AGGLUTINANTS OF ALL KINDS FOR ALL PURPOSES

STANDAGE

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REQUIRED BY

Architects, Artists, Builders, Bricklayers, Braziers, Bookbinders, Bootmakers, Carpenters, Cabinet Makers, Curriers, Chemists, Decorators, Draughtsmen, Furniture Makers, French Polishers, Engineers, Engravers, Electricians; Gardeners, Glaziers, House Painters, Hardware Trades, Inkmakers, Ivory Turners, Joiners, Jewellers, Librarians, Leather Workers, Mechanics, Masons, Marble Workers, Microscopists, Newsagents, Opticians, Painters, Plumbers, Plasterers, Photographers, Picture-frame Makers, Stationers, Stone Workers, Tanners, Turners, Wood Workers; and Workers in Brass, Copper, Iron, Stone, Zinc, etc.

BY

H. C. STANDAGE

Consulting and Manufacturing Chemist

AUTHOR OF "THE ARTIST'S MANUAL OF PIGMENTS"; "THE PRACTICAL POLISH AND VARNISH MAKER"; "CEMENTS, PASTES GLUES, AND GUMS"; "THE LEATHER-WORKERS' MANUAL"; "SEALING WAXES, WAFERS, AND OTHER ADHESIVES"; ETC.

NEW YORK

D. VAN NOSTRAND COMPANY

LONDON: ARCHIBALD CONSTABLE & CO., LTD.

1907

BRADBURY, AGNEW, & CO. LD., PRINTERS
LONDON AND TONBRIDGE.

PREFACE.

Between the covers of this book will be found cements and agglutinants suited to a variety of trade purposes, the majority of which have been found reliable by the author in his own practical experience, and the book will, he hopes, be found of service to all who seek information on such subjects. Those formulæ which the author has not had the opportunity of personally testing have, however, been utilised by "men in the trade" and not found wanting.

In publishing a volume of recipes and formulæ it is not too much to expect that no possible form of agglutinant will be omitted; that is a claim, however, which the author would not like to make, but the collection is so complete and comprehensive that if any special recipe suited for a specific purpose is not found in the book, there are recipes of a kindred nature which, in the hands of an intelligent person, can be adapted to fulfil any particular requirement.

The methods of preparing the compounds are such as the author has found to give the best and surest results. But one word of caution: Successful results will not be obtained unless the precise procedure in incorporating the ingredients be followed. The success of a cement, etc., more often than not, depends on the order in which the components are commingled rather than on the exact amount of each ingredient employed. By following the order specified in each recipe it is possible to mix what otherwise appear incompatible bodies—such, for example, as turpentine, paraffin or benzine, with water, etc. Now, by means of a suitable excipient, such "incompatibles" can easily be made to combine and form a product which at first sight it may have appeared impossible to attain. To produce such results, however, the procedure prescribed in each formula must be strictly followed.

By an intelligent working out of many of the recipes given in this book it will be possible to formulate practically any kind of agglutinant required, and suitable for any particular purpose.

The present arrangement of the contents of the book is not that originally made by the author, who had arranged them according to the chief ingredient or agglutinative component of the formulæ; but, acting on the suggestion of his publishers, the author has rearranged the recipes where feasible according to the particular trade or industry to which they are especially applicable. Now a recipe suited for one trade is often applicable to many others; but to repeat the same recipe in each section, or under each trade to which it is suited, would unduly enlarge the book. The reader is, therefore, referred to the Index for any particular recipe that he may not find under the trade in which he expects to find it. To facilitate reference of this kind, the Index has been made as complete as possible.

H. C. S.

ASTON MANOR, BIRMINGHAM.
November 9th, 1906.

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CHAPTER I.

RESINOUS CEMENTS.

THIS chapter comprises those cements in which resins are the chief components; they are used in a variety of trades, and for very diverse purposes.

The cements that come under this chapter may be divided into two classes:—(1) Those cements which soften with heat, but harden again when cold; (2) resinous matters which are soluble in various menstrua, but become hard by the evaporation of the solvent.

The first section comprises resinous agglutinative compounds which are (*a*) mixed in the dry state to form cements that soften by heat; (*b*) those which are fused together, or in which their solution is effected by a solvent.

Besides the above well-defined classes of resinous agglutinative compounds, there are others in which resinous matters are necessary components, but do not form agglutinants. To attempt a sharp distinction between these resinous bodies is not an easy matter. The method adopted for arranging the recipes and formulæ has been to keep together such resinous agglutinative compounds as are most suited for different materials, as for stone, marble, earthenware, etc.; metal, wood, glass, etc., some attempt being made to collect the recipes into groups to meet the wants of particular trades.

Resinous bodies differ widely in nature, qualities, and characteristics; for example, we have common rosin, which is the residuum left in the "still" after the distillation of oil of turpentine; shellac, which is a resinous substance, totally different to the last, obtained by suitable manipulation of the exudations of a certain insect on the twigs and branches of trees; amber and copal resins, which are fossilised bodies found naturally in the soil of particular districts, etc.

One rational way to treat this chapter would be to group all these substances under one heading, but to meet the exigencies of various industrial uses they have been scattered throughout the book according to the trades and purposes in which they are chiefly useful.

COMMON ROSIN

is the residue that is left after the distillation of turpentine from the several different varieties of pine resin. In colour, this residue is of an amber yellow or brown. It contains products which can be obtained by distillation. When all the products obtainable by this means have been drawn off, the residue remaining is black rosin and pitch. This rosin* softens by heat at a comparatively low temperature, and liquefying while hot solidifies when cold into brittle, friable masses that are easily pulverised, and which break with a glassy fracture (except "pitch," which retains a semi-fluid state). Owing to the brittleness of rosin, it does not, by itself, form a very adherent agglutinant; but by mixture with other bodies, such as starch-paste, glue, balsams, oils, etc., it may be made into a useful agglutinant for a variety of purposes where a cement that is insoluble in water is required. As each particular formula has a distinctive and comprehensive heading, the particular application of the formula is readily ascertained by a glance through the Index. By such an arrangement, no elaborate classification of the recipes is required.

* This substance is usually written "rosin," while the word "resin" is applied to the fossil, or natural, resins.

Recipe 1.—**Waterproof Cement for Aquariums, Cisterns, Tanks Vats, Tubs, etc.**

Ingredients.— 6 oz. dry whiting
3 oz. plaster of Paris
3 oz. white shell sand
3 oz. litharge
1 oz. powdered rosin.

Method of Incorporation.—Reduce each of the above ingredients to a fine powder, then mix them together by sifting, and make the mixture into a "putty" with sufficient coach-varnish. Use this putty as ordinary glazier's putty is used, to fill cracks, crevices, seams, etc.

Recipe 2.—**A similar Cement for the same purpose as No. 1.**

Ingredients.—10 parts, by measure, of litharge
10 parts, by measure, of plaster of Paris
10 parts, by measure, of white lead
1 part, by measure, of powdered rosin.

Incorporation.—Reduce each substance to fine powder, mix by sifting, and when wanted for use, take sufficient of the mixture and make it into a putty or "dough" by working it up with enough "boiled oil" to render it plastic and workable.

Both the above cements should be allowed to dry thoroughly before putting water into the vessel.

Recipe 3.—**A Cement for Marble, Stone, etc.**

Ingredients and Incorporation.—Mix together 2 lb. of rosin in powder and 1 lb. of plaster of Paris, then heat and stir the mixture until the ingredients are well incorporated.

Recipe 4.—**Another similar Cement**

is made by using 8 parts of rosin, 1 part of yellow wax, and sufficient plaster of Paris to make a putty.

Recipe 5.—**Cement for Gas-fitters' Use.**

Mix 4½ oz. rosin, 2 oz. Venetian red, and melt together, then add 1 oz. beeswax. When cold it can be remelted for use.

Recipe 6.—**Cement for fixing Iron Railings in Stone Copings, Balustrades, etc.**

Ingredients and Incorporation.—Melt together 2 oz. shellac, 1 oz. Venice turpentine, then add 5 oz. pumice-stone powder. Pour this mixture into the holes round the iron while hot, or else fill the holes with it, allow to cool, then heat the iron and plunge it into the cement. (If the pumice-stone be omitted, the cement remains plastic.)

Recipe 7.—**Cement for Statuary Marble.**

Process to follow.—Cover the fractured surface with linseed oil, then cement together with a putty made by mixing equal parts of dry brickdust and litharge, moistened with sufficient linseed-oil varnish.

Recipe 8.—**Cement for Terra-cotta.**

Ingredients and Incorporation.—Mix together 10 lb. rosin (powdered), 2 lb. sulphur, 10 lb. yellow wax, and incorporate the whole by heating together, then add 1 lb. of whiting and 1 lb. of quartz sand.

Recipe 9.—**Putty for Tile Roofs.**

(This does not melt like tar or asphalt.)

Ingredients and Incorporation.—Mix together 4 parts dry sand, 4 parts dry whiting, 1 part litharge, and make into a putty with linseed oil.

Recipe 10.—**Cement for Lavatory Basins.**

Process.—Heat up some flint glass and suddenly plunge it into cold water; this will break it down into small granules, which can be readily pulverised to glass meal. Then mix 2 parts of litharge and 1 part of linseed-oil varnish. The mixture of glass and litharge should be first moistened with a little of the oil, then the mixture heated and the remainder of the oil added. Give 3 or 4 days' rest before using the basin.

Recipe 11.—**Putty for Water Tanks.**

Process.—Mix dry red lead with stiff copal varnish to a stiff paste, and force it into the cracks and crevices with a putty knife.

Recipe 12.—**Waterproof Cement for Wooden Tanks, Troughs, Vats, etc.**

Ingredients and Process.—Mix together equal weights of rosin and oil of turpentine by gently heating, then add an equal weight of burnt ochre, and use as a putty with a knife or caulking tool.

Recipe 13.—**Cements for Marble.**

(a) *Ingredients and Process.*—Mix together—

13 oz. sandarach varnish
5 oz. boiled linseed oil
2½ oz. Venice turpentine
5 oz. marine glue
5 oz. sulphate of barium, "precipitated"
5 oz. dry carbonate of lead.

Heat over a sand bath and incorporate well by stirring.

(b) *Ingredients and Process.*—Mix together—

15½ oz. copal or shellac varnish
5 oz. drying oil
4 oz. india-rubber (or gutta-percha), dissolved in
7 oz. coal-tar oil.

Melt by gentle heating and then stir in—

5 oz. Roman cement, and
5 oz. plaster of Paris, in dry powder.

(c) *Ingredients and Incorporation.*—Mix together—

15 oz. copal or resin
2½ oz. Venice turpentine
2½ oz. essence of turpentine
2 oz. fish isinglass, in powder
3 oz. fine iron filings, and
10 oz. yellow ochre (or else rotten stone).

(d) *Ingredients and Incorporation.*—Mix—

2 oz. finely-powdered litharge
1 oz. dry white lead
1 oz. copal resin (powdered)
3 oz. boiled oil (linseed).

Rub the solids together in a mortar, then mix with the linseed oil and heat the mixture over a sand bath until the solids are dissolved to form a syrupy mass.

Recipe 14.—**Cement for affixing Metal Letters to Glass.**

Ingredients and Incorporation.—Put 3 oz. of copal varnish in a bottle, then add 1 oz. of drying oil and ½ oz. of turpentine, and stand the bottle in a vessel of hot water and heat the mixture until the ingredients combine, then add 2 oz. of finely-sifted lime which has been slaked.

Recipe 15.—**A Lime Cement.**

Process.—Melt some resin in a saucepan, and then add some calcined plaster of Paris to make a putty, and dilute to the consistency of honey with boiled oil. Use the cement hot.

Recipe 16.—**An Indestructible Putty.**

Ingredients and Incorporation.—Mix 4 lb. of brown umber with 1 lb. of linseed oil and boil the mixture for 2 hours, then stir in 2 oz. beeswax, remove from the fire and stir in 5½ lb. of chalk and 11 lb. of white lead; mix well.

Recipe 17.—**Wax Putty for coating Bricks, filling Cracks, etc.**

Ingredients and Incorporation.—Melt together 4 lb. yellow wax and 6 lb. Venice turpentine, then add 2 lb. tallow. When these ingredients have become incorporated, remove the vessel from the fire and add sufficient oil of turpentine to make of a suitable consistence, stir well and allow to cool before use.

Recipe 18.—**Resinous Paste for Paperhangers.**

Ingredients and Incorporation.—Mix 2 lb. of flour to the consistency of thick cream, with just enough lukewarm water, then add 1 oz. of powdered rosin, and ½ oz. of white acetate (*i.e.*, "sugar") of lead, then pour on sufficient boiling water to "cook" the flour (that is, cause the separation of the gluten), and stir the mixture until it thickens. It is very adhesive.

Recipe 19.—**Waterproof Cement for China, Glass, etc.**

Ingredients and Incorporation.—Dissolve isinglass in a sufficient mixture of water and alcohol to effect solution and mix this with an equal bulk of thick mastic-varnish. The compound sets hard when cold, but it remelts on heating over a water-bath, or by standing the vessel containing the cement in a basin or cup of hot water.

Recipe 20.—**Another Cement for China, etc.**

Ingredients and Incorporation.—Soak 1 oz. of isinglass in 6 oz. of water and evaporate until reduced to half its weight, then add 1½ oz. of rectified spirits of wine and heat the mixture for about a minute, then strain it, and add to it, while hot, first ½ oz. of a "milky" emulsion of gum ammoniac, and then 5 drachms of a solution of mastic rosin in alcohol. This cement is useful for mending glass, china, ivory, fixing precious stones, metal inlays, mother-of-pearl, leather ornaments, etc.

