6; lampblack, 3.

Transfer Writing Ink.—Virgin wax,

2 parts; white soap, 1; shellac, 1; lamp-black, ½.

Chalks.—Virgin wax, 16 parts; tallow, 2; white soap, 12; lampblack, 3½.

Manipulation of Writing Ink and Chalks.—Melt the wax and tallow, and mix with an iron spoon; then add the soap, which must be previously cut into strips, and when melted apply a light, and allow to burn until the whole is decreased to the same bulk as existed before the addition of the soap. The shellac is now to be carefully added, bit by bit, stirring the whole time to effect perfect amalgamation. The black is next to be added, and the whole well mixed while in a liquid state; then poured into a mould, or on a slab, and cut to the required size while warm. The same method of proceeding is alike applicable to the manufacture of transfer writing ink, proceeding with the wax only, there being no tallow.

Re-transfer Inks.—Stone Re-transfer Ink.—Litho. printing ink, 2 parts; writing ink, 2; thin varnish, 2; tallow, ½.

Copper-plate Transfer Ink.—Litho. writing ink, 4 parts; thin varnish, 1; wax, 1; tallow, ½; soap, 1. Carefully melt the ingredients, and when in a liquid state pour into moulds, or cut to the required size.

LITHO. PRINTING INK.—For making litho. printing ink, a copper or iron pot with a lid is provided. In this linseed oil of the best quality is boiled until it will ignite readily upon the application of a light. It is then allowed to burn until the required consistency for the varnish is obtained, which is known by taking a small quantity out with a knife, and permitting it to cool. The lid of the pot is then put on, which extinguishes the flames. It is obvious that this is a somewhat dangerous process to conduct under an ordinary chimney. With this varnish, which must not be too thick, as much best calcined Paris black is ground up as possible. The more black that can be ground in, the richer will the colour be.

Ink — Writing on Lithographic Stones.—Mastic in tears, 8 oz.; shellac, 12 oz.; Venice turpentine, 1 oz. Melt together, add 1 lb. wax, 6 oz. tallow: when they are dissolved add 6 oz. hard tallow soap shavings and mix. Then add 4 oz. lampblack. Mix all well together, let cool slightly, then pour into moulds, and cut into convenient-shaped cakes.

Writing and Drawing on Transfer Paper.—To dissolve solid lithograph ink, warm the pot at the fire or gas, using rain or distilled water to rub it down with, as it is softer than other water. The pen will be found to work better at first if it is dipped in oil, and then wiped previous to writing.

COPPER-PLATE PRINTING INKS.—Take linseed oil 1 pint, put into a dry iron saucepan and boil until it will readily ignite by applying lighted paper; let it burn 10 minutes, now put the lid on and it will cease to burn, add nearly ½ oz. of litharge, and stir well; when cool ready for use mix a little of this oil with lamp-black, forming a thick paste; grind this very fine with a muller. The grinding is most important. Boil the oil out of doors.

Black.—Frankfort black, finely ground with boiled linseed oil, or, for very fine work, fat oil.

Red.—Mineral orange red, 5 oz.; Chinese red, 2 oz.

Blue.—Celestial blue, 2 oz.; marine blue, 3 oz.

Green.—Mineral green, 2 oz.; chrome green, 3 oz.

Brown.—Burnt umber, 2 oz.; rose pink, 1 oz.

Lilac.—Prussian blue, 1 oz.; Chinese red, 2 oz.

Pink.—Mineral pink, 2 oz.; satin white, 1 oz.

Orange.—Orange red, 2 oz.; flake white, 1 oz. The above to be ground and mixed with Canada balsam. Or,

Red.—Vermilion.

Yellow.—King's yellow.

Blue.—Smalts.

Green.—King's yellow—green.

Lilac.—Prussian blue, and flake white.

Brown.—Burnt umber.

Dark Brown.—Burnt umber and Frankfort black.

Puce.—Frankfort black and vermilion.

Brown.—Frankfort black, and drop lake. These to be ground and mixed with nut or linseed oil.

Gold.—Gold bronze mixed with dark oak and mahogany varnish.

Silver, Copper, Ruby.—The same as for gold, merely substituting the different bronzes. Cards printed in gold, silver, or colours, should, when dry, be placed on a very smooth copper or steel plate, not engraved, and passed through a copper-plate press with rather a tight pressure; this would also improve the appearance of cards printed in like manner with letterpress.

To Clean Copper-plates.—Copper-plates are cleaned by laying them on the hob near the fire, and pouring on them some spirits of tar, and then rubbing them with a small soft brush.

Painting on Vellum.—The illuminated missals, or coats of arms, on vellum may be best done by the above colours, rather than by water colours with gall in them, as is often practised—the colours being applied with a brush as in ordinary painting; also, if more brilliancy is required for gold and silver, those metals may be used in leaf, a coat being first put on with gold size. Gold is best shaded with a bright transparent brown, silver with green.

Ink for Stone, or Marble.—Trinidad asphaltum and oil of turpentine, equal parts. This is used in a melted state for filling in letters cut on tombstones, marble slabs, and monuments, and is very durable.

Writing on Zinc.—1. Mix verdigris, 1 part; sal ammoniac, 1; chimney-black, or any mineral colour, ½; water, 10; stir well or shake the bottle before employing, and use a quill, not a steel, pen, for writing. This ink is a poison. 2. Get a lemon, squeeze the juice out of it into a pot, and put into it an old copper halfpenny or farthing, not the present bronze coin. Let it stand for a day or two. Write with a quill pen. 3. Dissolve 100 grains of chloride of platinum in a pint of water. A little mucilage and lampblack may be added.

Zinc Garden Labels.—For zinc plates use the following, with quill pens only;—1. Dissolve muriate of ammonia and crude sal ammoniac in strong vinegar. 2. For large labels, dip your pen in concentrated sulphuric acid, and write on the zinc, previously greased; a sharp point of copper wire is better than the pen; quench in water; wash thoroughly from fluid when your writing is plain enough. 3. Dissolve about half-a-crown's worth of chloride of platinum in hot distilled water, adding a very few drops of aqua regia. The liquid should be of a pale amber colour. Enough for hundreds of labels.

Gold Ink.—1. Gold, 24 leaves; bronze gold, ½ oz.; spirits of wine, 30 drops; best honey, 30 grains; gum arabic, 4 drams; rain water, 4 oz. Rub the gold with the honey and gum, and having mixed it with the water, add the spirit. 2. Take gold 1 part, nitro-hydrochloric acid 3 parts, mix and evaporate until chlorine in vapour is given off, cool and mix with ether by shaking well together, thicken with naphtha or any essential oil. Gold and silver inks, for illumination, are simply the metals very finely powdered and suspended in weak gum water. Gold leaf ground up with honey, washed and mixed with a thin solution of gum, is excellent for illumination.

Fluxes.—In metallurgical operations the following articles are used as fluxes;—Crude tartar, if on a small scale, commercial cream of tartar, borax, nitre, sal ammoniac, common salt, limestone, glass, and fluor spar. These articles being easy to fuse, are added to substances which are more refractory, to promote their fusion.

Black Flux.—Nitre, 1 part; cream of tartar, 2; mix and burn in small quantities in a red-hot crucible; mix the product with finely-powdered charcoal. Keep in a dry corked bottle. This is used in smelting metallic ores.

Flux for Reducing Arsenic.—Carbonate of soda in crystals, 8 parts; finely-powdered charcoal, 1; heat gradually to a red heat.

Cornish Reducing Flux.—Crude tartar,

10 parts; nitre, 4; borax, 3. Powder together.

Refining Flux.—Crude tartar and nitre equal parts, burnt together.

Crude Flux.—Same as the black flux, omitting the burning in the crucible.

Flux for Arsenical Compounds.—1. Dry carbonate of potassa, 3 parts; cyanide of potassium, 1. 2. Dry carbonate of soda and cyanide of potassium, equal parts.

Morreau's Reducing Flux.—Powdered glass, free from lead, 8 parts; and 1 part each of calcined borax and charcoal. Powder well, and mix together.

Candles.—In its natural state, fat of animals is always associated with cellular tissue and other foreign matters, which must be separated before it can be used as candle stock. In dry melting, the rough suet is cut into coarse pieces and exposed to the action of a moderate heat. By more recent processes the fat is not exposed to heat till it has been subjected to mechanical and chemical appliances, for the purpose of destroying the tissues. The first method possesses the decided advantage, that the residue can be profitably used as food for hogs and fowls. There is also an economy in fuel, and the simplicity of the process commends itself to inexperienced manufacturers. The disadvantages are an obnoxious smell, from the heating of rough tallow which has been collected and suffered to remain till it has become rancid, and the cellular tissues, blood, or other portions advanced towards putrefaction, and the small amount of fat obtained, as portions always remain with the residue when heated in this manner. The fat for tallow ought to be freed from the membranous and muscular parts, then cut into thin slices and hung up in a cool place, not heaped up while yet warm. By operating thus, the disagreeable odour can be delayed for several days.

Tallow Boiling.—First, the fat is chopped; cutting machines are often used similar to the straw-cutting table; sometimes a thin, sharp-edged, mincebatchet is employed, about 2½ ft. in length. This is held with both hands, and the fat, spread out on a beech block, is chopped into small pieces in all directions. A third instrument is a kind of stamp trough with muller, having a sharp blade in the form of an S, a contrivance frequently adopted for cutting beets. A more desirable instrument, however, is the ordinary rotary sausage-cutter. The fat is then placed in melting caldrons, hemispherical in form, and made of cast iron, which are heated by open fire. These caldrons are covered with movable tinplate hoods, so adjusted that, by means of pulleys, ropes, and counter-weights, they can be easily raised or lowered, whilst, at the same time, they serve to carry off the offensive vapours arising from the heated fat. Water is sometimes mixed with the fat in the caldrons, and this addition is specially beneficial when the fat has been long kept during the summer months, and has thereby lost it natural moisture by evaporation. By gradually raising the temperature in the pan the fat runs from the cells, and the whole is kept boiling from 1 to 1½ hour. During the whole operation of melting and boiling, the ingredients must be constantly stirred in order to keep the fat and cracklings in incessant agitation, otherwise pieces of unmelted suet, coming in contact with the sides or bottom, would become scorched and acquire a brownish tint, of which the whole melting would necessarily partake. Scorched tallow is not readily whitened. For separating the melted fat from the cracklings, it is ladled off from the caldron into a fine willow basket, or a copper box perforated at the bottom with innumerable small holes, set over large copper coolers, and allowed to remain undisturbed till all foreign matters have settled down. Before it congeals, it should be transferred into small wooden pails. This operation is continued so long as the cracklings yield any fat; and during the process the heat must be maintained at a moderate temperature, to avoid scorching the materials. When the cracklings begin to harden

they acquire a darkish tint, and hence are said to be browning. They are then pressed, and the fat thus obtained possesses somewhat of the brown colour of the cracklings, but not so much as to render it unfit for use as soap stock; it may, consequently, be mixed with that which has spontaneously separated while heating.

New Methods of Rendering.—D'Arcet's Apparatus.—This consists in conducting the rising vapours, consisting chiefly of hydrogen and carbon, through channels under the grate of the rendering pan, and using them as fuel. The pan is also covered with a strong iron plate, the front third of which can be lifted by means of a knuckle whenever it is necessary for stirring, filling, or emptying the kettle. D'Arcet was the first who employed chemicals for the purpose of neutralizing or destroying the noisome effluvia arising from the pans.

To Neutralise Infants from Tallow Pans.—Take 50 parts, by weight, of diluted oil of vitriol, put into the kettle, then 1000 parts, in weight, of chopped fat are gradually added in four equal portions; and lastly, 150 parts of water, to which 5 parts, in weight, of sulphuric acid of 66° B. have been previously added. The whole is then heated. Under the influence of the acid, which partly destroys, partly solves the membranes, the rendering of even greater amounts of fat is effected in 1½ to 2½ hours; 2 hours, however, are seldom required. The inventor's proposition of using acids was made when pans were heated by the direct action of the fire; but now steam is more generally employed. This, however, does not prevent the gases arising from the pans being thrown into the furnace and thereby aiding combustion. It is obvious that in the boiler of d'Arcet, stirring, as well as filling or emptying the contents of the pan cannot be accomplished so readily as in an open pan; nor can these processes be performed without opening the covers. To obviate this, a contrivance similar to that used by distillers in the mashing process could be introduced with decided advantage for keeping up the necessary motion, to prevent adhesions to the sides or bottom of the vessel, and consequent scorching.

Wilson's Process.—The chief feature of this process is to steam the rough suet for ten or fifteen hours in a perfectly tight tank, under a pressure of 50 lbs. to the square inch, or more when lard is being rendered. A higher pressure is not profitable, for, though expediting the process, it produces an interior quality of fat. No chemicals are used. The apparatus consists of an upright cylindrical vessel, made of strong boiler-plates, tightly riveted together. Its diameter is about two and a half times less than its height, and its capacity amounts to 1200 to 1500 gallons. It has a false bottom or diaphragm; below this a pipe enters, which is connected with an ordinary steam-boiler. There is a manhole at the top, through which the vessel is filled with the rough suet or lard to within about 2½ ft. of the top. By a safety-valve the pressure can be regulated. There are also some try-cocks, by which the state of the contents can be examined; if the quantity of condensed steam in the tank be too great, it will be indicated by the ejection of the fatty contents at the top one. There is a regulating cock at the bottom for drawing off the condensed steam, as well as cocks in the side of the digester, by which the fatty materials can be drawn off. Through a hole made in the diaphragm, which can be shut and opened at will, the residual matters can be let out.