Recipe 21.—**Waterproof Cement for Stone, Metal, etc.**

Ingredients and Incorporation.—Soak 1 lb. of good glue in just as much water as it will absorb in 2 hours, then melt the softened glue in a glue-pot and add 1 lb. of melted resin; when that has combined with the glue, stir in 4 oz. of red ochre which has been previously dried in an oven. (See also "Mineral Cements.")

Recipe 22.—**Waterproof Cement for "Roofing-felt."**

Ingredients and Incorporation.—Mix together, in dry powder, 1 cwt. of graphite, 1 cwt. of red ochre, 8 cwt. of cement, 8 cwt. of barytes (sulphate of barium, native), 3 cwt. of plumbic oxide, and then grind the mixture in an oil-varnish prepared as follows: boil 1 cwt. of linseed oil for 8 hours, in a suitable vessel, with

5 per cent. of "pyrolusite" (black oxide of manganese), then add 10 per cent. of flour of sulphur, and 20 per cent. of French pitch, which should be dissolved in the compound by heating it; $2\frac{1}{2}$ lb. of this composition, mixed with $1\frac{1}{2}$ gallons of linseed-oil varnish, is sufficient to cover 1,000 square feet of the roofing felt with two coats. The first coat, while still wet, should be covered with fine sand sifted over it, and any superfluous sand brushed off before laying the second coat. It is best to give the second coating in a week's time after the first. The second coat need not be sanded.

Recipe 23.—**Asphaltum Composition for Floors, Paths, etc.**

Ingredients and Incorporation.—Melt 15 parts, by weight, of bitumen, in a boiler, then add 35 parts of coal cinders and remove all scum until froth ceases to rise, then mix with the mass 10 parts of powdered coke and 130 parts of lime (which has been mixed with the coke and heated to 575° F. to dry the mixture), and finally stir in 160 parts of fine gravel.

Recipe 24.—**Waterproof Tarring Composition for Roofing Purposes.**

Ingredients and Incorporation.—Store coal-tar for several weeks to free it from all water, then mix it well with its own weight of ground levigated chalk and heat the mass to 110-140° F. At this temperature the mixture becomes gummy and of the consistence of soft soap; it is then readily applied, and possesses considerable binding power, a property it retains within a considerable limit of temperature.

Recipe 25.—**Resinous "Mastic" for Builders' Use.**

These mastics are made use of for repairing stone, tiles, plaster, etc.

Ingredients and Incorporation.—Mix together in the dry state 60 lb. of slaked lime, 33 lb. of powdered litharge, 7 to 10 lb. of old paint skins, and then knead the mass into a stiff dough with linseed-oil varnish.

Recipe 26.—**Hydraulic Cement for Salt Water.**

Ingredients and Incorporation.—Mix together in the dry state 9 lb. of litharge, 9 lb. of plaster of Paris, 9 lb. of pure white sand, and work the whole into a mass with 4 lb. of boiled linseed oil, and then with linseed-oil varnish if necessary. Give the compound a few hours' rest before using it. It sets very hard in water, especially so in salt water.

Recipe 27.—**A Cementing Putty for Water-pipes.**

Ingredients and Incorporation.—Melt 10 parts of rosin, and add to it 10 parts of cotton wool, 10 parts of calcined lime ("quick-lime"), 3 parts of linseed-oil varnish.

Recipe 28.—**Cement for fixing Metal to Stone, Glass, etc.**

Ingredients and Incorporation.—Mix 15 fluid oz. of copal-varnish with 5 fluid oz. of lead-boiled oil, then add 8 fluid oz. of a suitable solution of rubber (caoutchouc) in coal-tar oil, and 7 lb. of tar oil, then add 1 oz. of cement or plaster of Paris. This cement is especially useful for affixing metal letters to glass (such as shop-fronts), metal spikes in stone, mortar, etc.

Recipe 29.—**Cement for fixing Glass, or Metal, in Scientific Apparatus.**

Ingredients and Incorporation.—Mix 2 oz. of Canada balsam with ½ oz. of Venice turpentine, by heating over a water-bath, and then add 2 oz. of best quality glue solution, made in the usual way.

Recipe 30.—**Cementing Size for Plaster Walls, to stop Suction.**

Ingredients and Incorporation.—Soak 1¼ oz. of glue in water for some time, then melt it in a glue-pot by gently heating it: separately, in 5 quarts of boiling water, dissolve 1 oz. of borax, 5 oz. of crystallised carbonate of soda, and 1 oz. of powdered rosin, and make the mixture boil until the rosin has dissolved, then measure out 30 parts of the glue solution and mix it with 1 part of the rosin solution, and boil the mixture for about 15 minutes, then stir, and it is ready for use.

Recipe 31.—**Fireproof Adhesive Coating for Roofing Felt.**

Ingredients and Incorporation.—Mix together in a suitable vessel 15 lb. of "quick" lime (*i.e.*, not slaked) and 100 lb. of tar and heat the mixture, stirring well until the lime and tar are well mixed; they chemically combine and form a compound that is not melted by the sun's heat, nor dissolved by steam or hot water. It makes a smooth glazed coating if laid on not too thick or not too coarse.

Recipe 32.—**Mouldable Composition for Dados, Cornices, etc.**

Ingredients and Incorporation.—Soak 4 lb. of glue in cold water for 5 hours, then drain off all unabsorbed water and melt the glue in a glue-pot along with 4 lb. of hot linseed oil; separately melt 2 lb. of black pitch in a boiler and allow it to cool sufficiently to add 4 lb. of oil of turpentine; then pour the hot glue mixture into the pitch and when well mixed add 4 lb. of fine sawdust, 4 lb. of whiting, and 4 lb. of red ochre, while hot. The mass is plastic and can be moulded by pressure in moulds.

Recipe 33.—**Another Compo, suitable for Frames, etc.**

Ingredients and Incorporation.—Soften 14 lb. of glue in cold water for 10 hours, then pour off all unabsorbed water and melt the soft glue in a large water-lined vessel (a common gluepot is such a vessel), then put 7 lb. of powdered resin in the hot glue, and when that has melted add $\frac{1}{2}$ lb. of pitch, stir well; when that has become incorporated add 5 lb. of water, more or less, according to the consistency desired, then boil the whole, stirring until the mixture is homogeneous, then add as much dry whiting as will render the whole of a hard consistence; then put the compo in hard-wood moulds and subject it to pressure. For small patterns, boxwood moulds are used. The surface of the moulds should be oiled before putting in the compo, so as to prevent it adhering. If the compo becomes hardened before handling, it can be softened again by steaming it.

Recipe 34.—**Adhesive Coating for Damp Walls.**

Ingredients and Incorporation.—Melt together 3 parts of rosin, 2 parts of tar, 5 parts of asphaltum, then stir in 6 parts of quartz sand, mix well, and lay on the walls like plaster, if it is the external surface of the wall that is to be protected from damp; but if it is the interior of the wall, then the above composition should be made into slabs, and the slabs fixed to the wall by means of a mortar made by mixing 4 parts of sand, 2 parts of hydraulic lime, and 1 part of Portland cement.

These slabs need not be very thick; when they are laid on the wall-surface, their face should be coated with a shellac varnish which has been prepared by dissolving 1 part of shellac in 4 parts methylated spirit and adding 2 parts of oil of turpentine.

For filling in the cracks and joints, *in situ*, use a putty prepared by melting together 6 parts of resin and 1 part of asphaltum, then stirring in 2 parts of powdered stone lime.

After filling in the cracks, etc., and varnishing the surface, it should also be covered with fine sand; when dry this will give a "tooth" to the surface so as to enable it to hold a coat of plaster, which can then be papered in the ordinary way. The above bituminous compo can also be used for the "damp-courses," but it is especially adapted for application to end-walls that are beaten on by rain.

Recipe 35.—**Cheap Cement for Cracks or Holes in Stone or Brick.**

Ingredients and Incorporation.—Collect old paint skins and the remnants of linseed oil paint from paint pots, put them through a mill or strainer, then mix them with sufficient dry whiting to make a mass of the consistency of glycerine-putty, then add to it enough ground Portland cement to enable the mass to be handled without sticking to the hands. While in this condition it can be used like ordinary putty, it adheres well and becomes hard and waterproof and not much affected by heat.

REPAIRING CEMENTS for CHINA, GLASS, WOOD, METAL, etc.

Recipe 36.—**Cement for Stone, Earthenware, Glass, Marble, etc.**

Ingredients.—Mix in the dry state, by sifting through a sieve :—

6 oz. of sulphur
4 oz. of white Burgundy pitch
1 oz. of shellac
2 oz. of elemi resin
2 oz. of mastic resin
6 oz. dry kaolin.

Incorporation.—Melt the mixture over a slow fire and stir well. To use the cement, melt over a flame and apply to the edges of the fractured parts, which should have been previously warmed, so as to allow the cement to adhere well.

Recipe 37.—**A Universal Cement for Metals.**

Ingredients.—Mix, in dry powder—

2 oz. litharge
1 oz. dry white-lead
1 oz. copal resin.

Incorporation.—Rub up together in a mortar, then add 3 oz. boiled oil and heat over a water-bath until the solids are dissolved to a syrupy mass.

Recipe 38.—**Cement for Wood-turners' Use.**

There are several simple cementative compounds used by turners for fixing the wood in the lathe, of which the following will be found typical.

(1) Mix and melt together 1 part resin, 1 part potash, 2 parts beeswax, brickdust, q.s., (*i.e.*, sufficient to make of the desired consistence).

(2) Mix equal weights of rosin, pitch, whiting, and yellow wax.

(3) Use 8 parts rosin and 1 part wax.

(4) Melt together 4 parts resin and 1 part pitch, then add enough brickdust to make the melted mass hard when a little

is dropped on the stone. This will hold wood in the chuck and allow of easy removal by a smart tap with a hammer. The application of benzine will remove all traces of the cement from the wood. To use the cement, take sufficient of it to cover the chuck one sixteenth of an inch, lay it over the surface to be cemented, mixing it with one eighth of an inch of its bulk of gutta-percha, cut up in thin slices, then heat an iron to a dull red heat and hold it over the chuck until the mixture and gutta-percha are melted and mixed, stir the cement until it is well mixed, chuck the work, lay on a weight to keep in contact, and in 20 minutes it will be perfectly cemented.

Recipe 39.—**Cement for Wood, Ivory, Glass, etc.**

Ingredients and Preparation.—Put 4 oz. best orange shellac into a bottle or tin can and pour on it 3 oz. rectified spirits of wine (58 o.p.), and stand the vessel in a warm place, or in hot water, until the shellac has dissolved to the consistency of syrup, thick; to reduce the brittleness add a few drops of castor oil.

Recipe 40.—**Cement for Bone, Horn, Ivory, and similar Substances.**

Ingredients.—Mix—

6 oz. of linseed oil
5 oz. of mastic resin
2 oz. of oil of turpentine.

Incorporation.—Put these ingredients into a bottle or can, stand it on some clean dry sand held in a saucepan or frying-pan, and heat the sand over a fire until the solids are dissolved.

Recipe 41.—**Cement for fixing Lettering in Brass, Zinc, or Copper Plates.**

Ingredients.— 1 lb. genuine asphaltum
1 lb. brown shellac
1 lb. dry lampblack.

Incorporation.—Melt the asphaltum and shellac together, then stir in the lampblack and apply the hot mixture to the metal plate. Another way is to allow the cement to cool and harden, then pulverise it in a mortar, and for use, the dry powder is put in the sunk lettering and the metal plate held over a gas or spirit flame, so as to cause the resinous powder to melt and fill up the letters, the melted compound is then allowed to cool, and finally smoothed off with a fairly warm iron ; afterwards the surplus compo is scraped off the metal and a warm sad-iron held an inch or so above the lettering, to more or less melt the surface of the cement, and thus impart a glaze to it. Instead of lampblack, other dry colours can be mixed with the resinous mixture.

If the metal plate cannot be heated, make an unshrinkable putty, by mixing equal parts, by measure, of asphalt varnish and clear coach japan, and work into this enough dry calcined lampblack to make it very stiff, fill the letter spaces with this compo, press it in with a putty knife, then clear off the edges with a rag dipped in turpentine ; when the filling has become thoroughly hardened, polish the surface of the plate.

Recipe 42.—**A Liquid Cement for Wood.**

Ingredients.— 3 lb. shellac
19 oz. Venice turpentine
1 oz. balsam of Peru

Incorporation.—Melt the above ingredients together at a gentle heat, then allow the mass to cool and solidify and when cold reduce it to powder in a mortar and dissolve the powder in alcohol at a temperature of 97° F., in order to dissolve the remaining balsam. When all the solids are dissolved give a few days' rest to permit any debris to deposit.

Recipe 43.—**Border Wax for Engravers' Use.**

Ingredients.—(1) Melt together—
1 oz. beeswax
1 oz. tallow
2 oz. pitch.

(2) Melt together in a saucepan 2 oz. resin, 2 oz. beeswax, and then add sufficient olive oil to make a plastic mass, next

pour out into cold water and knead thoroughly with the hands. If too brittle, remelt and add more oil.

Recipe 44.—**Engravers' Wax for General Use.**

Ingredients and Preparation.—Mix and melt together by heating—

1 oz. gum benzoin
1 oz. white wax
8 oz. raw linseed oil.

Boil the mixture until reduced to two thirds in bulk.

Recipe 45.—**Cement for uniting Glass to Metal.**

Ingredients and Preparation.—Melt 5 lb. black rosin with 1 lb. yellow wax and then gradually stir in 1 lb. red ochre (or Venetian red) in fine dry powder, mix well. For use, remelt by heating; and, to increase its adherence, the surface to which it is to be applied should be warmed.

Recipe 46.—**Cement for coating Electroplating, and Electrotyping Troughs, Vats, etc.**

Ingredients and Preparation.—Melt together, as in last recipe, 5 lb. best rosin, 1 lb. beeswax, and 1 lb. red ochre (dry and warm), then add 4 oz. dry plaster of Paris and continue the heating, slightly over 212° F., and stir until the froth ceases.

Recipe 47.—**Jewellers' Cement for Precious Stones.**

Ingredients and Preparation.—Soak 8 oz. of isinglass in warm water to which a little spirits of wine has been added, when the isinglass is swollen draw off all unabsorbed fluid, separately dissolve 1 oz. of gum ammoniac and 1 oz. of galbanum in 4 oz. (fluid) of spirits of wine, and mix this with the isinglass solution by the aid of a water bath, stir well and put into wide-mouthed bottles. To use this cement, stand the bottle in a cup of hot water until the cement liquefies, then take out a little on the point of a stick and apply to the surfaces which are to be cemented together.

This formula represents that of the well-known glass and china cement that is sold in small bottles at 6*d.* & 1*s.* each, under such names as "Diamond Cement," "Giant Cement," etc. Other somewhat similar cements are made with gelatine and mastic resins (*vide infra*).

Recipe 48.—**Glue and Resinous Cement for Metal and Glass.**

Ingredients and Preparation.—Mix together and put through a paint mill—

16 oz. of copal varnish
5 oz. of drying oil
3 oz. of oil of turpentine
3 oz. of Venice turpentine
5 oz. (fluid) of "liquid glue"
10 oz. of Portland cement (or else pulverised stucco).

Recipe 49.—**Cement for affixing Glass to Metal.**

Ingredients and Preparation.—Mix 2 oz. of a thick solution of glue with 1 oz. of linseed oil varnish (or else $\frac{3}{4}$ oz. of Venice turpentine, liquefied by heat).

This cement is waterproof.

Recipe 50.—**Cement for fixing Glass or China Letters to Glass Windows, Show Cases, etc.**

Ingredients and Preparation.—Dissolve a thick solution of "marine glue" in wood-naphtha (acetone), have the glass chemically clean, coat the letters with the cement and fix them *in situ.*

Recipe 51.—**Universal Cement for Glass, Wood, China, etc.**

Ingredients and Preparation.—Soak glue in water until soft, then drain off the water and dissolve 1 lb. of this glue in 1 lb. of linseed oil varnish, by heating in a gluepot. Then add 3 lb. of copal varnish, and when that is incorporated thin the mixture with 1 lb. of oil of turpentine and make the mixture into a paste by stirring in 10 lb. of slaked lime.

Recipe 52.—**Another Universal Cement for Crockery, Hardware, etc.**

Ingredients and Preparation.—Make a varnish by dissolving equal parts of sandaric resin, and white pine rosin (colophony) in turpentine and then mix 15 fluid oz. of the varnish with 5 fluid oz. of boiled oil (linseed oil that has been heated with litharge) and add 5 fluid oz. of oil of turpentine, then mix in 5 oz. of marine glue, heat the compound over a water bath and then add 10 oz. of dry carbonate of lead (flake white).

Recipe 53.—**A Resinous Universal Agglutinant.**

Ingredients and Preparation.—Dissolve 1 oz. of resin in 15 fluid oz. of copal varnish and then add 5 fluid oz. of oil of turpentine, then put into the mixture 2 oz. of isinglass, reduced to powder, 5 oz. of fine iron filings, 10 oz. of levigated clay (or ochre) and mix well by heating.

Recipe 54.—**Waterproof Cement for Glass.**

(1) *Ingredients and Preparation.*—Dissolve 12 oz. of mastic resin and 4 oz. of dammar resin in 50 fluid oz. of chloroform; dissolve 1 oz. of rubber in 10 oz. of benzine, then mix the two solutions and allow to digest at a gentle heat.

(2) *Ingredients and Preparation.*—Digest at a gentle heat, $1\frac{1}{4}$ oz. of rubber and 12 oz. of mastic in 50 oz. of chloroform, or stand in a cold place for a few days, the resulting mass forms a very transparent cement for glass and adheres at once.

Recipe 55.—**Cement for Cutlers' Use.**

(1) Mix together—

4 oz. of borax
1 oz. of brickdust
4 oz. of wax.

Then melt the mixture by heating and pour it into the hole in the knife-blade handle, heat the tang of the knife and force it into the hole and allow to cool. The compo may be melted, cooled, reduced to powder, the holes filled with the powder, and then the heated tang of the knife forced in and left to cool.

(2) Mix together equal parts of resin and hot dry whiting, and add one-sixteenth part of wax, incorporate by heat, and use as above directed.

(3) Melt 5 oz. of pitch and 1 oz. of hard tallow, and then add 1 oz. of wood ashes, use as above.

Recipe 56.—**Cement for Jewellers' Use.**

(1) *Ingredients.*—Mix together—

15 oz. resin, powdered
4 oz. calcined whiting
1 oz. beeswax.

Incorporate by heating and stirring. Use hot.

(2) Mix together—

10 oz. of rosin, powdered
2 oz. of shellac
1 oz. of rouge, or red oxide of iron.

Melt them together by heat and add sufficient oil of turpentine to make the compound tough and flexible, so as to prevent it being brittle enough to splinter when subjected to pressure.

Recipe 57.—**Cement for Metal Foil.**

Preparation.—Dissolve dammar resin in benzol, then add one-fifth its weight of gold size.

Recipe 58.—**Cement for Metals.**

Ingredients and Preparation.—Mix 5 oz. of "absolute" alcohol and 10 oz. of ether, then dissolve in the mixture 5 oz. of shellac and stand the vessel in hot sand or in a water bath. When the solids are dissolved allow the sediment to deposit (or else filter) and then evaporate the clear fluid until of the consistency of syrup.

Recipe 59.—**Amber Varnish Cement for Metals.**

Preparation.—Put some amber resin in dry chips (genuine) in an iron saucepan, heat them until the chips are softened and semi-fluid, then pour on the hot amber an equal weight of raw linseed oil, and heat the mixture.

Recipe 60.—**Glazing Cement for Beer Barrels.**

The following cement is one that is cleaner and better than "pitching" them, as pitch engenders the growth of fungi.

(1) *Ingredients.*—8 lb. of rosin
1 lb. of shellac
$\frac{1}{2}$ lb. of Venice turpentine
4 lb. of yellow wax
4 gallons of strong spirits of wine.

Dissolve the above ingredients at a gentle heat until a clear fluid is obtained, which is then suitable for use. To use this glaze, apply it to the inside of the barrel by means of a sponge affixed to the end of a stick; give two coats. When the second one is dry, give an application of shellac, made by dissolving 4 lb. of shellac in 1 gallon of strong alcohol. This glazing closes the pores, and does not injure the taste of the beer which is put into the barrel.

(2) *Ingredients and Preparation.*—Melt in an open boiler 100 lb. of pine pitch (colophony), and then add, with constant stirring, 5 to 6 lb. of caustic soda-lye of 10° Bé, when the mixture in the boiler (*i.e.* the sodium "resinate") ceases to rise, or form bubbles, pour it out into tin moulds to cool. For use it is melted by reheating and applied hot, but it dries very slowly.

(3) *Ingredients and Preparation.*—Melt together by gentle heating:—15 lb. of pine pitch and 5 lb. of red transparent rosin, then add 1 lb. of "heavy" rectified oil of turpentine and mix thoroughly.

(4) *Ingredients.*—Prepare as in last recipe—
10 lb. of pine pitch
$8\frac{1}{2}$ lb. of pine resin
1 lb. of heavy rosin oil

(5) Ditto, $7\frac{1}{2}$ lb. of pine pitch
14 lb. of red rosin
$1\frac{1}{8}$ lb. of heavy rosin oil.

(6) Ditto, 4 lb. pine pitch

5 lb. of pine pitch
15 lb. of rosin
1 lb. of rosin oil.

(5) Prepare as above directed—

16 lb. of rosin
1 lb. of heavy rosin oil.

Recipe 61.—**Temporary Cement for Opticians' Use.**

Preparation.—Mix together at a good heat 2 oz. rosin, 1 drachm beeswax, and 2 oz. of whiting. Use this hot on the surface to be joined, when cold it is hard and firm, but may be removed by reheating.

The above cements and agglutinative bodies form a variety of useful adhesive compounds for repairing different kinds of materials; they are too diverse to be classified for use in various trades, but they have been given in one group because they are chiefly of a resinous nature, or have resins as their chief component. In other chapters will be found recipes, etc., for resinous cements which are particularly adapted for special use in the trades represented in the chapters.

CHAPTER II.

AGGLUTINANTS OF DIFFERENT KINDS AND NATURE WHICH ARE ESPECIALLY ADAPTED FOR USE IN THE BUILDING TRADES, TO CARPENTERS, PAINTERS, DECORATORS, BRICKLAYERS, PLASTERERS, STONEMASONS, ETC.

Recipe 62.—**Waterproof Cement for Iron Bolts, Nuts, Rivets, etc., to protect them from Rust.**

Preparation.—Mix together by melting in an iron pot:—

5 oz. of sulphur
1 oz. of tallow
1 oz. of rosin.

Dip the newly-forged rivets, etc., in the hot molten mass, and allow them to drain in a wire sieve.

Recipe 63.—**A Non-poisonous Elastic Cement for Water Tanks, Aquariums.**

Ingredients and Preparation.—Mix together 1 lb. of powdered rosin and ¼ lb. of lime, then heat the mixture to melt the rosin, and liquefy by adding 4 to 5 gills of linseed oil. By varying the proportions of the ingredients different consistencies are obtained. This cement, in many cases, is made fluid enough to be run into the crevices and cracks when warm, but not hot enough to fracture the glass. A vessel with a long spout is serviceable for pouring the hot cement where required.

Recipe 64.—**Cement to fasten Emery to Wood.**

Preparation.—Mix together 1 oz. of shellac and 1 oz. of colophony, melt by gentle heating and then add 1 oz. of crystallised carbolic acid. This cement is very tenacious.

Recipe 65.—**Waterproof Cement for Wood and Metal.**

Ingredients and Preparation.—Soak 1 lb. of glue in water (cold) for three hours, then melt it by heating in a gluepot, stir in 1 lb. of powdered black rosin and when that has melted add 4 oz. of dry red ochre. Use the cement *hot.*

Recipe 66.—**Waterproof Cement for coating Wood and Iron.**

Preparation.—Melt together 3 lb. of rosin and 2 lb. of asphalt and work in 2 lb. of brickdust. Use hot.

Recipe 67.—**Adhesive Cement for use as a "Putty" for Glass and Iron.**

Preparation.—Make into a stiff paste a mixture of zinc oxide ("zinc white") and silicate of soda, or potash, of 33° Bé.

Recipe 68.—**Japanners' Gold Size.**

Ingredients.—4 oz. acetate of lead
4 lb. gum animi
7 quarts oil of turpentine
8 quarts drying oil.

Incorporation.—Crush up the gum and heat it in the drying oil for four hours at a fairly high temperature until dissolved, then add the lead acetate and heat for half-an-hour longer; then cool slightly and add the oil of turpentine.

Recipe 69.—**Gold Size (Ordinary).**

Ingredients and Preparation.—Slowly heat 8 oz. of best drying oil and just before it begins to boil add 2 oz. of gum elemi and boil the mixture until it is of the consistence of tar; then strain through silk, add a little vermilion, and thin down with oil of turpentine. Sufficient vermilion should be added to make the compound opaque. The whole should be well ground together or rubbed up on a stone with a muller.

Recipe 70.—**Old Gold Size, and Size for Distemper Gilding.**

Preparation.—Put some boiled oil into a saucepan and heat it until the fuliginous fumes given off can be ignited; set these fumes alight and let the mass burn until the oil becomes thick; then extinguish the flames by putting on the lid of the saucepan, strain through silk and thin for use with oil of turpentine, then add a little chrome yellow or yellow ochre. Grind very fine in oil.

Recipe 71.—**A Quicker-drying Gold Size than the Above.**

Preparation.—Heat linseed oil to the boiling point under constant stirring, then add finely powdered gum animi and continue the boiling until all the resin has dissolved. When the mixture has become as thick and viscid as thick varnish, thin it with oil of turpentine to a consistency that enables it to flow easily from the brush. A small quantity of chrome yellow or vermilion is generally added to give the size a proper colour.

Recipe 72.—**Quick-drying Size for Aluminium and Gold Leaf.**

Preparation.—Mix 2 gills of gold size and 1 gill of fat oil. This size will permit of the gold leaf being laid on in four hours.

Recipe 73.—**A very Quick-drying Gold Size.**

Preparation.—One which will be ready in two hours: Mix ½ pint of fat oil and a dessertspoonful of gold size japan.

Recipe 74.—**A Special Size for Gold Leaf.**

Mix the size with a little medium chrome yellow that has been ground in japan; for aluminium leaf the size may be used clear or with a dash of flake white; for work that is to be burnished the slower drying size should be used.