Fouché's Process.—Fig. 59 represents a vertical, and Fig. 60 a horizontal section of the apparatus, after the line 1—2 in Fig. 59. Fig. 61 is a transverse section after the line 3—4 in the same figure. The vessel has a copper dome D, fastened by rivets. In this dome is a hole C for introducing fat, having a cover, which may be lifted by a chain going over a pulley, and the margin of the cover may be fastened to the vessel by clamps. This cover has a hole for observing the

Fig. 59

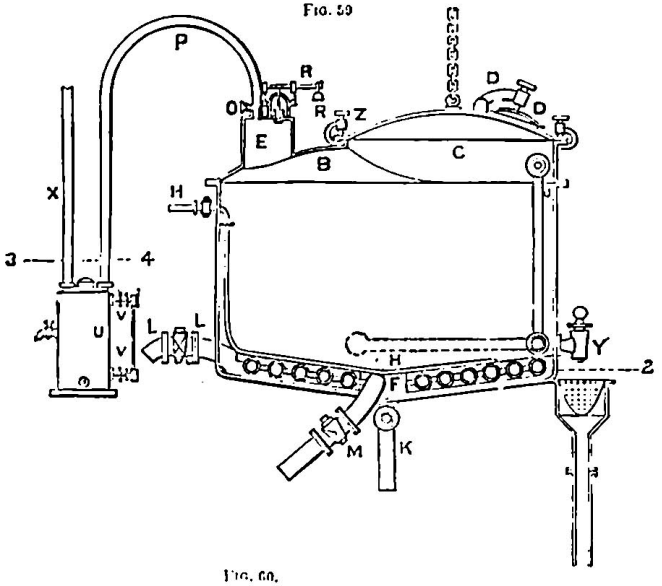


Fig. 60.

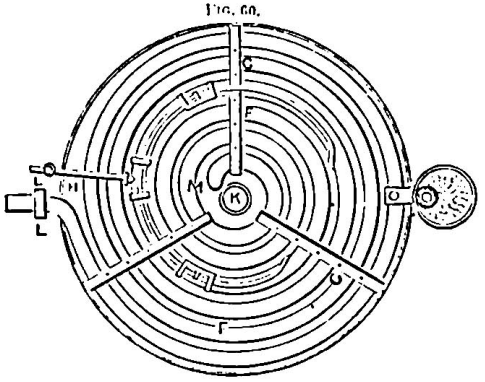
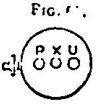


Fig. [illegible]



inside, which can be shut by a valve fastened to the lever D. E is a cap on the dome with the eduction-pipe for vapours, and P P is a safety-valve, with a counter-weight R. There is, moreover, an outer valve for the passage of air, either when filling or emptying the vessel, as well as a box for a thermometer. The vapours escaping through P, which may be opened by the faucet O, pass into U for the purpose of being condensed there,

or, when not condensed, for escaping through X. F is a worm, which, fastened to the stays G, Fig. 60, lies on the bottom of the vessel. Through L L steam is introduced from a boiler, and through M passes back into the same boiler. H H is a small pipe entering into the vessel A, through which steam also passes into the vessel, mainly for the purpose of keeping the melted fat in agitation. J is a tube, having a sieve at its upper end, and a movable crank below, by which it is fastened to the faucet Y. If the vessel is being emptied, the tube J is gradually let down until its upper part, with the sieve, reaches the bottom. The fat is then passed through J and Y, and through a fine sieve outside the vessel, which acts as a filter. In this, 1000 lbs. are first introduced with 80 lbs. of water; $2\frac{1}{2}$ lbs. of sulphuric acid of 66°, previously mixed with 16 lbs. of water, are then added. Steam is next turned on, which, as described, passes from the generator through the worm, and must have a tension of three atmospheres, or a temperature of 255° F. In the vessel, however, a tension of $1\frac{1}{2}$ atmosphere is sufficient, and when this is reached, the safety-valve is no longer charged with weights. The vapours formed in the vessel are conducted through X into the hearth of the steam-boiler furnace, so that all the noxious odours which, by the action of the sulphuric acid, are diminished, but not destroyed, are thus conveyed from the working rooms.

Evrard's Process.—The apparatus used very much resembles that of Wilson. The process is based on the application of caustic ley, in the proportion of 25 gallons, each containing $\frac{1}{10}$ to $\frac{1}{4}$ lb. of solid caustic soda, to every 250 to 350 lbs. of rough tallow. It is the object of the application of the ley to dissolve the membranous parts, so that no preliminary mincing is necessary. For boiling the fat, steam is employed. As the alkaline ley is heavier than water, it will, after the boiling is completed, more easily subside. It is then drawn off, and the fat left in the tank is again boiled with successive portions of fresh water, for the better separation of which this compound is left for 24 hours in a warm liquid state before being drawn off into the coolers.

Stein's Process.—A mixture of slaked lime and small pieces of fresh-burnt charcoal is prepared, and spread upon a coarse cloth stretched over a hoop, of 2 in. in depth, and the circumference corresponding with the size of the pan. During the process of rendering, it is securely adjusted by suitable catches above the pan. The rising vapours from the latter, in necessarily passing this chemico-mechanical arrangement, are said to be entirely absorbed, so that thus all cause of complaint against tallow factories as health-destroying nuisances would be effectually removed.

Clarifying Tallow.—By mere melting and straining we do not obtain a fat entirely free from admixture of fine, undissolved substances. For separating these substances, it must be clarified, by remelting it in water, either on free fire or by steam. Generally, no more water than 5 per cent. is taken, and stirred well with the fat till the mixture becomes emulsive. The whole is then allowed to rest, without further heating, till the water has separated, when the fat may be drawn off, or dipped off. Sometimes, to conceal the yellowish tint, a very little blue colour is added, consisting of indigo rubbed finely with some oil, of which a few drops are sufficient for large quantities of tallow. The process of clarifying is occasionally repeated. At the line of demarcation between the water and fat, a grey slimy substance is often perceptible, and the liquid itself is turbid. Instead of pure water, some tallow-melters take brine or solutions of alum, saltpetre, chloride of ammonium, or other salts. These agents have no chemical action upon the fats, but simply induce a more rapid settling of the impurities and water, principally when strong agitation is used.

Ozokerit.—This mineral is used in the production of illuminating oils of a

high firing point, and of solid hydrocarbons, more particularly adapted to the manufacture of candles of a high melting point; the inventors distil the raw material by heat, thereby obtaining an oily distillate, the solid and liquid constituent parts of which are then separated by pressure. The pressed solid material is purified by mixing and stirring with sulphuric acid when melted. After standing for some time, in order to effect the complete separation from the acid, the supernatant melted material is carefully decanted off, and thoroughly washed with hot water. The water having been removed, the material is repeatedly filtered through animal charcoal until the requisite degree of whiteness is attained.

Hardening of Tallow by Capaccioni's Process.—In 1000 parts of melted tallow, 7 parts of sugar lead, previously dissolved in water, are stirred, during which process the mass must be constantly agitated. After a few minutes the heat is diminished, and 15 parts of powdered incense, with one part of turpentine added, under constant stirring of the mixture. It is then left warm for several hours, or until the insoluble substances of the incense settle to the bottom. The hardening is produced by the sugar of lead, yielding a material similar to the stearic acid, while the incense is improving its odour; it is said that by this treatment the guttering of the candles is entirely prevented.

Cassgrand's Process for Bleaching Wax.—First melt the wax with steam, which pass together through long pipes, so that a large surface becomes exposed to the steam. After traversing the pipes, it is received into a pan with a double bottom, heated by steam; it is therein treated by water, left quiet for some time until its impurities are settled. It is then forced anew through the pipe together with the steam, washed a second time, and, if necessary, this process is repeated a third time. Probably water is absorbed by the wax, thus rendering it more easily bleached.

Arrangement of a Bleaching-house.—Stakes or posts are driven into the ground, and 2 ft. from the ground bag-clothes are stretched over them, or table-like frames are made from strips of cloth stretched over the frames in the same manner as a sacking-bottom is stretched over a bedstead, care being taken to fasten the ends of the cords to the posts sufficiently firm to prevent them loosening by the wind. This done, the wax ribbons are spread upon the cloth in a thin layer. It is important that the place selected for this process should be so arranged that the sun's rays may have full play upon the exposed wax, but at the same time protected from the prevalent winds. The ribboned wax is daily turned over, in order that fresh portions of it may be affected by the sun; and should it not be sufficiently moistened by the dew or rain, soft water is poured over it. When it is not gradually becoming whiter, but still continues yellow upon the fracture, it is remelted, ribboned, and again bleached. The continuance of the bleaching process varies, depending upon the weather; often one exposure to the sun and air suffices to bleach it, and no remelting is requisite. Four weeks are generally sufficient. The bleached wax is finally fused into cakes or square blocks, previously moistening the moulds. As fast as the wax congeals, the cakes are thrown into a tub of clean, cold water, and then taken out and spread upon a pack-thread sieve for draining. Eventually, they are dried and packed in boxes for the market, the loss being from 2 to 8 per cent.

Wicks.—Wicks are twisted or plaited; the former, loosely twisted, present the appearance of a spiral similar to the separate strands of a rope; the latter, now generally adopted for most kinds of candles, is made by interlacing and crossing the strands of the wicks in the same manner as plaiting straw of bonnets. Common wicks are simply an aggregation of several loosely-twisted threads forming one general cord of many fibres. This is effected by the ball winding machine, a very simple apparatus. For cutting wicks, Sykes's apparatus is in

general use, especially for tallow-candle wicks, which must be soaked with tallow at one end. Fig. 62 represents a vertical, and Fig. 63 a horizontal view of it. *c c*

Fig. 62.

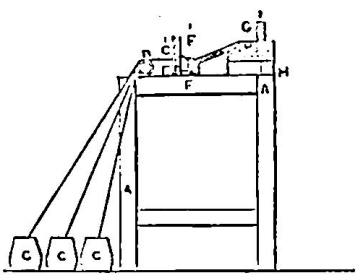
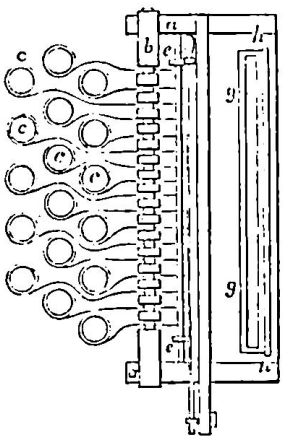
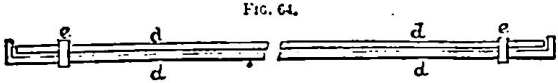


Fig. 63.



are spools on which the wicks are wound. *b* is a roller with grooves cut around it, by means of which the wicks are conveyed into the clamp *d*, represented in Fig. 64 on a larger scale, and as seen from the side. It consists of two wooden frames, which are made tapering from the middle towards the end. On each side there is a feather of steel attached, for the purpose of holding the frames, with a space between them, which may be diminished by sliding the feathered clamps *e e* towards the middle, or increased by drawing them towards the end. Immediately behind the clamp there is a cutting apparatus, consisting of an immovable *f* and a movable blade *f*, with a handle. *g* is a small vessel filled with liquid fat, which may be kept from solidifying by steam, and a board *i* lying on the lathe *h*. The use of the apparatus is as follows;—The ends of the wicks, wound upon the spools *c c c*, are passed through the frame *d*, properly tightened by the clamps *e e*, so that all the wicks are kept firm. The knife *f* of the cutting apparatus is then lifted out of the way; the frame, with the wicks enclosed, is drawn backwards to the vessel *g*, and the ends of the wicks dipped in the melted fat; this done, the fat-soaked ends are drawn farther back and placed under the weight I, which holds them firmly while the clamps are loosened on the frame, and this returned to its first-described position and again tightened. The knife is next used, cutting all the wicks off at a stroke, then elevated, and the process repeated till a sufficient number of wicks are cut. The thickness of the wicks varies according to the diameter of the candles and the material of which they are made. The number of the cotton threads requisite to form a wick also varies according to their firmness. The yarn is composed of a slack-twisted cotton thread; No. 16 generally for plaited,

Fig. 64.



and smaller, such as 8–12, for common wicks.

Index to the Thickness of Wicks.—The yarn employed is No. 16. For tallow candles, 8 to the lb., the wick

contains 42 threads; 7 to the lb., 45 threads; 6 to the lb., 50 threads; 5 to the lb., 55 threads, 4 to the lb., 60 threads. These wicks, composed of 10, 12, or even 16 cords, are very loosely twisted, and [illegible] a kind of hollow tube. For stearic candles, three-corded plaited wicks are generally used, smaller in size and of finer yarn. Stearic candles, 4 to the lb., the wicks consist of 108 threads; 5 to the lb., 96 threads; 6 to the lb., 87 threads; 8 to the lb., 63 threads.

Preparing Wicks.—This is done by wick-mordants, by means of which they are rendered less combustible, especially those for stearic acid, and composite candles. Compounds composed of solutions of ammoniac salts, of bismuth, of borates, or boracic acid, are used. A simple and cheap mordant for wicks is a sal ammoniac solution of 2° to 3° B. This concentration is strong enough, and if a weaker one be used, a spark will remain on the wick after the candle has been blown out, and burning down to the fat, make relighting more difficult. Before moulding is performed, the wicks, having been saturated, are thoroughly dried in a tin box, surrounded by a jacket, in which steam is introduced. Instead of the sal ammoniac, phosphate of ammonia is used in some factories. A very good mordant is also a solution of $2\frac{1}{5}$ oz. boracic acid in 10 lbs. of water, with $\frac{1}{4}$ of an ounce of strong alcohol, and a few drops of sulphuric acid. Some mordants have become unpopular, the fault is in the crude cotton, which does not always readily become moistened; consequently, from not having completely imbibed the mordant, portions of the thread remain unsaturated, and are not equally combustible with the others. An admixture of alcohol will remedy this defect, as cotton is more easily moistened in diluted spirit than in pure water.