Recipe 75.—**Resinous Size for Aluminium and "Bronzing" Powders.**

Ingredients and Preparation.—Mix 1 gallon of turpentine or benzine with ½ pint of good body copal varnish; apply this to the surface, and when faintly "tacky" dust on the dry bronze powder; then, when dry, rub off excess of powder with a piece of cloth. This varnish may be mixed with a bright yellow or a black with japan; a teaspoonful of the latter to 1 pint of the liquid size will be sufficient. The consistency of a vehicle for bronzing powders should be viscid enough to prevent heavy bronze powders sinking, and at the same time it should not harden in the pot. The best bronzing vehicle is one that hardens with rapidity throughout, because it does not give the bronze powder an opportunity to oxidise.

A good vehicle for such bronze powder is a mixture in equal parts of japan gold size (or coach japan), thin this mixture with pure spirit of turpentine, to which add only enough bronze to give it the lustre desired, and mix only sufficient at a time as can be worked up in about 10 to 15 minutes or so. If it sets too rapidly under the brush to permit of free application, dissolve some white or yellow beeswax in hot turpentine over a water bath and use this for thinning the varnish and japan, instead of the clear turpentine; 1 oz. of wax is sufficient for 1 quart of turpentine.

Recipe 76.—**A Quick-drying Bronzing Liquid.**

One that will keep bronzing powder soft, though it settles quickly, may be made by dissolving 3 lb. of pale orange shellac in 1 gallon of wood alcohol (acetone), adding 2 oz. of camphor, and straining the solution through a cloth ("cheese-cloth" is best). This liquid will not require more than one-fourth of its own measure of bronze, and the proportion must be deftly applied, as it will rub up again if gone over too often with the brush.

Recipe 77.—**Agglutinant for holding Gold Leaf on Glass.**

Ingredients and Preparation.—Mix lampblack, ground in japan, with a good quality coach varnish, first rubbing up the lampblack with a little turpentine, otherwise it will not mix readily with the varnish; genuine asphaltum in oil, such as is sold in tubes for artists' use, is also serviceable when the commercial asphaltum will not answer.

Recipe 78.—**Liquid Agglutinant for Painting on Glass.**

Ingredients and Preparation.—Melt 1 oz. of amber resin in an iron vessel and when somewhat cooled off, but not hardened, add sufficient oil of turpentine to keep it in a liquid state ; when cold, mix it with the colours which have been ground in oil.

Recipe 79.—**Gilders' Wax.**

Ingredients and Preparation.—(1) Melt together by heating, and stir until cold—

25 oz. of linseed oil
25 oz. of yellow wax
13 oz. of acetate of copper
37 oz. of ochre.

(2) For fine gilding. Mix as before—

24 oz. of white wax
6 oz. of copper scale
3 oz. of verdigris
½ oz. of borax.

(3) Mix as before—

12 oz. of Armenian bole
48 oz. of white wax
6 oz. of verdigris
2 oz. of burnt ochre
8 oz. of ferric sulphate
1 oz. of borax.

(4) Prepare as before directed—

48 oz. of white wax
12 oz. of sulphate of copper
12 oz. of verdigris
1½ oz. of borax
16 oz. of red chalk
6 oz. of sulphate of copper solution
5 oz. of verdigris
3 oz. of borax
6 oz. of burnt copper.

Recipe 80.—**Soft Cement for Temporary Purposes.**

This cement has the hardness of soap when cold, but it is easily softened and moulded with the fingers and is then very useful for sticking together things that are only required to be held together for the time being.

Preparation.—Melt yellow wax at a gentle heat along with its own weight of oil of turpentine, then colour it by stirring in a little dry Venetian red.

Recipe 81.—**A useful Paste for Paperhangers.**

Ingredients and Preparation.—Mix 4 lb. of wheat flour with 1½ to 2 gallons of water so as to make a smooth batter, free of all lumps, using only a portion of the water, which should be cold; then "cook" this batter by pouring on the remainder of the water boiling hot, that is, the flour must be made to lose its whiteness and become semi-transparent, otherwise the gluten will not be separated from the other constituents. While the paste is still boiling hot, stir in 2 oz. of crystallised alum, crushed to fine powder. The paste should be used thick on the walls if rough, and thin on smooth walls; but in the case of glossy walls it is best to omit the alum and substitute instead ½ pint of clear sugar syrup, or treacle, to each gallon of flour paste made as above.

Recipe 82.—**A Non-decomposable Paste, or "Cold-Water" Paste.**

This is useful to many trades and is made as follows:—

Ingredients and Preparation.—Dissolve 2½ oz. of sulphate of alumina in 1½ pints of cold water and filter it; then pour the filtered solution into 1½ lb. of farina and make into a smooth batter.

Separately dissolve 1¼ oz. of caustic soda in three pints of water by boiling it and then pour the boiling hot water on to the farina batter and stir until thickened. Put it into a boiling hot fluid consisting of 2 quarts of water in which 2 fluid oz. of hydrochloric acid has been added, and boil up the mixture until homogeneous. Instead of mixing the thick paste with the boiling acid solution, the paste can be made of a thinner consistency by using more water to the caustic soda solution and then mixing 1 to 1½ oz. of hydrochloric acid with the stiff paste.

If this paste be made very thick, then dried and ground, it can be made into a paste again at any time by mixing with cold water.

Recipe 83.—**Flour Paste that will not Liquefy.**

This paste is suitable for use with such materials as "Lincrusta-Walton" and other stiff wall-hangings where a thick paste is a necessity.

Ingredients and Preparation.—Mix separately in cold water to a stiff batter, 2 lb. of wheat flour and 1 lb. of starch, beat out all lumps, and then add more cold water until each batter is of a pudding-like consistency; then mix these two batters together in a pan and pour boiling hot water, in which 1½ lb. of alum has been dissolved per gallon of water, on the batter; pour the water slowly and stir vigorously while doing so, until the paste swells and thickens and darkens in colour. If by any chance it has been made too thin, it may be heated up over a slow fire for a few minutes.

Recipe 84.—**Paste for fixing Leather and Oilcloth to Woods.**

Ingredients and Preparation.—Mix together in the dry state, by sifting, 2½ lb. of wheat flour, 2 tablespoonfuls of gum arabic, and 2 ditto of powdered alum, and then add sufficient cold water to make a thick batter, pour it into a glue pot (*i.e.*, a water-lined vessel) and set it over a slow fire, so that it is gradually heated, stirring constantly, until the paste is uniform and free from lumps; when the mass has become so thick that the stirrer will stick upright in it, turn out the paste into another vessel and put a cover on so that it does not "skim." When cold, it is fit for use. To use this paste, a thin coat of it is spread on the leather or cloth which is then laid on the surface to which it is to be fixed, and the leather should then be neatly smoothed out from the centre towards the edges; when dry, trim off the edges and remove superfluous paste that has been squeezed out. Any puckers in the cloth should be smoothed out by rubbing with a duster.

Recipe 85.—**Cold Water Paste.**

A new form of paste has recently been introduced. Flour pastes are, as usually made, dependent for their adhesive qualities on the gluten that is separated from the flour; but when the albumenous particles are also separated, a more perfect adhesive still is obtained from flour. To separate these two adhesive bodies, hot water alone is not sufficient; by means of a caustic alkali, however, they can be separated. By suitable means the pasty product thus obtained is dried and ground, when it can be used for paste-making at any time by the simple addition of cold water: hence the name. Some firms sell a powder for mixing with the flour-batter, so as to make a paste; this powder generally consists of the dried powder above referred to, with the addition of a caustic alkali. We have given several recipes for making such pastes from flour and farina.

Recipe 86.—**Agglutinant for Paper, Wood, Metal, Leather, etc.**

Ingredients and Preparation.—(1) Soak 1 lb. of gelatine in 1 gallon of cold water for 4 or 5 hours, then heat up the softened glue in a gluepot along with unabsorbed water, and when the solution is boiling hot, pour in 16 oz. of wood-spirit (acetone) and stir well. This mixture is used hot.

(2) Soak 1 lb. of white fish glue (or isinglass) in its own weight of water, cold, for 4 hours, then dissolve the glue by melting it in a gluepot; when on the point of boiling, stir in 4 fluid oz. of glycerine; continue the heating for 5 minutes longer. This compound, when cold, is elastic and very tenacious and will soften by a gentle heat, such as that of a water-bath, but if repeatedly heated by dry heat (*i.e.*, by heating the containing vessel over a flame direct) the compound is increased in tenacity, but after several heatings it loses its property of dissolving and becomes hard and brittle. It is almost insoluble in spirits, and completely so in oils and hydrocarbon fluids.

Mineral matters can be mixed with the compound while fluid, such as lampblack, Venetian red, etc., to form an agglutinant that can be laid on like a coat of paint, but owing to the glycerine being hygroscopic in water and spirit, the compound is more or less soluble in alcohol and also in water. In fact, if wanted of a thinner consistence, it can be thinned with water while hot.

Recipe 87.—**A Water-resisting Glue Cement for General Use.**

Ingredients and Preparation.—Soak gelatine in cold water for an hour, take it out and drain off all unabsorbed water, then put the softened glue into a bottle and add $1\frac{1}{2}$ to 2 pints of alcohol. according as to whether the compound is to be hard or soft; dissolve the gelatine in the spirits by gently heating, by the aid of a water bath, and when the gelatine has melted, add 2 to 4 oz. of glycerine and stir well. The resulting compound is very adhesive and flexible, and is not readily softened by dampness or moisture, but it softens with heat.

Recipe 88.—**Glue Size for stopping Suction in Walls.**

Ingredients and Preparation.—Soak 1 lb. of glue in cold water until softened throughout, then draw off all unabsorbed water and melt the glue in a gluepot. Meanwhile, cut up the 1 lb. of resin-soap and dissolve it in just sufficient hot water to form a jelly when cold. Also dissolve 2 lb. of alum in just enough hot water to dissolve it; then pour the soap solution in the hot glue and stir well, then add the alum solution.

When the compound is ready for use apply hot to the wall, and when the first coat is dry, give a second application, when suction will be stopped in the most porous walls, whether of plaster or of brick, and thus permit the wall to be painted without loss of paint. The compound can also be used to form a fireproof coating to theätrical scenery. If the wall has been already whitewashed, scrub it down with a stiff brush and then brush over it a wash of strong vinegar, when dry, give two coats of ordinary glue-size of thin consistency; this will penetrate the whitewash that remains on the wall and hold it firmly to the brick or plaster walls. A coat of the above compound can be given if the wall is to be painted or varnished.

Recipe 89.—**Fish Glue for Gilding Glass.**

Ingredients and Preparation.—Fish glue dissolved in sufficient soft water is one of the best vehicles for use for gilding on glass. Not too much should be used, otherwise the gold size will not burnish well; a thin layer should be laid on and then tested with the hand. To be in the right condition for laying the gold on it should have only slight adhesive power.

Some sign-writers use a size made by dissolving isinglass in white wine vinegar and filtering the size before using it; other gilders steep quince seeds in whisky or brandy until the resulting liquid attains a proper cohesion, and then filter it. This forms a good but expensive size for glass gilding.

Recipe 90.—**Glue Size for Paperhangers.**

Ingredients and Preparation.—Soak 1 lb. of white glue in sufficient water to cover it, for 10 hours, then put it into a gluepot and add a boiling hot mixture of 2 gallons of water and ½ gallon of wood alcohol (acetone); mix this well with flour to give a slight "tacky" quality to it, so as to cause the paper to adhere; a little syrup may be mixed with the hot glue solution. Wall paper that is affixed to walls with this agglutinant can be varnished readily.

Recipe 91.—**A Liquid Glue Size for Use on Paper that is to be Varnished.**

Ingredients and Preparation.—Dissolve 2 oz. of borax in 5 oz. of boiling hot water and while boiling add 1 oz. of calcined potash. Separately soak 1 lb. of glue in 1 quart of water for several hours and then melt it by heating in a gluepot, and when boiling hot, pour on the borax solution and stir well. If too thick it may be thinned with hot water. The action of the alkali in the glue is to prevent it gelatinising, but at the same time to lessen its adhesiveness as an agglutinant, but not as a sizing material.

Recipe 92.—**A Glue Size for Paper that is to be Varnished.**

Ingredients and Preparation.—Glue and alum water is generally used to size paper with ; sometimes a mixture of starch or dextrine and alum are used ; the cheaper sizes are made by heating clippings of bones, horns, etc. The process is as follows :—

The materials are softened by soaking in cold water for a day or two, then they are well washed in running water, and after that put into a suitable vessel and heated with water at a temperature of about 85° F. (29·4° C.), if the temperature be higher than this the gelatine that is formed will not gelatinise on cooling. A steam-jacketed vessel should be used and the heating continued for about 15 hours ; then the solution is drawn off and filtered into some convenient vessel, and the residue again heated with more water for a weaker size ; the alum, to the extent of 20 per cent. of the weight of glue material is dissolved in water and added to the fresh size solution which is filtered through felt, and is ready for use.

Recipe 93.—**A Glue to Resist Damp.**

This is made by dissolving 1 lb. of glue in 3 pints of skimmed milk and adding a little powdered quicklime.

Recipe 94.—**A Glue insoluble in Water.**

Ingredients and Preparation.—(1) Prepare a solution of glue in the usual way, by soaking the glue and dissolving in a gluepot, and then stir in a little tannic acid and use while hot.

(2) Make a solution of glue as above described, then add a small quantity of bi-chromate of potash, not too much, about a fiftieth of the amount of the glue used. Glue thus made will harden when exposed to the air and light and become insoluble in water or moisture.