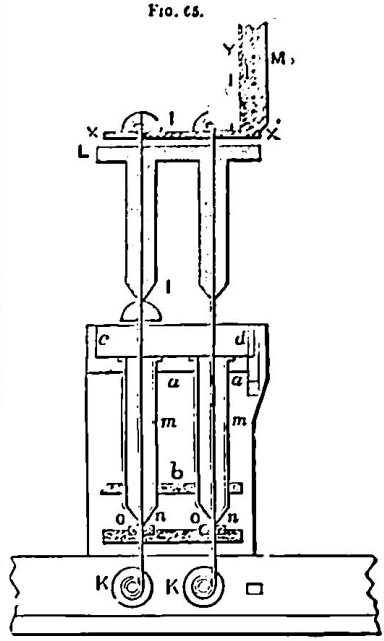
Dips.—These candles are made by stringing a certain number of wicks upon a rod, and dipping them in melted tallow repeatedly. The process is very simple; the clarified and remelted tallow is poured into a tightly-joined walnut or cherry trough, 3 ft. long by 2 ft. wide, and 10 to 12 in. wide at the top, gradually diminishing to 3 or 4 in. at the bottom. A handle is fixed on each end for its easy removal, and when not in use it is closed with a cover. The operator commences by stringing 16 to 18 wicks at equal intervals on a thin wooden rod, about $2\frac{1}{2}$ ft. long, and sharpened at the ends. He then takes 10 or 12 such rods and dips the wicks rapidly into the fluid tallow in a vertical direction. This tallow should be very liquid, in order that the wicks be soaked as uniformly as possible, after which the several rods are rested on the ledges of the trough, when, if any of the wicks be matted together, they are separated, and the rods so placed on a frame, having several cross-pieces, that the uncongealed tallow from the wicks may drop down, and while this is going on, which continues till the tallow is cooled and solidified, the operator is engaged in preparing another batch of rods. The fat in the trough, meanwhile, is so far cooled that in immersing the first dip again a thicker layer will adhere to the wicks. It is considered, that when the tallow solidifies at the sides of the vessel, the temperature is the most convenient for the object in view. It is sometimes necessary to stir the ingredients to produce a uniform admixture, and in such cases much care should be taken so that no settlings be mingled with the mass, whilst by the addition of hot tallow any desired temperature may be obtained. The tallow on the wicks between each dipping becomes so gradually hardened, that at the third or fourth immersion new layers necessarily solidify; as a natural consequence of the method of dipping, the lower ends of the wicks become thicker than the upper, to remedy which the lower ends are again put into the melted fat for a few minutes, when the heat, as a matter of course, diminishes their dimensions. The process of dipping is continued until the candles acquire the requisite thickness. The conical spire at the upper end is formed by immersing

deeper at the last dip, and if, eventually, the candles are too thick at the lower end, they are held over a slightly-heated folded copper sheet, so that the fat may melt, but not be warped.

Moulds.—For moulding, besides the common metal moulds, a mixture of tin and lead, moulds of glass are sometimes used. The former are slightly tapering tubes, varing in length and dimensions according to the size of the candle to be manufactured, and, when required, are arranged in regularly-perforated wooden frames or stands, with the smaller end downwards, forming the upper or pointed part of the candle. At this smaller end, the wick, previously saturated in melted fat, is inserted, filling the aperture, and, passing up the centre, is fastened perpendicularly at the upper end of the tube, to which is attached a movable cover. The melted fat is then poured in, generally with a small can, but a tinned iron siphon is better. It is requisite that the tallow should completely fill the mould, that it should remain uncracked on cooling, and should be easily removable from the moulds. This can, however, only be obtained when the fat at the sides cools more quickly than that in the interior, and when the whole candle is rapidly cooled. A cool season is, for this reason, far better; but a certain condition of the tallow, namely, that which it possesses at a temperature very near its melting point, is absolutely necessary. Candle-makers recognize the proper consistence of the tallow for moulding by the appearance of a scum upon the surface, which forms in hot weather between 111° and 119° Fahr., in mild weather at 108°, and in cold about 104°. The tallow is usually melted by itself, sometimes, however, over a solution of alum. The candles are most easily removed from the mould the day after casting, to be cut and trimmed at the base. Moulding by hand is a very tedious operation, and only practised in the smaller factories; in more extensive establishments, where economy of time and labour is a consideration, machinery is employed.

Kendall's Moulding Apparatus.—Fig. 65 represents a vertical transverse section through one of the mould-frames, exhibiting the candles drawn from the moulds. Fig. 66 represents a top view of a row of moulds, showing the clamp in place ready to centre the wicks. The moulds are mounted upon cars, for being carried from place to place as required, each capable of conveying several dozens, which are heated to about the temperature of the melted fat by running the car into an oven. The moulds thus heated are carried by cars to a caldron containing the melted fat, with which they are filled. The car is then attached to one of the empty trucks and allowed to remain till the candles are cooled, when it is moved to an apparatus, by means of which the candles are drawn

FIG. 65.

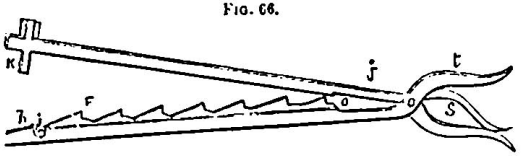


and the moulds re-wicked, and again ready to be heated and filled. In Fig. 65, *m m* represents moulds mounted on two horizontal boards *a* and *b*, in which round holes are cut, and tightly screwed at the upper end, around which a thin wooden frame is attached, ⅔ of which is firmly fastened, whilst the other ⅓ forms a slide. The lower end of the moulds rests on pieces of vulcanized india-rubber *o*, let into the cross-bar *e*; each piece of india-rubber being pierced with a hole somewhat smaller than the wick, and as the wick is passed through this hole, the latter compresses it so tightly as to prevent the fat from leaking out. In like manner, the leakage is prevented between the bottom or tip *n* by the pressure of the mould upon the india-rubber. The spools K hold the wicks firmly and centrically secured by clamps. On the ledge *c* of the bottom *a* there are four pins *i*, which tighten the clamps *j*, Fig. 66, by means of wicks are next cut off above the lower clamp, the candles with the clamps removed, when, by sliding off the spring catch K, the spring S, between the jaws *t t*, causes the arm F to separate and release the wicks.

Composite Candles.—Melt together, over a water bath, 100 parts of stearic acid, and 10 to 11 parts of bleached beeswax; but, to ensure success, the mixture must remain over the bath from 20 to 30 minutes, without being stirred or agitated. At the end of that time the fire is to be extinguished, and the fluid allowed to cool until a slight pellicle is formed on the surface, when it is cast direct into the moulds, previously heated to the same temperature, with the precaution of avoiding stirring the mixture, which would cause opaqueness.

Transparent Bougie.—For 100 lbs. of stock take 90 lbs. of spermaceti, 5 lbs. purified suet of mutton, and 5 lbs. wax;

FIG. 66.



small holes *g h*. On one side F of the clamp there are also toothed jaws, in which the wicks fit exactly, that is, they are thus kept vertical and in the centre of the moulds. The construction of the clamp, Fig. 66, is such that the arm working upon a joint at *o*, and being brought against the arm F, falls into a groove made in its length, so as to press and kink the wicks in the groove, and fasten them firmly there by means of the spring catch K. The object of this is, that in raising the candles from the moulds by this clamp they shall not slip nor move. As the candles are lifted out of the moulds, as in Fig. 65, the wicks are drawn after them from the spools K, and are then clamped in position in the manner described. The melt each separately over a water bath, and to the whole, when mixed together, add 2 oz. of alum and 2 oz. of bitartrate of potassa in fine powder; and, while stirring constantly, raise the heat to 176° Fahr.; then withdraw the fire and allow the mixture to cool to the temperature of 140° Fahr. When the impurities subside, the clear liquid must be drawn off into clean pans. For quality and good appearance, candles made of this cooled block are more than proportional to its cost. Substitute plaited wicks for the foregoing mixture to the wicks generally used for composite candles, and prepare them by previously soaking in a solution of 4 oz. borax, 1 oz. chlorate of potassa, 1 oz. nitrate of potassa, and 1 oz. sal ammoniac,

in 3 quarts of water. After being thoroughly dried, they are ready for moulding.

Diaphane.—It is made by melting together, in a steam-jacket, from 2½ to 17½ lbs. of vegetable wax, 1½ to 10½ of pressed mutton tallow, and 22 to 46 lbs. of stearic acid. Both the latter and the vegetable wax are the hardening ingredients. By changing the proportions between the above limits, a more or less consistent mixture may be formed. The moulding is performed in the same manner as for stearic-acid candles.

Parlour Bougies.—1. Melt slowly, over a moderate fire, in a well-tinned copper kettle, 70 lbs. of pure spermaceti, and to it add piecemeal, and during constant stirring, 30 lbs. of best white wax. By increasing the proportion of wax to 50 lbs., the resulting product is much more diaphanous; however, the bougies moulded of this mixture are not as durable as candles made exclusively of wax. They are tinted in different colours. For red, carmine or Brazil wood, together with alum, are used. Yellow is given with gamboge, blue with indigo, and green with a mixture of yellow and blue. Sometimes the bougies are perfumed with essences, so that in burning they may give off an agreeable odour. 2. Add 6½ lbs. of wax to 100 lbs. of pure dry sperm, candles made from this mixture very much resemble Judd's Patent Candles.

Composite Candles.—The block for these candles is made by adding a portion of hot-pressed cocoa stearine to stearic acid of tallow. This is a good and economical mixture.

Belmont Sperm is a mixed stock of hot-pressed stearic acid from palm and cocoa butters.

Belmont Wax is palmitic acid coloured by gamboge.

Candles with Snuffless Wicks.—The great objection to tallow candles is the frequent necessity for removing the snuff, or charred wick, which rises into the body of the flame and obscures the light. If the wick can be exposed to the air it will be entirely consumed. 1. This is done in composite candles by plaiting the cotton into a flat wick, which as it burns curves over. Sometimes a very fine wire is included in the wick, which is usually dipped in a solution of borax. 2. Twist the wick with one strand shorter than the others, which will bend the wick slightly when the fat melts.

Fire Lute.—1. Mix thoroughly 2 parts good clay, 8 parts sharp washed sand, 1 part horse-dung, then temper like mortar. 2. Linseed or almond meal mixed to a paste with milk, lime-water, or starch-paste. This lute stands to 500°.

Fat Lute.—1. Mix dry clay in powder with drying oil into a thick paste. The part to which this is applied must be clean and dry. 2. Plaster of Paris mixed with water, milk, or weak glue. Both these lutes stand a dull red heat.

Rust.—*To prevent Rusting.*—1. Boiled linseed oil will keep polished tools from rusting if it is allowed to dry on them. Common sperm oil will prevent them from rusting for a short period. A coat of copal varnish is frequently applied to polished tools exposed to the weather. Woollen materials are the best for wrappers for metals. 2. Iron and steel goods of all descriptions are kept free from rust by the following;—Dissolve ½ oz. of camphor in 1 lb. of hog's lard, take off the scum, and mix as much black-lead as will give the mixture an iron colour. Iron and steel and machinery of all kinds, rubbed over with this mixture, and left with it on for 24 hours, and then rubbed with a linen cloth, will keep clean for months. If the machinery is for exportation it should be kept thickly coated with this during the voyage.

Anti-rust Varnish.—Take the first three ingredients in a pounded condition, and digest them by a regular heat till melted, then add the turpentine very gradually, stirring all the while. Rosin, 120 parts; sandarac, 180; gum lac, 60; essence of turpentine, 120. The mixture should be digested until dissolution, then add rectified alcohol, 180 parts. Filter through fine cloth or

thick bibulous papers, and preserve in well-stoppered bottles or cases.

Extracting Rust from Steel.—Immerse the article to be cleaned for a few minutes until all dirt and rust is taken off, in a strong solution of cyanide of potassium, say about ½ oz. in a wineglassful of water; take out and clean it with a toothbrush, with some paste composed of cyanide of potassium, Castile soap, whitening, and water; these last are mixed in a paste about the consistence of thick cream.

India-rubber. — *Solvents.* — Benzine is an excellent solvent for caoutchouc and gutta-percha. Caoutchouc, or india-rubber, may also be dissolved in ether, sulphide of carbon, naphtha, or spirit of turpentine, and in chloroform.

India-rubber Solution.—1. A mixture of 6 parts absolute alcohol with 100 of sulphate of carbon; the latter is the real solvent, the alcohol has an indirect action. The quantity of solvent required depends on the consistency of solution required; if moderate heat is used, and the mixture shaken, the whole dissolves, but a better solution is obtained for adhesive properties by using a large quantity of solvent, not shaking, but drawing off the clear glazy liquid. 2. For a small quantity, place 1 fluid dram sulphuric acid and the same quantity of water into a phial bottle, and well shake together. Great heat is evolved. Allow to stand till cool; then add 2 fluid oz. of spirits of turpentine, and shake well. Great heat will again be evolved, and the colour changed to deep cinnamon. Allow to stand for 24 hours, after which a strong dark sediment will have settled at the bottom of the bottle. Pour off the clear liquor into another bottle, and add 1½ dram apothecaries' weight of common india-rubber cut up into fine shreds, and then place it uncorked over a very gentle heat, and allow to boil slowly for 5 hours. At the end of that time the india-rubber should be perfectly dissolved. It can be concentrated by longer boiling, or thinned by the addition of more turpentine.

Piecing India-rubber.—Make a long bevel on the ends to be joined with a sharp rough-edged knife and water, scrape the bevels rough with the edge of the knife, and when quite dry, give each a coat of india-rubber solution. Say 1 oz. of rubber not vulcanized to 5 oz. of turpentine. When the first coat is dry, give it another, and when that is dry, put the two ends together.

EBONITE AND VULCANITE.—The only difference between these two articles is in the colouring materials used. These terms are applied to a compound of india-rubber and sulphur, exactly the same as the common elastic bands, the only difference being in the time and heat required to vulcanize or harden the compound. To prepare it as sold in the form of combs, the india-rubber is put into a masticator along with a proper proportion of sulphur, and when thoroughly mixed a sufficient quantity is put into a mould of the right shape made of plaster of Paris, or other material which will not combine with sulphur, and exposed in a steam boiler to a heat of 315°, and a pressure of about 12 lbs. to the inch for 2 hours. It is then removed from the mould, and finished, and polished exactly in the same manner as ivory. The application of heat as above without a steam pressure is sufficient to vulcanize or harden the compound, but the result is not always so satisfactory, as the material is liable to be porous if not compressed whilst hardening. Gutta-percha may be treated in exactly the same manner as india-rubber, and cannot be distinguished from it, but is rather more troublesome to work. The vulcanite may be turned or carved in the same way as ivory, with the advantage that it may be moulded to the required form without the great waste which attends ivory carving. It is also much less liable to fracture. The smaller the proportions of sulphur in the rubber, and the lower the temperature used, the softer and more elastic will be the india-rubber. About 10 or 15 per cent. of sulphur, and a temperature of 270° or 275° for 4 hours, will make an elastic rubber; 30 per cent. of sulphur and a

temperature of 315° for two hours will make a hard vulcanite-like ivory.

Welding Cast Steel.—1. Heat the steel carefully, watching it, in a gentle fire kept free from dirt, and use the following composition;—Ten parts of borax and 1 of sal ammoniac; grind them together roughly, and then fuse them in a metal pot over a clear fire, taking care to continue the heat until all spume has disappeared from the surface. When the liquid appears clear the composition is ready to be poured out to cool and concrete, afterwards to be ground to a fine powder. This may be best done by running it into a strong iron vessel, or, if in a smith's shop, into a hole in the swage; put in a piston, and use the sledge-hammer. A small quantity of this composition will be sufficient sprinkled on the parts to be welded while in the fire. Care should be exercised in hammering the splice. To use this composition, the steel to be welded is raised to a heat which may be expressed by bright yellow; it is then dipped into the welding powder, and again placed in the fire until it attains the same degree of heat as before, it is then ready to be placed under the hammer. 2. Borax, 10 parts; sal ammoniac, 2; flour of sulphur, 1; grind or pound them roughly together; fuse them in a metal pot over a clear fire, taking care to continue the heat until all scum has disappeared from the surface. Use in the same manner as No. 1.

Lead Burning.—The apparatus required is a cast-iron furnace, two or three ladles, and some moulding sand. Burning is resorted to by plumbers generally for purposes where soldering will not stand, such as retorts used in bleaching works where the acid destroys soldering. Cast a sheet of lead of the proper thickness, and cut the proper length and width, turn it up round like a hoop, bringing the two ends well together to form a good joint on the outside, and firmly tack them together on the inside; roll it over to see that the joint is close on the outside, and paste a piece of stout brown paper about 4 inches wide over the whole length of the joint. The sand must be well tempered not to have any wet lumps in it; make a level bed with the sand about 5 or 6 inches thick; roll the hoop on the sand so that the joint will come under, be careful not to shift it backwards or forwards, but well ram up under both sides. Have a strip of wood rather longer than the joint, about ¾ inch thick, to form the runner with, place it along on edge on the top of the joint; now place some sand both sides and well ram it together, adding sand until there is a good bank on the top of the work; smooth it off with a trowel, cut it down towards the strip, so as to form a sort of funnel, leaving about 2 inches of the strip buried; draw out the strip endways, be careful not to break the sand, leaving one end stopped up, the other end stop up about 1 in. high. At this end make a bay or pond for the overflow metal to run into. Have the metal red hot, be careful that the runner is free from loose sand, shake a little pounded rosin along in the runner, have a trying stick that can be drawn easily along the runner. Now begin to pour the metal, of which have plenty, holding the ladle at least 1 ft. above the runner so as to give weight and force to the burning metal; pour plenty, not minding what is running off, as the metal that is pouring in has to melt the part which is in the cold sand. When the joint is burnt through try it by drawing the trying stick along in the runner; if it feels smooth along the bottom it is burned, if not pour some more until it is, then stop up the end where the metal has been running off, and fill up about 2 inches high, and watch for shrinkage, having some hot metal ready to fill up as it shrinks down in cooling, or else the joint will not be round. When set remove it from the sand, and cut off the runner with a mallet and chisel, finishing off with a piece of cardwire, the paper on the outside will strip off, leaving it clean, whereas if the paper was not used the sand would adhere to the metal, which would look bad. Having now completed this part and set it up, round in shape, proceed with burning in the bottom;

having a hole or pit in the floor deep enough for the hoop to go down level with the floor, place it in perfectly level. Having placed the hoop level, fill up with sand inside and out rather slack. When filled up within about 4 or 5 inches from the top, ram it down for the other part quite hard on the outside, leaving the sand rather higher than the edge; then with a straight-edge scrape off level with the edge of the lead. Now with a scribe take out the sand the thickness of the required bottom, plane the sand off with a trowel, and the work will turn out clean. The sand on the outside being up level with the edge, smooth off, and cut a bay all round to take the overflow, shake a little pounded rosin round the edge; having the metal red hot, begin to pour as before, only this is a work for two or three persons if it is any size, as it must be done quickly, pouring the hot metal along the edge until it is properly burned down; when it is burned deep enough, pour a few ladlefuls all over the bottom, so as to get it in a thoroughly fluid state; then with the edge of the trowel clean off the dross, leaving a perfectly bright surface; let it remain to set. This will not require any filling up, as it is open to the air and shrinks; when set it may be removed, and if well burned it will be perfectly solid.

Whalebone.—Whalebone is the substitute for teeth in the Greenland whale, and in the black southern whale; The surface of the blade is compact, and susceptible of a high polish by mere friction. Its texture is lamellar in the direction of its breadth, so that it easily splits and divides in this direction, but not in that of the thickness of the blade; the middle of the blade is of a looser texture than the rest, and is called the grain, being composed of coarse, bristly hairs. The general colour of whalebone is a dusky greyish black, intermixed with thin strips or layers of a paler colour, which are often almost white—very rarely the entire flake is milk-white. To prepare the whalebone for use, it is boiled in water for several hours, by which it becomes soft enough to be cut up, while hot, in lengths, according to the use to which it is to be applied; or, by means of a compound guarded knife, is cut into fibres for brushes, which are extensively used in stables for the first process in cleaning a horse. Whalebone that has been boiled, and has become cold again, is harder and of a deeper colour than at first; but the jet-black whalebone has been dyed. The principal consumption of whalebone is for stretchers to umbrellas and parasols, also for women's stays, and whips are made of plaited whalebone. White whalebone has been made into bonnets, and likewise into artificial flowers, as its texture is well adapted to this purpose; and it will, by the usual dyeing processes, take very bright and durable colours.

Silk.—*Solvents.*—Several substances dissolve silk, such as the ammoniacal solution of oxide of nickel; that of copper dissolves cotton as well as silk, the silk is precipitated by acids. Chloride of zinc saturated with zinc oxide also dissolves silk, but in no case can silk thread be dissolved without the thread being decomposed.

To Renovate Silk.—Potato-water is good to clean all colours and kinds; grate the potatoes into cold spring water, say a large potato to eve. y quart of water, of which five or six will do for a couple of dresses. If for very light silk, pare the potatoes; if for dark, merely wash them clean. The pan of water must not be stirred in the least for 48 hours; then, very slowly and steadily pour off the clear liquor, but not a particle of the sediment, into a large open vessel, dip the pieces of silk into this liquid up and down a few times, without creasing them; then wipe them on a flat table with a clean towel, first one side, then the other. It is as well to hang each one as dipped upon a line to allow the drops to drain off a little before wiping. Have a damp cloth to cover them in till all is done; then iron one way, on the soiled side.

Freezing.—In the production of

ice, or an extreme degree of cold, by saline mixtures, the salts should be in crystals, and as rich as possible in water, but not in the least damp. Coarsely pulverize when about to use them, and do not mix until just before throwing them in the liquid ingredients. The mixture should be made in a thick vessel, well covered with non-conducting material, to prevent the access of external heat; the substance to be frozen must be contained in a very thin vessel, so as to expose it more fully to the action of the mixture. Thus the ices used in confectionery are made by placing the cream, or sweetened water, in a tin, which is immersed in a bucket containing a mixture of powdered ice and half its weight of common salt—move the tin about in the freezing mixture until the cream has sufficiently solidified.

Freezing Mixtures.—1. Snow or pounded ice, 2 parts; chloride of sodium, 1. 2. Snow or pounded ice, 5 parts; chloride of sodium, 2; sal ammoniac, 1. 3. Snow or pounded ice, 12 parts; chloride of sodium and nitrate of ammonia, 5 of each. 4. Snow, 8 parts, concentrated hydrochloric acid, 5.

Freezing Powders.—1. 4 lbs. of sulphate of soda, 2½ lbs. each of muriate of ammonia and nitrate of potash; when about to use add double the weight of all the ingredients of water. 2. Equal parts of muriate of ammonia and nitrate of potash; when required for use add more than double the weight of water. 3. Nitrate of ammonia and water in equal proportions. 4. Carbonate of soda and nitrate of ammonia equal parts, and one equivalent of water.

Carré's Ice-making Machine.—It consists of an upright boiler partly filled with very strong ammoniacal solution, so strong that a glass bottle of it held in the hand at once gives off bubbles of gas. From the top of this rises a tube to about the same height as the boiler. This tube ends in a smaller one, which bends down to level of top of the boiler, and is inserted into a cylindrical vessel kept at a distance of about a foot and a half from the boiler. This cylinder has a smaller one riveted into it, in which the tin containing the water to be frozen is to be inserted. The whole of the machine is hermetically closed, so as to allow no escape of the gas. The boiler is put on a charcoal fire, and when a thermometer shows the temperature to have risen to the proper point the solution is converted into gas at a great pressure. The boiler is removed from the fire, and placed in a tub of cold water; the tin of liquid to be frozen is placed in the cylinder, and the gas begins to condense. In a certain time, according to the coolness of the water in the tub, such a great degree of cold is produced by the condensation that the contents of the tin are frozen solid. In hot countries the water in the tub must be changed two or three times as it gets warm. Instead of water, cream, or bottles of beer or wine may be placed in the cylinder. The wine, not requiring to be frozen, may remain only a short time, and then be replaced by a second or third edition, till the gas is completely condensed. The solution lasts many years. The boiler can be filled again, but it is a very troublesome operation, as the moment a soldering iron is brought near the aperture, the gas begins to escape; still it has been done.

To Preserve Ice.—1. Put the ice on a dish and cover it with a napkin, then set the dish upon a feather bed or pillow, and place another bed or pillow on the top of it. In this way a few pounds of ice may be kept for a week or more. 2. Wrap the ice in a piece of old flannel, and if not required immediately bury it in the ground.

Ice House.—If possible, choose for the site of an ice house the north-east side of a hill or plantation, or the inside of a plantation where it would be perfectly shaded with trees; then have the earth excavated to the required size, and, in addition, sufficient to allow of a double wall being built with from 6 in. to 1 ft. space between each wall. The shape may be either an inverted cone or a square; whichever form is used, there

must be perfect drainage insured from the bottom of the well, so that the ice will be kept dry. It can be arched over at top and covered with earth, or roofed with timber and well thatched with straw. The entrance should be by double doors, with the space between filled with straw; the inner door should be perfectly air-tight. In storing see that the ice is well smashed and pounded into the well, as upon this will depend a great deal its keeping properties.

Solders.—*Solder for Jewellers.*—Melt together in a crucible 19 parts fine silver; copper, 1 part; and brass, 10 parts.

Silver Solder for Plating.—Melt together 10 dwts. of brass, and 1 oz. of pure silver.

Gold Solder.—Melt together pure gold, 12 parts; pure silver, 2 parts; and copper, 4 parts. Fuse together 3 parts gold, 2 parts silver, 1½ copper, then add ½ part zinc, for a solder that will flow at a dull red heat, suitable for gold brooches, guards, &c.

Hard Solders.—1. 2 parts of good silver and 1 of ordinary brass pins, well melted, is a good, useful, jewellers' hard solder; but it must not be melted more than once. 2. Hard silver solder composed of 4 parts of fine silver and 1 of copper, made into an alloy and rolled into sheets, is very difficult of fusion. These alloys are run into convenient bars or strips for use. Silver solders are used for soldering silver-work, gold, steel, and gun-metal. A neater seam is produced with the hard silver solders than with soft solders.

Soldering Jewellery.—1. Jewellers solder with gold of a lower title than the article to be soldered—borax, flux, and blowpipe, enveloping the other part with tissue-paper and whitening. 2. Gilding by simple immersion, 1 dwt. fine gold, very small; put into a saucer, add ½ oz. muriatic acid, ½ oz. nitric acid; keep the saucer over a slow fire till the gold is dissolved, move the saucer till the acid evaporates and leaves the gold dry in dark red crystals around the saucer; then add 1 oz. cyanide of potassium, dissolve in ½ pint of boiling water; pour this over the crystals in the saucer to wash them off, let it all run into a basin, stir, and it is fit for use; lay the object to be gilt on a small bit of clean zinc. Put in bath, remove in a minute, scratch-brush, immerse again for a minute, scratch-brush, wash in boiling water, dry out with boxwood dust.

SOLDERING SILVER.—*Solder.*—Fine silver, 2 parts; brass wire, 1 part; melt the silver first in a crucible, when it is melted put the brass wire in the crucible, it will soon melt and mix with the silver; put a little borax with it, and give it a good heat for about 10 minutes, then pour it in the skillet and pass it through the flattening mills until it becomes the thickness of a threepenny piece, when it is ready for use.

Solders of various Hardness.—1. Hardest; silver, 4 parts; copper, 1 part; fuse together. 2. Hard; sterling silver, 3 parts; melt, add brass wire, 1 part. 3. Soft; silver, 2 parts, melt; add brass wire, 1 part, this is generally used; some add a little arsenic, to make it whiter and more fusible, but it becomes less malleable and more injurious. 4. Pure tin, or tin solder, 2 parts lead to 1 part tin, used for inferior work. 5. Fine brass, 6 parts; silver, 5; zinc, 2.

Soldering German Silver.—Clean the places where you want the solder to run by scraping, then paint it with spirits of salts, to which add, before using, a small piece of zinc; put a piece of pewter solder on, and direct the flame of the gas or lamp on the article. The solder will run into the places which have been touched by the spirits of salts.

Solder.—5 parts German silver, 4 parts zinc. Melt, run into thin cakes, and powder.

Silver Solder for Plated Metal.—Melt together 10 dwts. of brass and 1 oz. of pure silver.

Best Soft Solder for Cast Britannia Ware.—Tin, 8 lbs.; lead, 5 lbs.

White Solder for Silver.—Silver, 1 oz. tin, 1 oz.

Pewter and Britannia Metal.—10 parts tin, 5 parts lead, bismuth, 1 to 3 parts.

Soldering Zinc.—The parts to be

soldered must be well cleaned and bright; tin the copper soldering iron by rubbing it while hot in dry hydrochlorate of ammonia with a globule of solder. First wet the parts to be soldered with a solution of chloride of zinc. For zinc plates use the acid alone; next apply the solder, rubbing it with the iron till it unites with the metal. The solder for zinc is composed of 2 parts tin and 1 of lead.

Solder for Tin Plates.—Tin, 2 parts; lead, 1 part. Add 1 part bismuth if desired to use for pewter.

SOFT SOLDERS.—*Soft Gold Solder* is composed of 4 parts gold, 1 of silver, and 1 of copper. It can be made softer by adding brass, but the solder becomes more liable to oxidize.