(3) Soak glue in water until soft, but not swollen enough to lose its form, then drain from the water and put the glue into a gluepot with sufficient raw linseed oil to cover it, and dissolve the glue by heating it over a slow fire until it is jellified.

(4) Mix a handful of quicklime with 4 oz. of raw linseed oil, and boil the mixture until quite thick, then mix this with a hot solution of glue made in the usual way.

(5) Soak glue in cold water until soft, then melt it in the usual way, and mix 10 parts of the glue with 5 parts of linseed oil varnish and add 1 part of litharge, boil the whole for 10 minutes and use while hot.

Recipe 95.—Glue for Inlaying Veneers.

Ingredients and Preparation.—To a pint of hot glue solution add 5 oz. of malt vinegar and ½ oz. of isinglass and heat and stir until well mixed.

Recipe 96.—An Elastic Rubber-like Glue.

Ingredients and Preparation.—Mix a thick solution of glue with tungstate of soda and hydrochloric acid, whereby a compound of tungstic acid and glue is precipitated, which, at a temperature of 86° to 104° F., is sufficiently elastic to be drawn out into very thin threads or sheets.

Recipe 97.—To bleach Glue, by discharging its Brown Colour.

Preparation.—Make a hot solution of glue in the usual way, then add 1 per cent. of oxalic acid and 1 per cent. oxide of zinc.

N.B.—In using these glues, and in fact, all glues, they should be used as hot as possible, and it is often advisable to warm the surfaces that are to be joined before applying the glue. Frequent re-melting of the glue lessens its adhesive powers, and the addition of water to the glue, after once being made, renders it useless.

Recipe 98.—A Non-acid Glue.

Ingredients and Preparation.—Mix 4 oz. of spirits of wine (or "methylated" spirit, that has not been methylated with "mineral" oils) with 1 quart of soft water and add 1 lb. of best white glue, when the glue has softened, melt it in the glue-pot, together with any fluid that has not been absorbed, and then add 4 oz. of white lead.

Instead of mixing the alcohol and water, the glue can be dissolved in the water by itself (without any previous soaking) and when white lead has been added, stir in the alcohol and put into bottles while hot. The compound solidifies when cold, but is re-melted by standing the bottle in a basin of water nearly boiling hot.

Recipe 99.—**A Quick-drying Gelatine Cement.**

Preparation.—A permanent quick-drying glue is made by dissolving gelatine in a solution of chloral hydrate in water, to the consistency of cream.

Recipe 100.—**A Glue very adhesive to any Material.**

Preparation.—Make a pot of glue in the usual way and then add to it 20 per cent. to 25 per cent. of its weight of wood ashes, burnt sugar, or burnt treacle.

Recipe 101.—**Air-tight Cement for Cracks in Wooden Partitions.**

Ingredients and Preparation.—Melt some gelatine in a glue-pot and add 5 to 10 per cent. of glycerine, mix a little fine sawdust with some of this glue and fill up the cracks with it, when dry, brush over a solution of the glue, whereby an airtight film will be formed over the cracks; by going over the dry film lightly with a solution of bi-chromate of potash, the film will be rendered damp-proof.

Recipe 102.—**Cement for Stone and Marble, etc.**

Ingredients and Preparation.—(1) Mix together the following ingredients and make into a paste with water: 6, 9, or 12 parts of Portland cement, 12, 9, or 6 parts of chalk paste, 6 parts of fine stone and 1 part of silicious earth (*i.e.* "fossil-meal" or Kieselguhr). The hardness of the cement varies according to the proportions of chalk and Portland cement made use of.

(2) A cement for similar use (Hydraulic).

Ingredients.—Mix together—

2 parts of black furnace slag
2 parts of clay
5 parts of lime.

Calcine the mixture and grind it to a fine powder for use. When wanted for use, make into a paste with water as required and use in the usual way a cement is applied.

(3) *Ingredients and Preparation.*—Mix together 25 per cent. of "infusorial earth" (fossil-meal), and 75 per cent. of chalk (free from iron), into a paste, with 2½ per cent. of a solution of potash, or soda, and mould the mass into squares or bricks, which should be calcined at a white heat, and then ground to powder. Use like ordinary cement.

(4) Cheap cement for stone.

Ingredients and Preparation.—Mix together—

3 parts of freshly-ground plaster of Paris
2 parts of foundry cinders
1½ parts of brickdust.

Grind these three materials to a fine powder, then sift through a fine sieve, and mix with water, and just before the cement is required for use, mix 2 per cent. of sifted iron filings with the compound and use like ordinary mortar.

Recipe 103.—**Cement for Stucco and Plaster ("Bituminous" Cement).**

Ingredients and Preparation.—Mix 1 part of ground slaked lime with 2 parts of sand, and 2 to 3 parts of the mixture is mixed with the bitumen (heated to 1400° F.), which has been obtained in the production of paraffin and mineral oils.

Recipe 104.—**A Clay Cement.**

Ingredients and Preparation.—Mix 1 lb. of rye flour with 26 lb. of cold water and then boil the mixture, then for every pound of it stir in 8 lb. of clay and then thin the mixture for use with hot water as required.

Recipe 105.—**A Cement for Damp Walls.**

Process.—Give two coats of ordinary plaster to the walls, then a third coating, consisting of "fatlime," glazing this with pure lime that has been compounded with some clay, to which 5 per cent. of alum has been added.

Recipe 106.—**Size or Cement for laying on Silver-leaf.**

Ingredients and Preparation.—Melt in a pan, 1 oz. of Venetian red along with 1 oz. of beeswax and then add 9 oz. of Spanish chalk; when these are well mixed, stir in 18 oz. of pipe-clay in fine powder; when this is well mixed, rub up the compound with the whites of 20 eggs and use as directed for "gold-size" (see Index).

Recipe 107.—**Sizing Cement for Gilding on Wood.**

Mix together by sifting the fine powder of 3½ oz. of graphite, 2 lbs. French chalk, 7 lb. of Armenian bole; then put the mixture into a well glazed pot and add 17½ oz. of shavings of white beeswax and gently heat the contents of the crucible until they are well incorporated, then pour out the mass into a plate and allow it to cool; next break it up into small pieces, mix with the whites of 20 to 25 eggs and rub the whole to a powder on a hard stone; spread this mass on paper to dry, and for use mix it with water.

Recipe 108.—**A Calcareous Cement for Whitewashing Walls.**

Ingredients and Preparation.—Slake ½ bushel of freshly burnt lime with boiling water, cover it over during the process and keep in the steam, strain the liquid through a fine sieve, add to it 7 lb. of salt previously dissolved in warm water, 3 lb. of ground rice made into a paste with boiling water, ½ lb. of Spanish whiting powdered and 2 lb. of glue that has been previously dissolved by soaking it well and then melting it over a slow fire in a gluepot, add 5 gallons of hot water to the mixture, stir it well, and let it stand a few days covered from dust. This compound should be laid on quite hot; about 1 pint will cover a square yard.

(2) A calcareous cement for rough outside work, such as louvre boards, etc.

Ingredients and Preparation.—Mix well together in a tub or barrel ½ bushel of lime, 3 pecks of hydraulic cement, 10 lb. of umber, 10 lb. of ochre, and 1 lb. of lampblack ground up with a little vinegar (the lime should be slaked and mixed with the lampblack powder), then add the cement and fill the barrel with water, let it stand several hours with frequent stirring, use in one coat; a darker colour is obtained by using more ochre or umber.

(3) A cement for walls that will not peel off.

Make $\frac{1}{2}$ lb. of wheat flour into a batter with cold water and then make that into a paste by pouring boiling water on it, stir the paste into 5 parts of lime and water and mix well.

Recipe 109.—**A Fireproof Cement Wash for Walls.**

Process.—Put some stone lime into a large tub or barrel and slake it with boiling water and cover up the vessel; when the lime is slaked sift it through a sieve or fine screen and to 6 quarts of the sifted lime add 1 quart of rock-salt powdered and 1 gallon of water, boil the mixture, and skim it clean. To every 5 gallons of this skimmed mixture add 1 lb. of alum, $\frac{1}{2}$ lb. of copperas (sulphate of iron) by slow degrees, and $\frac{3}{4}$ lb. of potash, or hickory ashes sifted; then add whatever colouring matter is desired, using only colours that will mix with lime. This composition is useful for wooden roofs, bricks, or stone walls, etc.

Recipe 110.—**Cement Wash for Sheds.**

Process.—Slake 1 bushel of quicklime and add 2 lb. of common salt, 1 lb. sulphate of zinc ("white vitriol") 1 gallon of sweet milk. Dissolve the salt and sulphate before adding the lime and thin with sufficient water.

Recipe 111.—**Cement Wash for Ceilings.**

Process.—Mix zinc white (oxide of zinc) with common salt, lay it on the ceiling with a brush, then apply a wash of chloride of zinc with the oxide, which will combine with it and produce a glossy surface.

N.B., chloride of zinc is very *poisonous* to any cuts in the flesh, etc.

Recipe 112.—**A Hard-setting Cement.**

Process.—Mix equal weights of unslaked lime with demerara sugar and make into a paste with water, this cement is very strong and dries as firm as Portland cement.

Recipe 113.—**Firm-setting Cement, or Mortar, for Building Purposes.**

Process.—Mix 1 part of fine unslaked stone lime with 3 parts of sand, mix in the dry state and then make into a mortar by sprinkling water on it until plastic enough to be used by the trowel, the mortar being made as fast as the bricklayer or mason uses it.

Recipe 114.—**Turkish Mortar.**

Process.—Reduce some brickbats and tiles to powder, then mix them with two parts of fine sifted lime and mix with water to the desired consistency. Note, the tenacity of ordinary mortar is improved by the addition of calcined bones to the extent of not more than 25 per cent. of the weight of lime used in making the mortar.

Recipe 115.—**Cementing Wash for Walls, etc.**

Process.—Reduce to a fine powder 3 parts of silicious rock (quartz) and mix it with 3 parts of powdered marble and 3 parts of sandstone powder, 2 parts of fiercely burnt "China clay" (kaolin), powdered, and 2 parts of freshly slaked lime still warm. The mixture produces a mortar which forms a silicate if frequently wetted and becomes after a time almost like stone; the four constituents mixed together form a base to which any colouring matter can be added provided it be not affected by lime. It is applied thinly to the wall or other surface. It should be allowed one day to dry and then frequently covered with water.

Recipe 116.—**Cement for Architectural Purposes.**

Preparation.—Mix 1 lb. of alum, powdered, with 5 lb. slaked lime and make into a paste with 37½ oz. of beaten bullock's blood. This cement is very useful for wood, plaster-work, and as an architectural cement in general. This "blood" cement is no doubt what has raised the suspicion in the mind of the natives of India and other countries that the blood of young children is used in building by the "Christians."

A modification of the above process is to mix 20 lb. of slaked lime, 10 lb. of sifted coal ashes and 3 lb. of beaten bullock's blood to a paste. It is useful as a cement for filling cracks between floors, plaster skirtings and as a pointing mortar.

Recipe 117.—**Lime Cement as a Wood-filler.**

This cement is useful for closing the pores of wood that is to be polished or varnished.

Process.—Mix together 1 lb. of powdered slaked lime, 2 lb. of powdered rye-flour, burnt umber quantity sufficient to colour, and make into a paste with 1 lb. of linseed oil varnish. Coat the surface of the wood with this and pumice-stone it afterwards, or rub down with sand paper.

Recipe 118.—**Cement for filling Pores of Floor-boards.**

Boards that are to be polished or painted should be covered with this cement so as to prevent the varnish or paint sinking in.

Process.—Soak 1 lb. of glue in 7 lb. of water for some time, then melt the glue in the unabsorbed water by heating it in a gluepot and while hot add 1 to 2 lb. of litharge, and 2 lb. of plaster of Paris. Mix well and coat the boards, and smooth down when dry.

Putties.

These are used by the carpenter and builder more than by any other person, so we give below a representative set of recipes for same that will cover a multitude of uses.

A "putty" is a soft plastic mass that dries hard and becomes waterproof. The usual form of putty is that known as "glaziers' putty." It is made by kneading dry chalk, or whiting, with linseed oil to a dough-like mass, but for many purposes this kind of putty is not suited as it takes a long time to dry, and, moreover, does not always give a watertight cement, such, for example, as filling up the cracks or crevices between the stones on flat roofs, or in elevations, etc. The best putty to use in such a case is one prepared by boiling for a half hour 8 lb. of linseed oil with 12 lb. of litharge, and then stirring in 88 lb. of slaked lime. Before applying the putty give a coat of linseed oil varnish to the surface to be puttied; the metallic oxide (of lead) decomposes the oil more or less, separating its constituents into their fatty acids, which combine with the lime and form a lime-soap that is insoluble in water and does not expand by heat.

Recipe 119.—**A Putty that does not become affected by Damp.**

Dissolve 100 oz. of shellac in 45 fluid ounces of strong spirits of wine. This sets quickly and is impenetrable by water, but owing to the brittleness of the resin it is liable to crack; however this defect can be remedied by adding a little drying oil or yellow wax, but not too much, else the adhesiveness of the putty will be lost; or else a little of a solution of glue in which a small percentage of dry lime has been added to the shellac solution.

Recipe 120.—**Putty Cement for fixing Iron in Stone.**

Mix 7 lb. of fresh plaster of Paris with 1 lb. of clean iron filings and make into a paste or putty with water when wanted for use; it dries quickly.

N.B.—Other putties will be found in the chapter on Cement for Ironworkers, etc. See also the Index.