Soft Silver Solder.—A strong, easy-flowing and white solder for jewellers' use is composed of lead, 1 part; and tin, 2 parts. When the lead is melted put in the tin, and then throw in a small piece of rosin as a flux. In soldering fine work wet the parts to be joined with muriatic acid in which as much zinc has been dissolved as the acid will take up. It is cleaner than the old method of using Venice turpentine or rosin.

Soft Soldering Copper, or Pewter.—Copper, pewter, tin, lead, and brass, can be soldered with spirits of salts, which has been killed with zinc, for a flux. This will solder anything but zinc itself, for which free acid must be used. The killed spirits may remain open to the air for weeks without deterioration.

Plumbers' Soft Solder is composed of tin and lead in equal parts.

Hard Solder.—Copper, 2 parts; zinc, 1 part.

Chemical Soldering.—A neat mode of soldering for small articles;—Cut a piece of tin-foil the size of the surfaces to be soldered; dip a feather in a solution of sal ammoniac, and paint over the surfaces of the metal; then place them in their proper position, with the tin-foil between; put it so arranged on a piece of iron hot enough to melt the foil; when cold they will be found firmly fastened together.

Solder for Steel Joints.—Take 19 dwts. of fine silver, 1 ditto of copper, 2 ditto of brass; melt under a coat of charcoal dust. This solder possesses several advantages over the usual spelter solder or brass, as it fuses with less heat, and has a better appearance than brass.

Soldering without Heat.—Take 1 oz. of ammoniac and 1 of common salt, an equal quantity of calcined tartar, and 3 oz. of antimony. Pound well together and sift. Put this in a piece of linen, and enclose it well round with fullers' earth about an inch thick; let it dry, then put it in one crucible covered by another crucible, over a slow fire, to get hot by degrees. Keep up the fire until the contents of the crucible get red hot and melt. Then let it cool gradually, and, when cold, pound the mixture. When you wish to solder anything, put the two pieces you want to join together on a table close to one another. Make a crust of fullers' earth, so that, passing under the joint and holding to each piece, it shall be open at the top. Then throw some of the powder between and over the joint. Dissolve some borax in some hot wine, and with a feather dipped in the solution rub the powder at the place of joint. It will immediately boil up. As soon as the boiling stops the consolidation is made. The calcined tartar is made by placing crude tartar in a covered crucible, and raising it to a low red heat. Allow it to cool gradually.

Chloride of Zinc Soldering Fluid.—1. Muriatic acid with zinc dissolved in it till it will take no more. 2. Dissolve zinc in hydrochloric acid until the acid will dissolve no more.

Solder for Tinware.—The lining of tea-chests makes a good solder for tinware, being made of tin and lead in about the proper proportions.

To Braze Steel and Iron without Heat.—Take ¼ oz. fluoric acid, 2 oz. of brass filings, and 1 oz. of steel filings. Put them all into the fluoric acid; touch each part of the work with the mixture, and put them together. Take care that the fluoric acid is put into an earthern vessel.

Soldering Iron and Lead Pipes.—File the end of the iron pipe bright, then see that the soldering iron—which should be as large a one as can be got—is well tinned; this is important in all soldering operations. Having the iron ready, and as hot as it will bear, wet the part to be tinned with a little spirits of salt that has had as much zinc chippings put in it as it will dissolve, then apply the solder with the iron; the pipe will have to be very hot with the iron before it will tin; it would be as well to tin the iron pipe with a little block tin or pewter, if available. If any difficulty is found in tinning the iron pipe, a little powdered sal ammoniac can be sprinkled over it when very hot, which would assist the tinning; this done, the lead pipe must be widened out so as to form a lip all round the iron pipe, and soldered round with fine solder, taking care to keep the heat of the iron on the iron pipe rather than the lead; or a plumber's joint may be made by pouring on a quantity of plumbers' solder from a ladle, and wiping off the superfluous solder with a greased cloth.

Brass Solder for Iron.—The plates of brass are to be melted between the pieces that are to be joined. If the work be very fine, as when two leaves of a broken saw are to be brazed together, cover it with pulverized borax, melted with water, that it may incorporate with the brass powder which is added to it; the piece must then be exposed to the fire, without touching the coals, and heated till the brass is seen to run.

Soldering Cast Iron to Brass.—First clean the iron and brass well, and then tin them both before placing them together for soldering. The articles can be tinned by rubbing while hot with rosin, sal ammoniac, or muriatic acid with zinc dissolved in it; then rubbing them over with solder. If done while hot, wipe the solder off with rag; sufficient will be left on the articles for the purposes required.

Solder for Gold.—1. Melt together in a charcoal fire, 24 grains gold, 9 grains pure silver, 6 grains copper, and 3 grains good brass this makes a solder for gold ranging from 12 to 16 carats fine. For finer gold, increase the proportion of gold in the composition. To make it darker in colour lessen the proportion of the silver and increase that of the copper. 2. To 1 dwt. of gold add 6 grains of silver, if the alloy is dark; if light, 4½ grains silver, ½ grain copper. If the solder is not good, ½ grain of either silver or copper will set it right.

A Good Solder.—Take 1 lb. of pure Banca tin, and melt it, then add ½ lb. of clean lead, and when it is melted stir the mixture gently with a stick or poker, and pour it out into solder strips.

Plumbers' Solder. — Lead, 1 part; tin, 1.

Tinman's Solder.—Lead, 1 do.; tin, 1.

Pewterers' Solder.—Tin, 2 parts; lead, 1 part.

Yellow Solder for Brass or Copper.—1. Copper, 1 lb.; zinc, 1 lb. 2. Stronger;—copper, 32 lbs.; zinc, 29 lbs.; tin, 1 lb.

Solder for Copper.—Copper, 10 lbs.; zinc, 9 lbs.

Black Solder.—Copper, 2 lbs.; zinc, 3 lbs.; tin, 2 oz.

Black Solder.—Sheet brass, 20 lbs.; tin, 6 lbs.; zinc, 1 lb.

To Joint Lead Plates.—The joints of lead plates may be made as follows;—The edges are brought together, hammered down into a channel cut out of wood, and secured with a few tacks. The hollow is then scraped clean with a scraper, rubbed over with candle-grease, and a stream of hot lead is poured into it, the surface being afterwards smoothed with a red-hot plumbers' iron.

Brazing and Resetting Band Saws.—1. Get the edges to lay flush, and then braze them with a blowpipe, and file off all the superfluous solder. They should be sharpened with a three-cornered file, and the teeth cut deep. The saw should be kept tight when in use, and slacked out when done with. 2. Procure a piece of charcoal, a blowpipe, some spelter and borax, file the ends of the saw even, then file the sides so that one side laps over the other; fit the teeth opposite each other, bind it with iron wire to keep in place; moisten the

lap of the saw with borax, first dissolved in water; place the saw on the charcoal. The broken parts place by side of a gas jet, sprinkle the part previously wetted with the spelter, blow the flame of gas until the spelter runs; let it get cool before removal; when quite cold file it flat with the other part of the saw; to set the saw, drop one side on the ground, the other side up, and set on edge of the vice.

Solder for Copper, Iron, and Dark Brass.—Copper and zinc, equal parts melted together. For pale brass use more zinc.

Fine Solder.—Tin, 2 parts; lead, 1 part; used for copper and tin plates.

Glazier.—Three parts lead, 1 part tin.

Soldering Small Pieces.—Such small articles as parts of the eye-pieces of telescopes may be soldered by wetting them with a strong solution of sal ammoniac and putting a bit of tin-foil between the pieces properly placed, put on a plate of iron and held over a gas-light till the solder melts.

Removing Soft Solder from Gold.—Place the articles in a vessel containing muriatic acid and allow them to remain in about a couple of hours; the acid should be slightly warmed, say 90°. The articles would require to be re-coloured or gilt afterwards. Nitric acid will dissolve solder without affecting the gold unless it be of very inferior quality.

Lute for Soldering.—A lute for the joints of iron vessels may be composed of 60 parts of finely-sifted iron filings and 2 of sal ammoniac in fine powder, well mixed with 1 part of flowers of sulphur. This powder is made into a paste with water, and immediately applied; in a few seconds it becomes hot, swells, disengages ammonia and hydric sulphide, and soon sets as hard as the iron itself.

AUTOGENOUS SOLDERING, OR BURNING TOGETHER.—The method of burning together only admits of limited application, but when successfully performed, the work assumes the condition of greatest strength, from all parts being alike. There is no dissimilarity between the several parts as when ordinary solders are used, which are open to an objection, that the solders expand and contract by heat either more or less than the metals to which they are attached. There is another objection of far greater moment; the solders oxidize either more or less freely than the metals, and upon which circumstance hinge many of the galvanic or electrical phenomena; and thence the soldered joints constitute galvanic circuits, which in some cases cause the more oxidizable of the two metals to waste with the greater rapidity, especially when heat, moisture, or acids are present. In chemical works this is a serious inconvenience, and leaden vessels and chambers for sulphuric acid must not be soldered with tin solder, the tin being so much more freely dissolved than the lead. Such works were formerly burned together by pouring hot lead on the joint, and fusing the parts into one mass, by means of a red-hot soldering iron; this is a troublesome and tedious operation.

Pewter is sometimes burned together at the angles of work, that no difference of colour may exist; one edge is allowed to stand a little above the other, a strip of the same pewter is laid in the angle, and the whole are melted together, with a large copper-bit, heated almost to redness; the superfluous metal is then filed off, leaving a well-defined angle without any visible joint.

Brass is likewise burned together; the rims of the large mural circles for observatories are sometimes cast in six or more segments, and attached by burning. The ends of the segments are filed clean, two pieces are fixed vertically in a sand mould in their relative positions, a shallow space is left around the joint, and the entire charge of the crucible, say 30 to 40 lbs. of the melted brass, a little hotter than usual, is then poured on the joint to heat it to the melting point. The metal overflows the shallow chamber or hole, and runs into a pit prepared for it in the sand; but the last quantity of metal that remains solidifies with the ends of the segments, and forms a joint as perfect as the general substance of the metal; the process is repeated for each joint of the circle.

Cast Iron is likewise united by burning. To add say a flange to an iron pipe, a sand mould is made from a wood pattern, but the gusset, or chamfered band between the flange and tube, is made rather fuller than usual, to afford a little extra base for the flange. The mould is furnished with an ingate, entering exactly on the horizontal parting of the mould, at the edge of the flange, and with a waste head or runner proceeding upwards from the top of the flange, and leading over the edge of the flask to a hollow or pit sunk in the sand of the floor. The end of the pipe is filed quite clean at the place of junction, and a shallow nick is filed at the inner edge to assist in keying on the flange; lastly, the pipe is plugged with the sand and laid in the mould. After the mould is closed, about six or eight times as much hot metal as the flange requires is poured through the mould; this heats the pipe to the temperature of the fluid iron, so that on cooling, the flange is attached sufficiently firm to bear the ordinary pressure of the screw-bolts or steam. The method of burning is occasionally employed in most of the metals and alloys, in making small additions to old castings, and also in repairing trifling holes and defects in new ones; it is only successful, however, when the pieces are filed quite clean, and abundance of fluid metal is employed, in order to impart sufficient heat to make a natural soldering.

Waterproofing.—*For Cloth.*—1. Moisten the cloth on the wrong side with a weak solution of isinglass, when dry apply an infusion of nut-galls. 2. Apply a solution of soap to the wrong side of the cloth, when dry go over again with a solution of alum. 3. Sièvier's Process;—Apply a solution of india-rubber dissolved in oil of turpentine, then lay on a coat of another india-rubber varnish made very drying by the addition of driers. 4. 1 lb. of sugar of lead, 1 lb. of alum; pound separately, and mix in a basin; pour 2 quarts of boiling water on the mixture, let it stand 6 hours, and then bottle off for use. Apply to the cloth with a sponge or soft brush on a table till well saturated, and then iron it over and hang up to dry. 5. Take 3lbs. of alum, and dissolve it in water, and to it add 1 lb. of acetate of lead previously dissolved. Let this stand till clear, then pour off the clear solution on to 1 lb. of glue previously dissolved in water. Heat up to 185°, and place the cloth in for about ½ of an hour; take it out and place in running water, afterwards dry.

To make Cotton Waterproof.—To do this, without making it sticky, it must be dried at about 150° Fahr. by artificial heat. The sun will do it on a hot day. Set as much boiled oil as is necessary, mix enough lampblack to blacken it, if for black work; if yellow, use ground yellow ochre instead. Then lay the fabric on a smooth surface, and put the oil on with a brush, a shoe-brush is best; let the first coat get quite dry before putting on another. A little patent driers will make it dry quicker, say ½ lb. to a gallon of oil; if the last coat remains sticky after it is dry, take shellac 1 lb. to 2 quarts of water, simmer it gently, and when near boiling add a little liquor ammonia to dissolve the shellac. When this is cold mix a little lampblack for black; if yellow use it as it is. If the fabric is coated over with this it will make it hard; put it on with a sponge. Lay the oil on as thin as possible or it will not dry.

Waterproofing Rick Cloths and Awnings.—Plunge the fabric into a solution containing 20 per cent. of soap, and afterwards into another solution containing the same percentage of sulphate of copper; wash, and the operation is finished.

Waterproof Cart-coverings. — The sheets used for covering railway and other wagons are rendered waterproof by coating them with a composition of 95 galls. of linseed oil, 8 lbs. of litharge, and 7 lbs. of umber, boiled together for 24 hours. The mixture may be coloured by the addition of 8 lbs. of vegetable black.

To Repair Oilskins.—If they are not painted, give them another coat of the

original liquids. The best is made by dissolving 1 oz. of beeswax in 1 pint of the best boiled linseed oil over a gentle fire, applying it when cold with a piece of rag, rubbing it well in, afterwards hanging it up to dry, which will take about 4 days. If they are painted, the best plan is to give them another coat of good black paint.

Waterproofing Fishing-lines. — Two parts boiled oil, 1 part gold size, put in a bottle, shake well, and it is ready for use. Apply with a piece of flannel; expose to the air, and dry. After using the line two or three times it should have another coat, the application being repeated when necessary.

Waterproof Paper.—Dissolve 8 oz. of alum and 3½ oz. of Castile soap in 4 pints of water, and 2 oz. of gum arabic and 4 oz. of blue, separately, in 4 pints of water; mix the solutions, heat slightly, dip in the single sheets, which hang up until dry.