Recipe 121.—**Cement Wash for kalsomining Walls.**

Process.—Soak 1 lb. of good glue, for 1 hour, in cold water and pour off any unabsorbed water, then melt the softened glue in a gluepot: next mix 20 lb. of gilders' whiting to a paste with sufficient water, in which 1 oz. of alum has been dissolved, combine with the whiting suitable tinting pigments ground in water; do not mix the colour in dry, as that would cause the distemper wash to shrink; test the tint by putting a little of the mixture on a piece of paper, and when the right tint is obtained, add the glue solution, and test the compound again to see if sufficient glue solution is added to act as a binder, if not, add more of the glue solution—sufficient glue must be in the first coat to bind it, so that it will not rub off when the second coat is applied.

For a clear whitewash distemper, add a little ultramarine blue to the whiting, for a green tint use chrome green and ultramarine blue, for terra-cotta tint use Venetian red.

Recipe 122.—**Cement for repairing old Plaster Walls.**

Process.—To fill a crack in old walls, cut all the cracks V-shape, clean out the holes and level the edge, then make a filling cement, with fine plaster of Paris and thin glue size, and carefully fill the cracks : when dry, smooth down the filling level with the walls by sand papering. Then go over all the walls, and break off any small lumps that may be there ; wherever you find loose plaster, sand paper down such patches a little below the level of the wall surface and break off the loose plaster. Give a coat of glue size and trowel on a coat of plaster of Paris, mixed with glue size ; when that is dry sand paper it smooth and level. To stop suction on the patches, give a coat of oil and drier, and when that is dry lay on a coat of white lead, thinned with equal parts of japan varnish, and turpentine. To preserve the wall surface, mix not more than 8 lb. of white lead with 1 gallon of good linseed oil and add 1 pint of turpentine to make it more penetrating : if the wash is to be done quick add a little liquid drier ; three coats of paint are required to make a good job, and if the third coat shows dry patches, due to suction, a coat of glue size should be laid on the finishing coat. The second coat should be mixed so as to dry with a fair gloss, with 3 pints of oil, and 1 pint of turpentine and drier. The last coat, if required to be "flatted," should be mixed with equal parts of turpentine and some drier ; the flatting should be done by an operator following the painter, before the paint has any time to set.

Recipe 123.—**A Cementing Size for Plaster Walls.**

Process.—Soak $1\frac{1}{4}$ lb. of good white glue, for 10 hours, in enough cold water to make it into a jelly, then melt it into a gluepot and add 1 to 2 quarts of boiling water ; separately dissolve 1 lb. of good white hard soap in 1 quart of boiling water, and also 2 oz. of alum in 1 quart of boiling water, and when all are thoroughly dissolved, mix the glue and soap solutions, then slowly add the above solution, stirring during the operation. Finally, add 1 gallon of cold water. In order to make this compound penetrate the plaster it should be laid on warm, otherwise it will not hold the whitewash securely to the wall.

When whiting is mixed with the above vehicle it forms a "kalsomine" or "distemper" wash on the walls which is practically water proof. When the plaster wall is to be painted, no whiting should be laid on, but just a thin coat of white lead applied; this priming coat is made by mixing about 10 lb. of "keg-lead," in 7 pints of raw linseed oil, 1 pint of turpentine, and about $\frac{1}{4}$ lb. of paint drier. The glue size to use with such a priming is made in the usual way, and when nearly cold, 1 oz. of acetic acid should be mixed with it for every 10 lb. of glue used. This will keep the size liquid and prevent it spoiling by decomposition (nothing is more offensive on a wall than putrid size). When the glue has dried hard, as many coats of it as are necessary to cover it should be applied, using white lead in oil thinned with raw oil or turpentine, finishing in either white lead or zinc white.

When old, patched, dirty walls are to be repainted, they should be dusted carefully and then scrubbed with soap and water to which a little ammonia has been added. This will kill the germs in the walls: the scrubbing should be followed with a sponge and clean water and the wall wiped dry with sponge or cloth.

Recipe 124.—**A Soft Glaziers' Putty,**

Such as is often required for greenhouses, top-lights, and structures that are exposed to high and low temperatures, can be made by mixing 9 parts of boiled linseed oil with 1 part of tallow, and sufficient white lead, or any suitable substance, to impart the requisite consistence. This putty will bear alterations of temperature because it never thoroughly hardens, but remains plastic, though water-tight.

Recipe 125.—**Putty for filling Cracks and Crevices in Shop Windows.**

(1) Mix fine sawdust into a dough with linseed oil varnish and use in the ordinary way of using putty.

(2) Dissolve 1 oz. of glue in 1 pint of water, by soaking and heating the mixture, and then add sufficient fine sawdust to make a putty-like mass.

(3) Dissolve 2 parts of glue in 10 parts of water, then add ½ part of ordinary cement, and 5 to 7 parts of sawdust.

Recipe 126.—**Cement for filling the Pores of Wood.**

Ingredients used.—Silica, terra-Alba (plaster of Paris, or gypsum), China clay (kaolin), Barytes (native sulphate of barium, or "heavy-spar"), starch, rye flour, etc., are used as the fillers for closing the pores of wood before polishing or varnishing same.

Whichever of the above mineral or vegetable substances is used, it should be mixed to a stiff paste with one-third each of pale linseed oil, pale gold size or japan, and turpentine. The mixture thus made may be either run through a mill or given a very thorough mixing, and to test for quality it should be thinned with turpentine to the consistency of varnish. This "filler" is applied with a varnish brush to the open-grained wood and the excess of filler removed by wiping across the grain in the usual manner; after 24 to 30 hours the surface should be lightly sand papered and a good coat of "rubbing" varnish applied, which, when firmly set, will not show any "pitting" or "pinholes." If it does do so, it shows that the filler is defective in binding properties and the proportion of japan should be increased with a corresponding decrease in the proportion of turpentine. The linseed oil and gold size japan must be of good binding power and if corn starch or rye flour is used in connection with silica the proportions should be almost one-third of the former to five of the latter by weight.

The following formulæ for "wood-fillers" are of American origin, and are good for all purposes where a "filler" is required—

Recipe 127.—**American Wood-filler.**

(1) *Ingredients.*—100 lb. silica
35 lb. soapstone ("steatite" or French chalk)
2½ gallons raw linseed oil
3 gallons of thin, strong liquid drier.

For colouring matter, use—
3 lb. Vandyke brown
1½ lb. burnt siena
2¼ lb. burnt umber.

Make into a paste, and put through a paint, or "cone" mill.

(2) *Ingredients.*—100 lb. silica
16 lb. China clay
3 gallons raw linseed oil
3 gallons turpentine japan.

This forms the white base, which is coloured as required.

(3) *Ingredients.*—99 lb. barytes
4 pints raw linseed oil
4 pints thin strong drier
4 pints turpentine
3 oz. of borax
4 pints of water
12 oz. brown soap.

The borax and soap are dissolved in the water, then the oil added to saponify it, and other ingredients worked in.

(4) Liquid wood-filler.

Ingredients.—60 lb. China clay
40 lb. carbonate of magnesia
12 gallons of coach varnish
15 gallons of turpentine.

(5) *Ingredients.*—75 lb. China clay
7 gallons raw linseed oil
8 gallons turpentine
15 gallons of resin varnish.

(6) A cheap wood-filler for common use.

Ingredients.—Melt 135 lb. of light-coloured resin and run in on it at the proper temperature 100 gallons of turpentine and the same amount of naphtha; add 7½ gallons of good coach varnish and stir in 135 lb. of whiting.

(7) A good paste wood-filler that does not harden too rapidly, is tough and does not shrink—

Process.—Make some flour paste in the usual way and boil it; allow it to become cold before making use of it; let it be so stiff that it will just run when poured out upon a mixing board. Separately mix whiting and linseed oil to the same consistency as the flour paste, then mix these two together and incorporate well. For a thinning use naphtha or whatever is cheapest, and liquid drier, in proportions required to meet the necessities in drying. "It will take some time and experimenting to make this combination in just the proportions to give prompt and proper hardening and other qualities. If you do not succeed upon your first efforts, carefully note your proportions, and change them slightly; your flour, whiting, and oil may differ—they undoubtedly do—from ours."

"There is still another variety of filler—a dipping filler, which is used in large factories, where cheap furniture and such goods are made. The filler is put up by the barrel into tanks, and the pieces of furniture to be filled are dipped into it. It is much like the ordinary liquid goods, save that it is cheaper and hardens quicker. One coat of dip filler and one of cheap varnish is all the finish some furniture receives."

Recipe 128.—**Fireproofing Compound for Wooden Sheds.**

Ingredients and Preparation.—Mix together—

1 measure of fine sand
2 measures of sifted wood ashes
3 measures of lime in powder.

Grind up the mixture in linseed oil: give two coats, first a thin and then a thicker one.

Recipe 129.—**Composition for closing the Pores of Mahogany.**

Ingredients and Preparation.—Take equal parts by weight of whiting, plaster of Paris, pumice stone and litharge, to which may be added a little French ochre, vandyke brown or burnt siena. Mix these ingredients together and then form into a mass with 1 pint of japan, 2 pints of boiled oil and 3 pints of turpentine and grind the mass in a paint mill.

To use the compo lay it on the wood with a brush, rub it well in and let it set 20 minutes, then rub the surface clean.

Recipe 130.—**Cement or Compo for moulding Pilasters, Cornices, etc.**

Ingredients and Preparation.—Make a very clear glue with 5 parts of Flanders glue and 1 part of isinglass (good gelatine may be used for cheapness) by dissolving the two separately in a quantity of water 2 or 3 times the weight of the dry substance. Then mix them together (after straining them), allow the compound to cool, and for use, gently melt it and add sufficient sawdust to make of a consistence rather stiff; then put into moulds and dry in a warm room or in very dry air. The quantity of water used will depend on the quality of the glue. Good glue will absorb more water than common glue.

Recipe 131.—**Composition for Artificial Marble.**

Ingredients and Preparation.—(1) Pulverize marble into dust and white limestone to an impalpable powder by grinding and sifting, then mix with it about 25 per cent. of its weight of zinc oxide and 12½ per cent. of its weight of Portland cement. Mix the whole thoroughly into a paste with a sufficient quantity of a hot aqueous solution of water-glass (silica of soda) containing about 40 per cent. of the soluble glass. Mould this under pressure while warm and expose for a week or ten days to warm air.

(2) Make a saturated solution of alum in cold water and then put sufficient plaster of Paris in the solution to make a stiff paste, dry the paste in an oven at a fierce heat: it will

become as hard as stone, but when ground to powder it can be made into a composition that rapidly hardens and takes a good polish.

(3) Mix together in the dry state—

2 parts of magnesia
2 parts of lime and quicklime
1 part of carbonic acid
1 part of silicious acid
1 part of magnesium chloride
$1\frac{1}{4}$ parts of infusorial earth.

(4) Mix Portland cement with calcium carbonate and make same into a paste with the least quantity of water ; make several coloured marbles and roll this into coloured layers of different thicknesses, then place one layer on top of another ; press the mass on all sides and heat it in different positions so as to commingle the coloured masses indiscriminately : by this means various colours, more or less deep, penetrate the mass, which, when hardened, is turned into plates which are pressed in moulds for 12 days during which time it is necessary to keep them moist as long as they are not entirely hardened. When fully hardened the moulded mass is polished in the same way as marble.

Recipe 132.—**Adhesive Compo for forming Ink-pencils for writing on Glass, for Sign-writers' Use.**

Process.—(1) Make a mixture of flour, liquid ammonia and hydrochloric acid and thicken with gum arabic to form a fluid vehicle that can be used with a pen or as a pencil (when made of a stiffer consistence), colour by the incorporation of an aniline dye, q.s.

(2) Adhesive compo for forming pencils for writing on glass or china.

Process.—Mix together—

4 parts of white wax
1 part of tallow
1 part of lampblack, for black, but for white, use white lead.

(3) Mix as before—

2 parts of wax
1 part of tallow
1 part of chrome yellow, for yellow pencils, or
1 part of Berlin blue, for blue ones.

Recipe 133.—**Adhesive Filler for writing on Glass.**

Process.—Dissolve equal parts of white and brown sugars in water to a thin syrup and add a little alcohol; on applying this to the glass, the surface of which has been heated, any drawing or design can be done on the film with pen or pencil.

Recipe 134.—**Moulding Composition for Statuary.**

Process.—Soak 8 lb. of glue for 10 hours in cold water and drain off superfluous water, then melt the glue, stir until froth begins to arise, then put in 7 lb. of treacle previously made hot, stir briskly, continue the boiling for 30 minutes, then pour out and allow to cool; for use remelt as required.

Recipe 135.—**Paraffin Moulds for Plaster Casts.**

Process.—Prepare the specimen, making it as clean as possible; place an oiled paper in a position that shall show it to advantage; soft projections may be laid in position, into threads suspended from a frame or from a heavy cord stretched across the room; then melt some paraffin wax over a water bath and paste it over the preparation with a soft brush, the first layer being put on with a single and quick stroke so that the rapid cooling of the paraffin may not cause the brush to adhere to the preparation; then draw the soft tissues over it in place until the mould is formed about $\frac{1}{8}$ in. thick. All under-cuts must be well filled. When the mould is hard it can be easily separated from the preparation; then wash well with clean water; stir fine dental plaster into cold water to the consistence of cream, pour this into the mould and out again several times, so that there will be no air bubbles on the surface, then fill the mould and let it stand until hard: place the whole in a vessel containing boiling water until the paraffin is well melted, wash with clean water; when the cast is thoroughly dry it may be painted over with oil colours, first coating it with shellac varnish. Casts of any part of the body may be made from a living person if the parts are not too sensible or sensitive; the heat of the paraffin wax should be about 50° F.

Recipe 136.—Compo for coating Damp Walls.

Process.—Heat 5 lb. of oil of turpentine and stir in 10 lb. of pulverised "glass resin," when that has dissolved add 1 lb. of fine sawdust, clean the wall and warm the surface by means of a lamp-flame (such as used by painters for removing old paint) and apply the hot compo to the walls, smoothing it out with a flat iron or trowel. The compo can be coloured with lamp-black or earthy pigments.

Instead of oil of turpentine, Venice turpentine can be used, and instead of resin, glue (first softened by soaking in cold water) may be used; the glue should be drained and partly dried before melting it in the hot turpentine.

Recipe 137.—Cementing Compo for fastening Metals in Stone, etc.

Process.—Melt together in a blast furnace or copper 60 to 80 parts of black furnace slag, 10 to 12 parts of soda water, or alkali, and 1 to 2 parts of lime and "pyrolusite" (black oxide of manganese), so that the mass has about the following composition—

60 per cent. silica
10 per cent. lime
10 per cent. alumina
8 per cent. ferrous and manganese oxides
12 per cent. alkali.

The mass is so hard and bright that it can be turned like steel and resists the action of the atmosphere and acids to such a degree that it can be used for building purposes.

Recipe 138.—**Composition as a Substitute for Plaster of Paris.**

Process.—Soak $2\frac{1}{2}$ lb. of glue in cold water until soft, pour off superfluous water, put the soft glue in a gluepot, pour on it $2\frac{1}{2}$ lb. of linseed oil and heat the mixture until the glue has dissolved, then stir in 5 lb. finely powdered whiting, mix thoroughly, allow it to cool, then pour it out into a strainer which is covered with powdered whiting and heat until the mass is tough and firm; cover with wet chalk and keep moist. This compo may be used for taking casts by pressing it into moulds with a screw press. It becomes very hard after a time.

Recipe 139.—**Composition for Artificial Stone, etc.**

Process.—Expose hydraulic lime to the air until it falls to a powder, then mix 100 lb. of this powder with water to form a paste and add 250 lb. of gravel and 50 lb. of coal ashes, or levigated wood ashes. Mix well and add sufficient water to make the volume of the mass equal to 500 lb.; pour this into wooden boxes, troughs or other suitable moulds and allow it to set. Instead of gravel the same weight of ground oyster shells may be added to the lime paste.

(2) Mix ground quartz sand with 2 to 10 per cent. of finely-powdered plumbic oxide (oxide of lead); the larger the amount of lead-oxide the harder the compo will become. After mixing the dry materials together by sifting, moisten with water-glass and then thoroughly mix and press the mass into moulds, expose to a red heat for 2 hours.

(3) Mix 1 part of cement with 3 parts of lead-oxide (litharge), make it into a dough with water that has been acidulated with 2 per cent. of sulphuric acid and subject the mass to pressure, then dry the stone for two days in the air and afterwards put this in a solution of water and sulphuric acid—100 parts of water and 3 parts of acid for 12 hours, then it is ready for use.

(4) Grind up 100 lb. of unslaked lime with 30 to 40 lb. of water and then mix the lime paste with 400 to 500 lb. of dry sand and 25 to 100 lb. of hydraulic cement; then grind the mass and press it in moulds.

(5) Dissolve 1 lb. of alum in 15 lb. of water and add 2 lb. of hydraulic lime, 10 lb. of sand and 1 lb. of cement; work the whole into a dough or mortar, then press into moulds and allow it to remain 24 hours. 2 weeks' drying will be required before the bricks or slabs are fit for use, but a longer time is required for them to remain to thoroughly dry.

(6) Mix the refuse of granite quarries with Portland cement in the proportion of four parts granite chips to one part of cement and make into a paste with water; the mass is then put into moulds and allowed to set solid; when the bricks are immersed in a solution of silicate of soda. The compo thus produced is akin to stone.

Recipe 140.—**A coloured Artificial Stone.**

Process.—Mix 4 parts of coarse sand with 1 part of cement, along with some gravel, pebbles, etc., then make the mixture into a paste with limewater; press the paste into moulds and coat the face of the compo with a composition consisting of 2 parts of fine sand, 1 of cement and 1 part of dry colouring matter such as red oxide or earthy colours. Before the surface of the block is quite dry, cover with a solution of water-glass.

Recipe 141.—**Cement for heavy Culverts.**

Process.—Mix together—

400 parts of sand
53 parts of limestone
6 parts of burnt clay (or brickdust)
15 to 25 parts of water-glass.

Recipe 142.—**Compo for Mill-stones.**

Process.—Mix together and put in moulds—

400 parts of coarsely powdered quartz or flint
50 parts of chalk or limestone
½ part phosphate of lime
6 parts of feldspar
1 part of florspar
25 parts of water-glass.

Recipe 143.—**Compo for Grindstones.**

Process.—Melt 100 parts of water-glass in a closed vessel and add 25 parts of flour of sulphur which has been mixed with 450 to 500 parts of emery or some other abrading body; well knead the mass and then put into moulds, and while in the moulds submit it to the temperature of 572° F., after removal from the furnace allow to cool and then resubmit it to the same temperature. This composition is waterproof.

Recipe 144.—**Compo for ordinary Grindstones.**

Process.—Mix together—

225 parts quartz sand, or emery
75 parts of limestone
30 parts of calamine (carbonate of zinc)
30 parts of calcium phosphate
75 parts of water-glass
4 parts of feldspar.

Recipe 145.—**Compo to imitate Marble.**

Ingredients and Preparation.—Mix together in fine powder by sifting—

280 parts of stone
140 parts of limestone or chalk
5 parts of burnt calamine
3 parts of calcined feldspar
2 parts of florspar
2 parts of calcium phosphate
40 parts of water-glass.

When the water-glass is added, mix the ingredients quickly, and then shape up or press in moulds. The finished pressed masses are then dried at a temperature gradually rising to 125° F.

(2) Mix powdered marble chalk with milk of lime to the consistence of stiff paste and then work in some broken limestone; use at once as it quickly hardens.

Recipe 146.—**To render Sandstone, Bricks, etc., impervious to Heat.**

Process.—Heat the material to a temperature of 350° F., and then steep it in coal-tar (which has also been heated to a similar temperature) for 8 hours. The lowest temperature of the coal-tar should not be below 235° F.

Recipe 147.—**Waterproofing Composition for Bricks, Plaster, etc.**

Process.—Spread out some hydraulic cement and small lumps of finely powdered quicklime so as to make a heap about as high as 12 or 14 inches and sprinkle the lime with water and allow it to remain undisturbed until it breaks down to a fine powder, then mix this lime powder with an equal weight of earth (infusorial) which has been washed, dried by gentle heating and ground to powder, and make the mixture into a paint with water as required for use.

Recipe 148.—**Waterproofing Process for Bricks, etc.**

Process.—Wash the bricks with a solution of Castile soap and water, and before quite dry give an application of alum and water. The latter solution chemically reacts on the soap, converting it into aluminium sebate which is insoluble in water; $\frac{3}{4}$ lb. of soap to 1 gallon of water, and $\frac{1}{2}$ lb. of alum to 4 gallons of water is the best proportion to use. The wall should be quite dry before applying the soap water and the temperature of the compound not below 50° F. When applying the alum solution the temperature should be 60° to 70° F. at least. After 24 hours the operation should be repeated until three or four coatings have been given of both solutions. Stone troughs, cement tanks and similar substances can also be rendered waterproof by this means.

Recipe 149.—**Putty or Composition for glazing Hot-houses.**

Process.—The ordinary glaziers' putty, made of linseed oil and whiting, is not durable for glazing hot-houses because of the action of moisture within the house and the hot air outside. Putty made as follows, however, has been used with good results. Boil old paint skins with linseed oil until they become soft, so that they may be put through a paint strainer, and give a gummy paint of fairly thick consistence. Then mix the paint with 10 parts of "bolted" whiting and 1 part of powdered litharge (both by weight) and work the mass up until it is of the consistence of soft putty. This compo is laid on the frame with a glazier's or "putty-knife," and the glass embedded therein. To stiffen this putty for the framework more whiting is mixed with some of it.

Recipe 150.—**Composition to fill the Pores of Oak.**

Process.—Mix together equal quantities of raw linseed oil, japanners' size and turpentine, and then add sufficient burnt umber, ground in oil, or else vandyke brown and a trifle of "drop black" ground in oil, to make a homogenœus paste; put it through a hand mill and use as directed for wood-fillers.

Recipe 151.—**Sizing Compo for laying Aluminium Leaf on Wood Signs, Fascias, etc.**

Process.—Mix a little white lead with heavy boiled oil and use this as a slow-drying size; for a quick-drying one use pale gold size japan and enough white lead to take off the yellow colour of the japan; thin with a little "turps" and use this size-paint as oil size is used in laying gold leaf.

Recipe 152.—**Quick-drying Plaster of Paris.**

Process.—Dissolve 8 oz. of gum arabic in 1 gallon of water and mix the plaster with the solution to the consistency desired.

Recipe 153.—**Composition for pointing Terra-cotta.**

Process.—Mix oxide of lead with glycerine in suitable proportions to meet the requirements. The yellow oxide of lead (massicot) is the best, next in order is "flake litharge" ground very fine; this cement sets in a short time under the influence of a gentle heat, and then will resist pressure and heat, and will neither contract nor expand. When hard it exhibits the colour and sonorous qualities of terra-cotta.

Recipe 154.—**Cheap Cement for repairing Cracks in Stone, Brick, etc.**

Process.—Collect paint skins and the remnants from paint pots and put them through a paint mill or a strainer; next mix them with sufficient dry whiting to make a mass of the consistency of glycerine putty and then add to it enough ground Portland cement to enable the mass to be handled without sticking to the hands. In this condition it is used like ordinary putty and will adhere and become quite hard; at the same time it is waterproof and will not be much affected by heat.

Recipe 155.—**Cement for Marble.**

Process.—Crush up some oyster-shells and grind to powder, sift the powder and mix it with sufficient gum arabic mucilage to make a stout stiffness; apply this in a thin layer to all holes or fractures, and press firmly together, then allow it to remain undisturbed for 24 hours and remove with a sharp knife the portion of the cement which has squeezed out.

Applications of Water-Glass.

When this substance was first introduced it was believed that it would prove a veritable boon to the painter and decorator in the many uses to which it could be put, but experience has shown that this body has a nasty habit of efflorescing as it becomes dry, allowing a white powder to form on its surface. As an agglutinative, or binding vehicle, however, water-glass has proved very useful, and below are given some of the compounds that can be formed with it.

The peculiar property of silicate of soda, or of potash, of combining with very diverse substances, renders these silicates very serviceable in preparing adhesive compounds. Thus, when a flour and glue paste is prepared and some silicate of soda added, a very tenacious stiff paste is obtained that is useful for a wide range of purposes; again, silicate of potash mixed with lime and other earthy materials will produce compounds that dry as hard as stone. Between these extremes in compounds and uses, a great variety of combinations can be made with water-glass, or "soluble glass," as these alkaline silicates are termed. There is one drawback, however, to the employment of silicates, and that is, in many combinations, the silicate effloresces in the form of a white powder, and by this decomposition causes a disintegration of the compound or agglutinant. But it is only in some few cases that such changes occur. The following formulæ form a representative list of what can be done with water-glass, and they will serve as a useful guide for the formation of other compounds adapted for special purposes. In other chapters of this book will be found more recipes in which soda silicate is an ingredient, only such recipes being given in the present chapter as come under the trades it represents.

Recipe 156.—**Cement for repairing Plaster Figures, Ornaments, etc.**

Ingredients.—Mix together by sifting—

2 parts of Portland cement
1 part of slaked lime, dry
1 part of fine sand (all parts by weight).

Make the whole into a paste with silicate of soda, of 33 degrees Bè., beat up to a consistence equal to ordinary cement, and apply it to the fractured pieces; press it, remove the superfluous cement that squeezes out and bind up the parts if possible. In 24 hours the cement will become so hardened that the plaster cannot break again at any joint.

Recipe 157.—**Water-glass and Lime Cement for cementing Stone, etc.**

Process.—Mix together 1 oz. quicklime, 10 oz. whiting and $2\frac{1}{2}$ oz. solution of water-glass. This solution hardens slowly and is useful for many purposes. Artificial flagstones can be made by mixing small sharp granite chips into the cement and pressing in moulds. By omitting the quicklime and mixing the whiting in the proportion of 4 parts to 17 parts water-glass, the cement dries in a short time and can be polished. This is especially useful as a cement for joints in marble (water-glass and casein forms a useful cement for glass and china).

Recipe 158.—**Cement for Earthenware.**

Process.—Mix 1 oz. of casein with 6 oz. of solution of water-glass, use at once and dry in the air.

N.B.—When water-glass is mixed with powdered chalk (calcium carbonate) it makes a "mastic" that hardens in 6 to 8 hours.

When water-glass is mixed with sulphide of antimony it forms a dark mass that can be polished.

A mixture of water-glass and iron filings gives a greyish black, very hard mass, while a mixture of water-glass and zinc filings gives a very hard metallic mass that is suitable for cementing zinc with.