Waterproof Solutions. — 1. India-rubber in small pieces, 1 oz.; boiled oil, 1 pint: dissolve by heat, then add 1 pint hot boiled oil stir well, and cool. 2. Of beeswax and yellow rosin, 2 oz. each; melt in 1 pint boiled oil. 3. Of white wax and spermaceti each 1 oz.; 4 oz. mutton suet: melt in 1 pint of olive oil. These solutions should be applied to the articles warm, and may be used for waterproofing leather work of all descriptions.

Waterproof but not Airproof. — 1. Potter's Process;—Cover the wrong side of the cloth with a solution of isinglass, alum, and soap; when dry brush against the grain, and go over with a brush wetted in clean water. 2. Cooley's Process;—Spread the cloth on a smooth surface, wrong side up, rub it over with pure beeswax free from grease, until an even but thin coat is applied, then pass a hot iron over it, and brush whilst still warm. Wearing apparel thus coated is waterproof, and has the advantage of not being impervious to air, the great drawback of ordinary mackintoshes and waterproof articles.

Manufacture of Floor-cloth. —The main part of the manipulation is similar to calico-printing, the figures upon the blocks being upon a much larger scale, and the cloths which are printed being of much greater size. The common dimensions of a floor-cloth are 210 or 220 square yards, and hence the immense size and often unseemly appearance of floor-cloth works. A stout canvas is chosen in the first instance. This is nailed to one extremity of a wooden frame, and stretched by means of hooks which are attached to the other side. It is then washed with a weak size, and rubbed over with pumice-stone. No other substance has yet been found which answers the purpose so well as this mineral. The next step is laying on the colour, which is performed by placing dabs of paint over the canvas with a brush, and then rubbing or polishing it with a long peculiar-shaped trowel. Four coats of paint are thus applied in front, and three on the back of the cloth. To remove it from the frame when these processes are finished, a roller on the carriage is employed, upon which it is rolled, and conveyed to the extremity of the manufactory for the purpose of being printed. It is then gradually transferred from the roller and passed over a table which is 30 ft. long and 4 ft. wide, and as it proceeds over the table, the blocks, dipped in the appropriate colours, are applied. The colours used are ochre, umber, vermilion, and different kinds of chrome, mixed up with a little linseed oil and a little turpentine. The number of blocks applied to one pattern depends upon the number of colours. The first mode of applying the patterns was by stencil plates. Then a combination of stencilling and hand printing was used, the former process being first made use of; afterwards a block was applied, the stencilling forming the groundwork. Stencilling is now abandoned. In printing, it is necessary that the cloth should first be rubbed over with a brush, or else the colours will not adhere. Every square yard of good oilcloth weighs 3½ to 4½ lbs., each gaining by the application of the paint 3 or 4 lbs. weight, and hence the quality of this manufacture

is judged of by the weight. Whiting is often used in spurious cloths mixed with oil. Cloth prepared in this way speedily cracks and becomes useless. Good cloth, with a very stout canvas, is used for covering verandahs, and will last nine or ten years, while spurious cloth will become useless in one year. Floor-cloth is employed to cover roofs, and for gutters. In the latter case it is remarkable that water remaining in contact with it produces no injurious effect. Painted baize for tables is usually manufactured with a smooth side, and is printed with blocks of a fine structure, resembling calico blocks. Fine canvas is employed; several coats of paint are laid on upon one side, and the other receives one coat, and is then strewed over with wool, or flocked, as it is called.

Rendering Wood Incombustible.—1. Deal boards become almost incombustible when painted over with a diluted solution of waterglass or silicate of soda. The waterglass is usually sold as a thick fluid, like honey. This may be thinned out with water, about six or seven times its own bulk. The water must be soft—boiled water will do—and apply the solution warm. In about 24 hours apply a second coat, and perhaps a third. Use a new brush, and wash in clean water after using, or it will get too soft. Avoid grease or fat on the boards before painting them. 2. Soak the wood in a strong solution of alum and sulphate of copper. About 1 lb. of alum and 1 lb. of sulphate of copper should be sufficient for 100 gallons of water. These substances are dissolved in a small quantity of hot water, then mixed with the water in the vessel in which the wood is to be steeped. The timber to be rendered fireproof can be kept under the liquor by stones or any other mode of sinking it. All that is required is a water-tight vessel of sufficient dimensions to hold enough of the liquor to cover the timber, which should be allowed to steep for about 4 or 5 days. After this it is taken out and allowed to dry thoroughly before being used. 3. A plan of rendering the wood partially fireproof is to whitewash it two or three times.

Glue to Resist Fir.—Mix a handful of quicklime in 4 oz. of linseed oil, boil to a good thickness; then spread on tin plates in the shade and it will become exceedingly hard, but may be easily dissolved over the fire, and used as ordinary glue.

Ivory.—*Bleaching Ivory.*—Ivory is very apt to take a yellow-brown tint by exposure to air. 1. It may be whitened or bleached, by rubbing it first with pounded pumice-stone and water, then placing it moist under a glass shade luted to the sole at the bottom, and exposing it to sunshine. The sunbeams without the shade would be apt to occasion fissures in the ivory. The moist rubbing and exposure may be repeated several times. 2. Immerse for a short time in water slightly mixed with sulphuric acid, chloride of lime, or chlorine, or it may be exposed in the moist state to the fumes of burning sulphur, largely diluted with air. Ink stains may be removed by repeatedly using a solution of quadrozalate of potassa in water.

Dyeing Ivory Black.—If the ivory is well washed in an alkaline ley, and is then laid for several hours in a dilute solution of neutral nitrate of pure silver, with access of light, it will assume a black colour, having a slightly green cast. 2. A still finer black may be obtained by boiling the ivory for some time in a strained decoction of logwood, and then steeping it in a solution of red sulphate or red acetate of iron. 3. Immerse frequently in common black ink.

Blue.—When ivory is kept immersed for a longer or shorter time in a dilute solution of sulphate of indigo, partly saturated with potash, it assumes a blue tint of greater or less intensity.

Green.—1. This is given by dipping blued ivory for a little while in solution of nitro-muriate of tin, and then in a hot decoction of fustic. 2. Boil in solution of verdigris in vinegar until dark enough.

Yellow is given by impregnating the ivory first with the above tin mordant,

and then digesting it with heat in a strained decoction of fustic. The colour passes into orange, if some Brazil wood has been mixed with the fustic. A very fine unchangeable yellow may be communicated to ivory by steeping it 18 or 24 hours in a strong solution of the neutral chromate of potash, and then plunging it for some time in a boiling-hot solution of acetate of lead.

Red may be given by imbuing the ivory first with the tin mordant, then plunging it in a bath of Brazil wood, cochineal, or a mixture of the two. Lac-dye may be used with still more advantage to produce a scarlet tint. If the scarlet ivory be plunged for a little in a solution of potash, it will become cherry-red.

Violet is given in the logwood bath to ivory previously mordanted for a short time with solution of tin. When the bath is exhausted, it imparts a lilac hue. Violet ivory is changed to purple-red by steeping it a little while in water containing a few drops of nitro-muriatic acid.

Brown, as for black, using a weaker solution of silver.

Purple.—Steep in a weak neutral solution of terchloride of gold, and then expose to the light. With regard to dyeing ivory, it may be observed, that the colours penetrate better before the surface is polished than afterwards. Should any dark spots appear, they may be cleared up by rubbing them with chalk; after which the ivory should be dyed once more to produce perfect uniformity of shade. On taking it out of the boiling-hot dye bath, it ought to be immediately plunged into cold water, to prevent the chance of fissures being caused by the heat.

Artificial Ivory.—Make isinglass and orandy into a paste, with powdered egg-shell, very finely ground. Give it any desired colour; oil the mould, into which the paste must be poured warm. Leave the paste in the mould until 'ry, when its appearance strongly resembles ivory.

Flexible Ivory.—Immerse the ivory in a solution of pure phosphoric acid, sp. gr. 1·13, until it partially loses its opacity, then wash in cold soft water and dry. This renders ivory very flexible, but it regains its hardness if long exposed to dry air. Its pliability may, however, be restored by immersing it in hot water.

To Prepare Ivory for Miniature Painting.—It is usual to paint miniatures upon ivory which is sold prepared for the purpose by the artists' colourman, after being subjected to a bleaching process by boiling, or exposure to the rays of the sun; but the bleaching can be more expeditiously performed by placing the ivory before a good fire, which will dispel the wavy lines, if they are not very strongly marked, that frequently destroy the requisite uniformity of surface. Ivory of the best quality has but few of these wavy lines, but it is frequently expedient to employ that of inferior quality.

Defective Ivory.—By holding the ivory up to the light, it will be seen whether there are any specks or holes in it; if any exist, they will be fatal to the success of the painting. It is often necessary to remove the defects found in the ivory in the state in which it is sold. To remove the marks of the saw, scrape the surface equally in every direction with an eraser, or an old razor with a fine edge, by which the marks of the saw are removed; then, with a piece of fine cork, or a roll of paper, dipped in finely pulverized and sifted pumice, or tripoli powder and water, rub the ivory with a circular motion in every direction, until the surface presents one uniform tint, but it must not appear polished; finish with a stump and a little cuttlefish powder carefully sifted; then, with a large camel-hair pencil and water, wash the surface of the ivory, and it will be ready to receive the colours. To render the ivory perfectly flat, place it between two pieces of white paper, and subject it to pressure by placing a weight upon it.

Mounting.—The ivory should be fastened at the four corners to a piece

of cardboard, for the convenience of painting on; the back of the ivory should be kept perfectly clean, as any application of gum or glue to its surface destroys the transparent quality upon which its usefulness depends. After the surface to be painted on is properly cleaned, it should be on no account touched with the fingers, as the employment of ox-gall to remove greasiness must be scrupulously avoided. An ivory palette is best adapted for miniature painting, because the tints appear on it the same as when worked on the miniature, a matter of considerable importance.

Soaps.—When fats or oils are heated with caustic leys, a combination of fatty acids with alkali is formed; this is designated saponification. Soaps are divided into hard and soft, the former having soda, and the latter potash, for their bases. The former, however, is the most extensively manufactured, whilst the demand for the latter is limited. Acids decompose soaps, combining with their base and expelling the fatty acids, for these being insoluble in the former, float on the surface of the liquid. By this means soaps are easily analyzed.

VEGETABLE OILS.—Vegetable oils have been divided into two classes, the drying, and the fluid oils. Of the first-named are oil of linseed, hempseed, and poppy oil. Of the second, olive oil, palm oil, sweet almonds, and cocoanut oil. According to the mode of obtaining oils, they are distinguished as oils of the first and second pressure. Those of the second pressure are more serviceable to the soap manufacturer, for though less liquid and often mucilaginous, they contain more stearine, and the richer the oils are in stearine, the harder are the soaps they yield.

Cocoanut Oil.—Six fatty acids have been discovered in the cocoa butter, most of which being solids, accounts for the great firmness of the soaps it forms. This fat is also remarkable as uniting with soda leys in any proportion, without separating from them. Owing to this property, this fat is used in large quantities for the making of filled soaps. It is very slow to unite with ley by itself; it is therefore usually applied in combination with tallow or palm oil, increasing their emollient properties, and also giving to the tallow soaps a brilliant whiteness.

Palm Oil.—This is of an orange colour, and when not rancid, of a violet odour. Palm oil is employed both in the bleached and in the natural state. In the bleached state it produces a soap of most beautiful whiteness, and rich with the characteristic odour of the oil.

Bleaching Palm Oil.—The bleaching of 1000 lbs. requires 5 lbs. red chromate of potassa, 10 lbs. strong hydrochloric acid, and 2½ lbs. sulphuric acid. First, the chromate of potassa is pulverized and dissolved in hot water. The palm oil should then be transferred to a wooden tank, and heated with steam to 120° Fahr. The steam is turned off and a portion of the solution of the chromate of potassa is added, agitated, and a proportional portion of hydrochloric acid used; at last the sulphuric acid. After thoroughly agitating this mixture for a few minutes, the oil changes in colour, becoming first black, then dark green, and soon afterwards light green, when a thick froth appears on the surface, an indication of the completion of the process. If a sample, when taken out and allowed to settle, does not appear sufficiently bleached, an additional portion of the bichromate of potassa, with muriatic and sulphuric acids, should be added. The whole has to be left quiet for 1 hour, so that the solution of the resulting salts may settle. The clear oil is then drawn off into a wooden cask, mixed with some water, and heated again by the introduction of steam. It is again left alone for some time, and the fat subsequently drawn off. In making soaps palm oil is usually employed with tallow, in the proportion of 20 to 30 of the former to 100 parts of the latter. It is also employed in making rosin soap, to correct the flavour of the rosin and brighten the colour.

Olive Oil.—There are three kinds,

namely, the virgin oil, obtained by a gentle pressure of the fruit; a second kind, gained by submitting them to the action of hot wate: and pressing them between metallic plates previously heated; and the third, an inferior kind, is the product of this residuum when boiled in water. Only the two latter kinds serve in the manufacture of soaps; they yield an excellent soap, esteemed for its fresh and agreeable odour. It is very extensively used by soap manufacturers in Marseilles and for Windsor soap.

Oil of Poppy.—It is whitish yellow, of an almond taste, and is especially used for the manufacture of soft soaps; and in France it is employed with tallow for the manufacture of an imitation Marseilles soap.

Mafurra Tallow.—It has a yellow colour, and an odour similar to cocoa butter. It is less fusible than tallow, and with the alkalies forms a brown soap. It contains a large percentage of solid fat.

ANIMAL FATS.—There is a great difference in the consistency of animal fats, the richer they are in solid constituents the higher is their melting point. In the class of whale fishes the fats are generally fluid; in the carnivorous animals, soft and rank-flavoured; nearly scentless in the ruminants; usually white and copious in well-fed young animals: yellowish and more scanty in the old. The fat of the kidneys is generally harder and more compact than that found in the cellular tissues and in the bowels of animals. The colour and odour of the fats, of course, affect the manufacture of soaps.

Beef Tallow.—This is the most used of all animal fats; it has a yellow tint, due to colouring matter, separable by several washings in hot water, and is firm, brittle, but not so white as mutton suet. That rendered by steam is generally the whitest.

Mutton Suet.—Mutton fat is richer in stearine than beef tallow, and is consequently much sought after by tallow as well as stearine candle manufacturers. Saponified with soda ley it yields a beautiful white soap, but being so rich in stearine it is liable to become too hard and brittle. In order, therefore, to obtain a more unctuous product it is generally mixed with about 20 per cent. of lard or cocoanut oil, whereby a superior soap is obtained.

Lard.—Lard is an excellent material for soap manufacturers; it forms a white, sweet, and pure soap. For the purpose of rendering it more frothing it is saponified either with tallow or cocoanut oil.

Horse Fat.—The soap made from horse fat, after several successive boilings, is white and firm; but owing to its peculiar odour it can only be advantageously employed in the preparation of palm and rosin soap.

Bone Fat.—Bones contain about 5 per cent. of fat, brownish white in colour, and of an oily consistency. Only fresh bones are adapted for the extraction of fat. They are generally split up lengthways by a hatchet, boiled in water, by means of which the fat is extracted, decantered, and filtered. For purifying bone fat, melt the fat and a small quantity of saltpetre together, and afterwards add sufficient sulphuric acid to decompose the latter. The mass scums very much, becomes of a light yellow colour, loses its noxious smell, and furnishes a fat well adapted for soaps.

Fish Oil.—Fish oil is used as a burning fluid, for making soft soaps, and for adulterating other oils.

Sperm Oil.—Sperm oil is found in commerce bleached and unbleached, the latter having a brownish appearance and disagreeable odour. It is easily saponified, and the resulting soap is readily soluble in water.

Oleic Acid.—There are two kinds in commerce. The one formed by the process of distillation is only fit for making soft soap, owing to its disagreeable odour, whilst the other, the result of simple pressure, yields soaps of great consistency, whether saponified alone or with an admixture of tallow or other fats. It often contains a small amount of sulphuric acid, hence it ought to be washed with some weak ley before using it.

Elaidic Acid.—By the action of hyponitric acid upon oleic acid, a pearly white crystalline substance is obtained of the consistence of tallow, and termed elaidic acid. It has been found equally serviceable to both soap and candle manufacturers.

Of Potassa, Soda, and Caustic Soda.—*Potassa.*—This is called in commerce vegetable alkali, sal tartar, pearlash, potash, and hydrated protoxide of potassium. The sal tartar is simply purified pearlash. Potash is derived from certain plants, and especially from forest trees. These are cut down, converted into ashes, and lixiviated. The liquor thus obtained is evaporated until it is brought to a solid state. This residue is subjected to the heat of a reverberatory furnace, for the purpose of drying it completely and freeing it from its sulphur and organic particles. In this state it is sold as pearlash.

Soda.—Soda is of more importance to the manufacturer of soap than potash, because he could not make hard soap without it. The amount of native soda is gradually decreasing, and inadequate to supply the increasing demand. A small quantity is produced from the incineration of certain plants, but the largest portion now used is acquired from the transformation of salt. The best quality of native soda is generally imported from Spain and the Levant, and known as barilla. It contains from 15 to 30 per cent. of carbonate with a little sulphuret, and is mixed with sulphate and muriate of soda. It is considered superior to the artificial, as the hard soap made with it is found to be less brittle and more plastic.

Soda Ash.—The method of manufacturing soda ash is based upon the preparation of sulphate of soda from salt, its transformation into crude carbonate of soda, designated black ash, and the purification of the crude soda by lixiviation, evaporation, and calcination. The product thus obtained is white ash, or soda ash.

Caustic Soda can be purchased either as a solid or a liquid. In the latter state it is called concentrated ley, and soapmakers find it a convenient commodity, as it saves them the trouble of preparing it themselves. A certain weight of caustic soda represents a larger amount of soda combining with the fats than the ordinary soda. Both red and white are of equal value, for when the red caustic soda is dissolved, the colouring matter generally settles at the bottom, and the liquid becomes entirely clear.

Testing the Chemicals.—To estimate the commercial value of soda ash or potash, or solid caustic soda, it is necessary to ascertain the amount of water they contain, the amount of caustic and carbonated alkali; the foreign substances in them.

To Estimate the Amount of Water.—One hundred grains of the alkali are heated in an iron capsule over suitable heating apparatus, until all the water is expelled, which may be tested by a plate of cold glass held for a moment over the capsule, when whatever vapour rises from the heated material will be condensed on its surface. After all the water is thus driven off, the loss of weight will indicate the amount of water in every 100 grains of material, and the absolute weight of the dried sample will be the percentage of alkali contained in the crude material; the loss will indicate the percentage of water contained therein.

To Estimate the Amount of Caustic and Carbonated Alkali.—It is very important to ascertain if there is only caustic alkali or only carbonated alkali, as well as the amount of each. For example, if a potash or soda is only one-third caustic, and two-thirds carbonated alkali, the latter must be changed into the caustic state before it can be used in soapmaking. It is best first to determine the amount of caustic alkali. Concentrated alcohol will only dissolve caustic soda, and not in any way affect the other ingredients always found in commercial potash, soda, or caustic soda. Take 100 grains of commercial soda, reduce them to powder in a glass mortar, put half of it in a flask, with the addition of 1 oz. of alcohol of 95 per

cent.; shake all well together, and let stand for a few hours, afterwards transfer the liquid floating on the top carefully into an evaporating capsule of porcelain, and let it quickly evaporate over a lamp, gradually increasing the temperature until nothing more evaporates; when cooled, immediately weigh the capsule to ascertain the actual amount of caustic soda which the sample contained. Before the evaporating process is commenced, in order that nothing is lost, a little alcohol should be mixed with the deposit in the flask, and being filtered added to the liquid which had already been transferred. In estimating the amount of carbonated alkali, it is requisite to determine, first, the actual amount of alkali existing in the soda or potash, and this being ascertained, the quantity of carbonated alkali is reduced by calculation. Fifty grains of the alkaline sample are to be dissolved in a flask containing 2 oz. of water. Next weigh out, on a watch-glass, 100 grains of well-crystallized oxalic acid, reduced to a fine powder. Small portions of this powder are to be added at a time to the alkaline solution, shaking the liquid between each addition, or stirring it with a glass rod, heating and testing it with litmus paper till the latter becomes slightly reddened, while the liquid is hot. The residue of the oxalic acid is then weighed, and supposing it is 43 grains, it is obvious that to saturate the alkali in the 50 grains of the sample, 57 grains of oxalic acid were consumed; 7·87 grains of oxalic acid are capable of saturating or removing the alkaline reaction of 5 grains of caustic soda, or 7 grains of caustic potassa.

To Determine the Nature of Foreign Ingredients.—These may be soluble or insoluble. As they are not taken up by the ley, the soapmaker need care nothing about the insoluble substances. Generally the soluble ones are found to be chlorides or sulphates. The former are detected by adding a solution of nitrate of silver to a clear solution of the substance to be examined, which has been previously slightly acidulated with chemically pure nitric acid, and if there is chloride of potassium or salt present, a white curdy precipitate will be formed, which, by exposure to light, becomes first violet, and afterwards black. Sulphates are detected by first neutralizing the solution with nitric acid and then adding a solution of chloride of barium, a fine heavy white precipitate is formed. To many it is of importance to ascertain if there is any sulphide of sodium, because a potash or soda containing it would be unfit for the manufacture of white soap. It is often detected in the potash and soda, but never in the caustic soda. Its presence will be indicated by the development of hydrosulphuric acid, on adding an acid to a solution of the alkali, a gas very much resembling rotten eggs in its smell. Where the odour of the gas fails to afford sufficient proof of the presence of hydrosulphuric acid, the application of the following reagent will remove all doubt. The air suspected to contain it is tested by placing in it a small slip of paper, moistened with a solution of acetate of lead; if the gas is present, the slip will be covered with a thin, brownish black, shining film of sulphide of lead.

PREPARATION OF THE LEYS.—*Water.*—Only spring or river water should be used in making soap. It must also be perfectly clear, otherwise clear ley cannot be produced. It must be free from organic matters, for these are often dissolved, and, though imperceptible, soon cause the water to become putrid. Nearly all waters contain mineral matters in solution. When such waters are used, though the leys are equally good, there will be a loss of material in proportion to the quantity of alkali neutralized. A water containing more than twelve grains of such substances in one gallon, should be rejected.

Leys.—Ley is an aqueous solution of caustic soda or potassa, by the agency of which the chemical decomposition of the fat and its conversion to soap are effected. Caustic soda is a commercial commodity, but it may happen that the

soapmaker will have to prepare his own leys. 1. Reduce the soda or potassa into small pieces, mix it with slacked lime, let it stand 24 hours, and then leach it out with water. For this purpose large tanks are used, having a perforated floor, placed from two to four inches above the bottom, and covered with a layer of straw, on which is poured the mixture of lime with the alkali. A faucet is inserted between this perforated floor and the bottom, by means of which the liquor can be drawn off. The leys prepared in this way are never perfectly caustic; whilst in this process more lime is requisite than when the following method is adopted, which gives a perfectly caustic soda. 2. The potash or soda, not too concentrated a solution, should be thoroughly brought together with lime-milk, this process being assisted by heat. Insoluble carbonate of lime forms, which settles at the bottom. There should not be more than about 15 per cent. of alkali in the solution, otherwise a portion of the carbonated alkali will remain undecomposed. For the thorough decomposition of the carbonates of the alkalies, the process of boiling must be continuous and uninterrupted, and the lime of a milky consistency. To ascertain whether the ley is caustic, take a test-glass full, let it stand till cool, then filter, and drop into the clear liquid some nitric acid; if it effervesces, the ley is not caustic; the boiling has to be continued till the portion taken from the kettle shows, when filtered, no escape of carbonic acid, if nitric acid be added. As soon as no carbonic acid escapes from the ley, the fire should be taken out, the liquor carefully covered, and suffered to remain undisturbed for 12 or 15 hours, so that the lime may settle. After this, the clear liquor should be transferred by a siphon into a wooden vat, lined inside with sheet lead, and having a perforated false bottom, and cock fitted near the bottom so that the clear ley may be drawn off. The lime used must not have been exposed to the atmosphere; only the quantity actually required should be slacked at a time, because the hydrate of lime, as well as the leys, loses its causticity when exposed to the air. For 100 lbs. of crystallized soda 24 lbs. of quick-lime are required; for 100 lbs. of pearlash, double that quantity; and for 100 lbs. of soda ash, 60 lbs. will be required. For the transformation of pearlash or soda into caustic leys, more or less quick-lime is necessary, according to the amount of carbonated alkalies they contain, and an excess of lime will do no harm.

KETTLES.—These are made of wood, wrought iron, cast iron, or bricks, lined with glazed stone. Their dimensions vary, but the larger the kettle the better, as much labour, fuel, and ley are thus saved. The shape is cylindrical, widest at the top, having a faucet for the purpose of discharging the spent ley.

Brick Kettles are best in one respect, they retain heat the longest during the paste operation. The bottom of these can be composed of brick when steam is employed, in other cases a metallic bottom is necessary. If steam is employed, the superheated is preferable, as it can be introduced directly into the material, assisting the heating process, and causing a more forcible agitation of the ingredients than manual exertion can accomplish.

Cast-Iron Kettles are used in small factories. In large establishments the lower portion is made of cast iron, and the upper of wood or brick. In purchasing kettles entirely of cast iron, the thinnest should be selected, as they are always composed of finer grain, and can be more easily filed than the thicker.

Sheet-Iron Kettles will last longer than cast iron. Those of the best soft sheet iron should be selected, the bottom piece being from $\frac{3}{8}$ to $\frac{1}{2}$ in. in thickness, and the sides from $\frac{3}{16}$ to $\frac{1}{4}$ in., according to the dimensions. A soft sheet-iron boiler, carefully cleaned after each operation, will last 5 or 6 years, or longer, without requiring any repairs.

Heating the Pans with Open Fire.—

In kettles for soap boiling, the heat must be confined to the bottom, for if it is allowed to circulate round the sides, the ingredients will be burnt. In order to concentrate the heat, it is necessary that the grate is placed in the centre of the hearth and vertically below the kettle. The inside of the fireplace must be built of refractory bricks, so that the heat may be thrown back below the bottom of the kettle. The fuel employed must be that which produces the most heat and the least flame, hard coal should be selected. The openings through which the products of combustion enter the chimney should possess together the same surface as the grate: this is the best way to obtain a good draught and effect a complete combustion of the fuel.

Heating Pans with Steam. — Both ordinary and superheated steam are employed; the latter is preferable, because the heat can then be introduced directly into the material, whereas ordinary steam has to be condensed through a worm, or conveyed intermediately under a kettle with a double bottom, and a tub for the discharge of the condensed vapour. By applying superheated steam both time and fuel are saved; high-pressure steam mingling with the fat increases the necessary agitation of all the ingredients, thus expediting saponification. A steam-boiler 8 ft. long and 3 ft. in diameter, with two atmospheres pressure, will manufacture weekly 100 cwt. of soap. Among other advantages of steam, not only can wooden vessels be used, but the temperature can be regulated by stopcocks; the fats combine more readily and rapidly with the alkalies; the boiling is uniform throughout the whole mass, and the soap never burns.

BOILING SOAP. — *The Paste.* — This operation is to produce a preliminary combination of fat and ley. Some soapmakers use during the whole operation a ley of the same strength, while others commence with a weak ley, then use one of middle strength, and finish with a strong one. In the first case, a ley is employed of 10 to 15° B. In the second, of 7 to 10°, 15 to 18°, and 18 to 25° B., successively. In some cases, as for red oil soap, very strong leys are employed, say of 25 to 30° B.; usually the fat is first put in the pan and then the ley is added. For the paste operation, no leys should be used containing foreign salts, such as are found in inferior kinds of soda, for it is then very difficult to form a union of the fats with the ley, and no good sud is obtained. But when the soap has been separated from the ley by salt, leys containing salt may be used. In saponifying red oil, salty leys may also be employed from the beginning. It is imperative in all operations that the ley should be caustic, because carbonate of soda will not unite with fat. For transforming 100 lbs. of fat into soap, about 14 lbs. of caustic soda are necessary, but generally more is employed, because the soda used is never a pure hydrate of soda. The quantity of ley taken is also differently regulated by the manufacturers. Some add the whole amount of ley at the commencement, others add it gradually in small quantities. This last mode is preferable. From time to time, in order to test it, a drop of the paste should be put on the tip of the tongue, when, if there still is free alkali in it, a burning sensation will be produced, in which case the boiling must be continued until the soap gives a sweetish taste. More ley should then be added, under constant stirring, until the entire quantity is consumed. At this stage the contents of the kettle are transformed into a homogeneous, clear liquid, in which neither ley nor fat can be discovered. If the liquid is perfectly clear, it shows that the right proportion of fat and ley has been applied. Should saponification progress too slowly, a weak ley of from 1 to 2° B. may be added, and soap scraps will facilitate the combination of the fat with the alkali. By heating with an open fire, it sometimes happens that a portion of the paste, when it thickens, sticks to the bottom of the vessel and burns. This is indicated by a black smoke passing off here and there with the vapour. When this occurs, the fire should forth-

with be reduced, and some gallons of the strongest ley added to prevent further mischief. By these means a slight separation of the soap from the ley is occasioned, and the contact between the former and the metallic surface destroyed. In all cases the paste operation is complete, when, on taking out the stirring rod, the paste no longer drops from it, but slides down in long threads.

Cutting up the Pan.—This is done by stirring into the ingredients of the soap-kettle either soda ley containing salt, or a solution of salt, or dry salt. The separation is founded upon the insolubility of the soap in brine or strong caustic leys, whereas weak leys would dissolve it. Of all soaps the cocoanut oil is the most remarkable, for, being dissolved by a brine solution, it is peculiarly serviceable for washing in salt water, whence its name, marine soap. This soap becomes so hard, that when separated from the glycerine, it cannot be cut with a knife, and consequently the salting operation should not be performed, but the soap boiled in strong ley with one water. The following is the method by which the salting operation is effected;—One workman gradually adds the brine or dry salt, while another agitates the paste with a stirring rod from below upwards. This is done under gentle boiling. It is essential to add the salt in the right proportion; the whole amount requisite should not be stirred in at once, but in portions of about one-sixth. After half of it has been dropped in, the soap should be allowed to boil for about 10 minutes before any addition is made. According to concentration, 12 to 16 lbs. of salt are necessary for 100 lbs. of fat, to separate the formed soap from the surplus of water. The separation is perfect, when the aqueous portion is observed to run off from the curdy mass; when a sample is taken with a spatula, it is not of an adhesive character whilst hot; and when, on placing some in the palm of the hand, and rubbing it with the thumb, it hardens into firm scales. The termination of the process is also indicated when the surface splits up into several fields, separated from each other by deep furrows, in which there is not the fresh and soft appearance of froth, but of dry slabs. The fire should be extinguished when the soap, hitherto covered with froth and bubbles, suddenly sinks, and the froth breaks up into roundish massive grains, distinctly separated from each other and from the saline solution. The salting being completed, let the mass remain quiet for several hours, and then the under-ley may be drawn off by the faucet.

Clear Boiling.—This operation is to obtain hardness, consistency, and complete neutrality of the soap. Commence to boil the paste gently with tolerably strong leys. Some manufacturers proportion the quantity of ley to be used, and having put in the first, boil for 8 hours or so, then draw off the ley, put in the second, boil again, draw off, and so on. Should the soap, during the intervals, become too liquid, which may happen if a too weak ley has been applied, some handfuls of salt must be added, or the soap boiled with a weak ley containing salt. After each addition of ley, there should be, in taking up a portion by the spatula, some difficulty in running off the ley. Should this not be the case, water must be added, whereupon a quicker union of the alkali with the fat will be obtained. The process is terminated when large, regular, and dry scales appear on the surface, and when these give elastic, brilliant, white scales, and are easily pulverized by rubbing them in the palms of the hands. The soap should then be covered, left for some time, and eventually removed in the ladles.

Marbling.—The formation of veins in the soap is produced, either as the effect of the ley itself, or by the addition of foreign substances to the soapy paste. Some kinds of sodas employed in the manufacture of soaps contain both the sulphuret of iron and sodium. In saponification a chemical combination takes place between these and the fatty acids. These diffuse themselves throughout the mass, together with black sulphuret of

iron, and being held in intimate suspension, form bluish veins in the white ground, thus giving to the soap the appearance of marble. In Castile soap these in course of time, after exposure to the atmosphere, assume a brownish colour, a change caused by oxidation. If the soda employed does not contain those constituents in itself, sulphate of protoxide of iron, or copperas, previously dissolved, is introduced into the soapy paste, say 4 oz. of the dry substance to 100 lbs. of fat. By the chemical union of this oxide with the sulphuret of sodium, always existing in the crude soda, the colouring principle of marbling is produced. Mottled soap, made as above, contains necessarily less water than any other soap, as a superabundance of water would have precipitated the colouring matter, and rendered veining impossible. For successful marbling, a thorough practical knowledge is absolutely requisite. The essential point is to run the soap into the frames as soon as it presents the indications necessary for obtaining a good marbling. The eye is the best guide in this respect, as there are no precise regulations for this operation. The interspersion of the blue with the red veins is effected by stirring some pulverized colcothar into the soap, after marbling in the ordinary way.

Pelouze's Process.—When crystallized sulphuret of sodium is brought together with neutral fats, they are saponified at ordinary temperature and in a very short time. A mixture of equal parts of crystallized sulphide of sodium, olive oil, and water, produces after 10, sometimes after 5 or 6, days a thoroughly saponified paste, consisting of soap, glycerine, sulph-hydrate of sodium, and the surplus of monosulphuret of sodium. When subjected to heat, sulphuretted hydrogen will escape, and soap remain. In this case, one equivalent of sulphide of sodium produces the same quantity of soap as one equivalent of pure caustic soda, but it is not at all necessary to make use of crystallized and chemically pure sulphide of sodium, as that which is obtained by decomposing the sulphate of soda by charcoal can be employed. It is much cheaper than the caustic soda. The appearance of the soap made in this way is exactly the same as that made in the ordinary way; but it retains a disagreeable smell not easily destroyed. For ordinary purposes, however, such as scouring woollen fabrics, this kind of soap may well be used.

Saponification by Agitation.—Hawes.—Twenty gallons of ley, of 1·125 sp. gr., are employed for every 100 lbs. of tallow. The apparatus consists of a cylinder 6 feet in diameter and 12 feet in length, and is capable of working 2½ tons of tallow. Through the cylinder, lengthwise, a shaft extends, provided with radiating arms, to which an oscillating or rotatory motion is communicated. Convenient doors are attached for charging and emptying the cylinder. After charging the vessel agitation is continued for about 3 hours, when the whole is left undisturbed for a time, and ultimately removed into an open boiler, and completed in the ordinary way.

Gossage's Process.—The boiling of the paste is effected by blowing steam into the bottom of the pan, and the mixture is treated with successive additions of stronger ley, undergoing between each a thorough boiling, until the fatty matter has taken up all the soda possible, and has thus become completely converted into soap; the excess of ley settles at the bottom of the pan, and is drawn off. The charge of soap is then drawn off from the pan without hand labour, by means of air pressure; the top of the pan is closed by a cover, the joint being made air-tight by an india-rubber packing ring, and compressed air is forced into the top of the pan by a pump, whereby the entire liquid mass of soap, amounting to as much as 20 tons, is expelled from the pan, being forced up through a discharge pipe passing through the cover, and flows through a long trough into the moulds. These are 45 inches long, 15 inches wide, and 52 inches high, each containing ¼ a ton of soap, and are made simply of 4 cast-iron side-plates secured by clamps; the soap takes 3 days to cool

and solidify, and the sides of the mould being then removed, the large block of soap is cut horizontally into slabs, which again are divided into bars by a wire frame. The bars of the finer qualities are cut into cakes, which are stamped in a press having a heavy falling die lifted by a cam. The ley, or solution of caustic soda, is concentrated to the required strength for the soap-boiling pan by waste heat of the soda furnaces.

Silicated Soap.—A solution of silicate of soda is employed in place of a portion of the tallow or oil used in the soap-boiling pans, thus producing a much cheaper soap with equal cleansing power. As ordinary soap owes its cleansing power to the fact that the soda, which constitutes the real detergent, is only in a state of weak combination with the tallow or other fatty substance, the latter can be to a considerable extent replaced by silicate of soda, in which soda exists only in weak combination with silica, thereby retaining its cleansing power, as in ordinary soap. The silicate of soda, known as soluble glass, is made by melting in a reverberatory furnace a mixture of fine white sand and soda ash; the melted charge is run out through a tap-hole, and solidifies in lumps of a kind of glass, which is soluble in water.

Quality of Soaps.—A good soap is easily soluble in alcohol, leaving scarcely 1 per cent. of solid residue, and forms a gelatinous liquid in boiling water. Hard or marbled soap should not contain more than 25 per cent. of water, rosin soap not more than 40, and a soft soap not more than 52. In cocoanut-oil soaps a larger amount of water than 52 per cent. may be allowed. In yellow soap a part of the fat may be replaced by 10 to 25 per cent. of rosin.

HOUSEHOLD SOAPS.—*Hard Soaps.*—Hard soaps are always soda soaps. There are grained soaps, those in which a separation of the under-ley has been made as described, and filled soaps, those in which the whole contents of the boiling pan are kept together and sold as soap. The cocoanut oil is especially employed for the manufacture of filled soaps, because it is easily soluble in brine, requiring a very large quantity to separate them, and then they become so hard that they can scarcely be cut with a knife. The more solid constituents a fat contains, the harder the soap produced; the more oleine, the softer the soap. By mixing the fats in different proportions, soaps of any consistency can be obtained; this also depends upon the strength of the ley used in the process. Weak and middling strong leys will produce a light soap, while leys of 25° to 35° B. will produce a soap heavier than water. Sometimes a small admixture of sulphate of soda is employed in making soap, for the purpose of preventing its too great solubility when used in washing. In the manufacture of soaps, ⅓ or ¼ of fat is frequently substituted by rosin. For the transformation of 100 lbs. of fat into soap, there are generally necessary 12½ lbs. of solid caustic soda; this quantity must be more or less, in proportion to the nature of the fat.

Tallow Soaps.—To saponify 1000 lbs. of fat, commence by putting the tallow into the boiler, and melt it with a slow heat, add 70 to 80 galls. of ley of 10° to 12° B., stir well, and keep a gentle fire for several hours. Should part of the fat separate from the mass, which is often the case, an oily liquid will be observed floating on the top. Then add, gradually, 35 to 40 galls. of ley of 15° to 18° B. By this addition the whole contents will soon form a homogeneous mass of a greyish-white colour. In order to establish the necessary consistency to the paste, boil gently for several hours, adding every hour 6 to 7 galls. of ley of 20° B. The time necessary for the first operation is from 10 to 12 hours for 1000 lbs. of fat. After this, pass to the cutting process, and operate as before described. It is essential that care be taken to stir the ingredients well while adding the salt. When the separation has taken place, leave altogether quiet for several hours, and then draw off the coloured

under-ley; 90 galls. of ley of 25° should then be added; increase the heat, there being strong ley at the bottom of the pan, which preserves the soap from burning. Boil this mass from 10 to 12 hours, adding every hour 5 galls. of ley of 25°. 4 or 5 hours' boiling will often be sufficient to saturate the soap, this being accomplished, extinguish the fire, leave it quiet for an hour, and then draw off the under-ley. It will measure from 25° to 30° B. To complete the process, add about 50 galls. of ley of 4° B. Let this boil gently for 1½ to 2 hours, stirring from time to time with the crutch, and finally extinguish the fire and cover the pan. The soap will separate from the ley, and rise to the top. After 5 to 6 hours, while yet in a liquid state, pour it in the frames, taking due care that no ley is mixed with it. In the frames it should be well stirred for some time. For neutralizing the disagreeable tallow odour, 1 to 2 oz. of a well-scented essential oil should be added to 100 lbs. of the soap, and after 7 to 8 days it may be cut. 100 lbs. of tallow will yield about 170 lbs. of soap.

Tallow Rosin Soaps.—Rosin, incorporated with a soap, to a certain amount, will make it more soluble and detersive. The lighter the rosin the more it is valued; 15 per cent. of rosin with 85 per cent. of tallow is allowable, but beyond that limit the soap loses in colour, in firmness, and quality. Even for the cheapest article the quantity of rosin should not exceed 33 per cent., otherwise the soap will be soft, and unprofitable to the consumer. The rosin can be saponified with alkali; 12 galls. of ley of 30° B. are needed for every 100 lbs. of rosin. Some soapmakers melt it with the fat at the commencement of the boiling for soap, but a much better product is obtained by first producing a tallow soap, and afterwards mixing the rosin soap with it, made in the meantime in a special kettle. Both mixtures have to be stirred and beaten thoroughly for half an hour, and the whole passed through a sieve before they are filled into the frames, and therein well stirred and crutched. Some palm oil, when saponified with the tallow, very much improves the appearance of the soap.

Rosin Soap.—Place 80 galls. of ley into a kettle of sufficient capacity, first boil the contents, and then throw rosin in at intervals of 5 or 6 minutes, and in portions of 15 to 20 lbs., until 1320 lbs. have been added. The rosin must be previously well pulverized, and while one workman is occupied with throwing it in, another should be constantly engaged in stirring it, as the mixture easily ascends. The heat must not be too rapidly increased, nor is it necessary that it should boil all the time, but keep the temperature near the boiling point. It is absolutely requisite to keep stirring the paste all the time. Saponification will be finished in 2 hours, and then the mixture, with the fat, is converted into soap as above described.

Cocoanut-oil Soap.—Cocoanut oil acts differently from any other fats, in combination with which weak leys produce a milky mixture. Such leys have no effect upon cocoanut oil, for it can be seen floating on the top, while strong leys of 25° to 30° very soon produce saponification throughout the whole mass. This soap is sometimes called marine soap, as it will lather well with sea water. A ley of 27°, cold weighed, will saponify an equal weight of cocoanut oil, 100 lbs., for instance, making nearly 200 lbs. of soap. The oil is put in the pan together with the ley, and then heat is applied. After continually stirring it for 1 or 2 hours, the paste will gradually thicken, when the temperature of the heat applied should be moderated, but the stirring continued. After a time the paste turns into a white semi-solid mass, which forms the soap, and this has to be filled immediately into the frames, because solidification takes place very quickly. A mixture is often used of equal parts of tallow and cocoanut oil, or of bleached palm oil and cocoanut oil, which yields a very fine soap. 90 to 95 per cent. of cocoanut oil, with 5 to 10 per cent. of natural palm oil, yields also a nice soap; and all these fats, when mixed with cocoanut