Recipe 159.—**Coating Composition for Vats, Cisterns, Wooden Vessels, etc.**

Process.—Mix 2 parts of plaster of Paris with 1 lb. of asbestos, finely powdered, and make the whole into a paste with sufficient bullock's blood to form a thick mass, but not too stiff to be used with a brush; coat the wood uniformly with this and in a few hours give a second coat to which a little linseed oil varnish has been added. When thoroughly dry, a wash of water-glass may be given so as to impart a glaze.

Casein Compounds, that are useful to the Trades represented in this Chapter.

Casein, or the "curd" obtained from milk, forms a variety of agglutinative compounds that are useful for a great many purposes and suited for different trades; in the following recipes, however, only such as are useful to the builder, mason, carpenter, and other trades heading this chapter are given. For other formulæ the reader is referred to the Index.

Cements and Agglutinants made with Casein.

Casein is a substance which has been known for ages in the familiar form of "cheese" and "curds and whey," but it is only within the last decade that its peculiar properties have been turned to practical use in various trades and industries. All its capabilities are not yet found out, as, so varied are the products that can be made with casein that it can be used in many different conditions, such for example, as a mucilage for adhesive use, as a varnish for imparting a waterproof gloss to paper, etc., as a solid body like horn or ivory, that can be turned in the lathe, or even as a vehicle for making paints.

One only of its many applications has been known for any length of time, and that is the production of a cement for mending china, glass, etc. A mixture of cheese and lime has been used for many years (a fact that was well known to some medieval Italian fresco painters, who, when working in a monastery on the Continent, were fed so constantly on cheese that at last they rebelled against such food under the plea that their stomachs would become a mass of cement).

Casein is the "curd" obtained from milk and of which cheese is made. This curd is dissolved by alkalies, in which condition it is useful for conversion into many serviceable products by suitable manipulation. For an outline of the physical and chemical properties of casein the reader is referred to the chapter dealing with the materials mentioned in this book.

Recipe 160.—**Casein Cement for Earthenware, Porcelain, Stone, etc.**

Process.—Mix 1 part of powdered lime with 6 parts of dry casein in powder and make into a paste with cold or warm water; this forms a quick-setting cement.

Recipe 161.—**Quickly-made Casein Cement.**

Grind up the curd in a mill and gradually add powdered slaked lime, continue the milling until a tough mass is obtained, which should be used at once as it quickly hardens.

Recipe 162.—**Casein Mucilage or Varnish, for coating Paper, use as Gum, etc.**

Process.—Make a saturated solution of carbonate of soda, or potash, and dissolve casein in it to the desired consistency. This fluid can be used as a varnish for coating paper, or other suitable material, and such coating can be rendered waterproof by the application, before the casein is quite dry, of a solution of basic chrome alum.

Recipe 163.—**Waterproof and Fireproof Cement from Casein.**

Process.—Add a little vinegar to 7 gills of milk to curdle it, collect the curd by draining the whey off through a cloth, then mix 4 or 5 eggs with the soft curd and, when well mixed, add sufficient of the freshly made curd to make it into a stiff paste, and use at once as it sets quickly; it resists fire heat and is also waterproof, and is useful as a cement for earthenware and pottery and similar substances.

Recipe 164.—**Cement for filling Cracks, Holes, etc. in Building Stones.**

Process.—Mix together in the dry state equal weights of fine sand and slaked lime, and then dry casein in powder to the extent of 12 per cent. of the weight of the mixture.

Recipe 165.—**Casein Cement for Earthenware, Pottery, Tiles, Stone, etc.**

Process.—Mix together in the dry state 4 lb. of grated cheese, 1 lb. of slaked lime, 1 lb. of wood-ashes, and make into a paste with $\frac{3}{4}$ gallon of cold water and use at once. The cheese should be washed in water until it is soft enough to be drawn into threads.

Recipe 166.—**Casein Cement for Alabaster, Marble, etc.**

Process.—Steep very finely powdered casein in solution of soda until dissolved and then stir in sufficient finely ground magnesia to make the solution into a paste, use at once, as it quickly becomes very hard. Powdered meerschaum may be mixed with the compound until the cement closely resembles genuine meerschaum, for which it forms a good cement.

Recipe 167.—**Casein Cement as a Wood-filler.**

Ingredients and Preparation.—Dissolve 1 lb. of casein in 12 fluid oz. of liquid ammonia, separately mix 1½ oz. burnt lime ("quicklime") and 5½ pints of water, then mix the casein solution and brush over the surface of the wood, when dry smooth down with sand paper.

N.B.—The casein made use of should be prepared so that there is no fat, salt, or acid in it, as their presence interferes with the adherent qualities of the cement.

Method of making Casein free from Fat, Salt, or Acid.

A good way to prepare the pure casein is to carefully skim all cream off fresh milk and allow it to curdle, by standing the milk in a warm place, then filter the curd from the whey and wash the curd with soft water (*i.e.*, free from lime) until the wash-water shows no trace of acid. To remove all fat, put the casein in a linen cloth and boil it, then spread out the casein on blotting paper and allow it to dry in a warm place until it is of a horny nature, then pulverise the hard casein.

Recipe 168.—**Casein-putty Cement (waterproof) for filling Joint and Knot Holes in Wooden Floors, Panels, Partitions, etc.**

Process.—Mix 5 parts, by measure, of fresh cheese, and 1 part of unslaked lime and knead the mixture to a stiff dough, and for colouring matter, while kneading work, in raw or burnt Sienna, umber, mineral browns, Venetian reds, or Indian red to make it of the shade desired. When the knots and holes have been filled and the surface levelled up, the putty will dry as hard as stone, and be insoluble in water.

Recipe 169.—**Technolithe or Artificial Asphalt for Paving Purposes, etc.**

Process.—This material is obtained by mixing the residuum from the distillation of tar, petroleum, or resin, with sulphur and some oxidising agent, such as pyrolusite, chloride of lime, oxide of manganese, by the aid of heat. Solidarity is imparted to the mass by incorporating it as a mixing "mastic," with calcium carbonate, or argillaceous earth, and milk of lime; these admixtures being properly mixed together (*vide infra* "Mastics") and then dried, ground, and added in the proportion of about 10 parts to 1 of the bituminous first product. The finished product is characterised by a high degree of resistance, and great tenacity.

Lime Cements, "Mastics," Concretes, Mortars, etc.

Ordinary mastics consist of a mass of sharp, clean sand, with quicklime, these ingredients being mixed together in the dry state and then the water added to slake the lime. During the slaking process the lime becomes more or less carbonated, whereby the silicious nature of the sand is chemically acted on, and combines to a great extent with the lime to form a compact, hard mass when dry.

If, however, the lime be at all carbonated before slaking or the sand be water-worn, such as sea sand, whereby the sharp edges have become worn down, the chemical action between the two ingredients is lessened. The sand should be completely free from clay and should not be too fine; it is best in the state of a mixture of sand and fine gravel. The water also should be pure, and if previously saturated with lime, a little sugar should be added, which forms a saccharate of lime, and increases the tenacity of the mastic. The best proportions to use are given in the recipes below.

Recipe 170.—**Builders' Mortars, etc.**

Three parts of fine sand, 4 parts of coarse sand, and 1 part of recently-slaked quicklime, and as little water as possible, the whole being well trowelled or worked with the shovel until plastic; by the addition of a little manganese acid, the mastic acquires the property of setting under water (*i.e.*, forms hydraulic mortar). Limestone that becomes brown when calcined, contains manganese, and is therefore very useful for making hydraulic mortars. Besides sand, lime, and water, as the sole ingredients in making mortar, several other materials are used, so as to give the mortar greater binding power and reduce its friability when dry, etc. Thus, cow-hair is often mixed in with the mortar, and the shorter hair of horses when properly commingled with mortar greatly increases the cohesive qualities of the mortar and prevent it crumbling; but the lime must be well separated before mixing with the mortar, that is, it should not be mixed with the other components, as lumps or clumps of lime, for such lumps would only weaken the mortar. Manilla fibre is a cheaper material than hair and forms a good substitute. Jute and other fibrous substances have also been used as materials for making such mortars as are used in building, and for increasing their coherence. Sawdust also has been used as a substitute for hair, and also as a substitute for sand in forming wall plasters; owing to its pulverulent state, it has no properties of causing the mortar to cohere as hair does, but it forms a cheap material as a substitute for sand in forming plasters where cohesion and compressive strengths are not required, such, for example, as plaster for ceilings, etc. It certainly is preferable from a sanitary point of view, to sifted coal ashes or the refuse from dustbins.

An American patent has been taken out for the employment of sawdust in mortar, of which the following formula is an example—

Recipe 171.—**Patent Mortar.**

$4\frac{1}{2}$ parts of slaked lime
$4\frac{1}{2}$ parts of sawdust
1 part of plaster
$\frac{1}{4}$ part of glue
$\frac{1}{16}$ part of glycerine, with a small quantity of hair.

Recipe 172.—**Another Patent specifies—**

35 per cent. of sawdust
35 per cent. of sand
10 per cent. of plaster
10 per cent. of glue
10 per cent of whiting.

With the exception of the sand, these compounds are somewhat akin to the plastic compounds used for moulding into picture frames (see section on "Plastic Compo").

Mastics.

Definition and Qualification.—This is the term applied to mortar-like cements used in the building trades. They are waterproof, heat resisting, and very adherent to brick, metal, glass, stone, and some other materials. The following formulæ are typical of their production —

Recipe 173.—**Scotch Mastic.**

Ingredients.—14 parts of white or yellow sandstone
3 parts of whiting, and
1 part of litharge.

These ingredients are dried and heated and mixed while hot, so as to expel all moisture, and then they are sifted to exclude any coarse particles, so that the mixture shall be uniform in its degree of fineness; the mixture is then "gauged" (*i.e.*, mixed) with raw and boiled oil, in the proportion of 2 parts of raw and 1 part of boiled oil. This mortar is used like Portland cement, and the surface on which it is laid is coated with linseed oil before applying the mastic. The binding vehicle is formed by the action of the oil on the litharge, which is an oxide of lead that forms an agglutinative body with linseed oils. All "parts" are by measure.

Recipe 174.—**London Mastic.**

Ingredients.—160 parts of stone (pulverized)
50 parts of silver sand (or else fine river sand)
15 parts of litharge.

Preparation.—Have all the above ingredients in powder, which should be sifted and mixed together, and the mixture passed through a fine sieve, and if not wanted at once it may be stored in casks, or in a dry place until required for use. It is gauged with a mixture of equal quantities of raw and boiled oils until of the consistence of "fine stuff," that is, of the consistency of the final coat of plaster put on ceilings and walls when plastered. To bring it to this condition it requires to be well kneaded and beaten, in fact, the more it is kneaded the better it works. To test its fitness for use, spread a smooth layer of it on any surface, and if the surface shows any separate parts of the different materials or bright specks, it must be again "knocked up" (kneaded) until it is of even texture. The addition of 15 parts of red lead is sometimes added to increase its tenacity.

Recipe 175.—**Hamlin's Mastic.**

Process.—This cement consists of sand and pulverised stone, or pottery scharf (*i.e.*, pottery ware pulverised), to which are added different oxides of lead, such as litharge, grey oxide (silver litharge), minium, red lead. These oxides being in the state of powders, the powdered glass or "frit" is intimately mixed with the whole, and the mixture made into a suitable consistence with linseed oil.

Proportions of Ingredients.—These are as follows :—

To any given weight of sand or pulverised pottery ware, add two-thirds of the weight of Portland, Bath, or any other stone of the same nature, then to every 550 lb. of the mixture add 40 lbs. of litharge, 2 lb. of pulverised glass or "flint" stone, 1 lb. minium, and 2 lb. of grey oxide of lead; thoroughly mix these ingredients together and sift through a sieve, the fineness of which will depend on the different purposes for which the mastic is intended.

The method of using the mastic is as follows:—To every 30 lbs. of the mortar, add 1 quart of linseed oil, and well mix together, either by beating or with a trowel. As soon as it begins to set it is ready for use, the wall surface being first coated with linseed oil. "Knock up" only so much of the mortar as can be used at any one time.

Recipe 176.—**Mastic Cements.**

Ingredients and Preparation.—Mix 60 parts of slaked lime, 35 parts of fine sand and 3 parts of litharge; then mix these to a stiff paste with 7 to 10 pints of old linseed oil, well beating the mass until the ingredients are incorporated, and thereby a plastic mass is obtained.

A very smooth surface can be given to the mastic by trowelling. It is impervious to damp, and not affected by change of temperature.

The manipulation of mastics is generally carried out as follows:—The walls are prepared by raking out the joints, and scraping and sweeping with a coarse broom, and the brush marks should be obliterated by the application of a coat of linseed oil.

Narrow "screeds" about 1 in. wide are formed in plaster to act as guides for floating the wall with a level coat of the mastic.

When spreading the mastic, it must be firmly pressed on and the floating rule carefully passed over the surface until it is strictly flat.

The screeds are next cut out and the spaces filled with "extra stiff" mortar.

The whole surface is then finished with a sycamore or beechwood hard rule having a close and uniform texture.

Mastic mouldings are first roughed out with medium or rather quick-setting cement.

The running mould is supplied so as to allow $\frac{1}{4}$ in. for the mastic cement.

CASEIN PAINTS.

"The addition of milk and lime water increases their durability; such a mixture constituted the first casein paint, the casein of the milk forming with the caustic lime a compound which is at the basis of all such paints, the casein is rendered soluble, a result that can be produced not merely with quicklime, but also with various substances having an alkaline nature.

"The coatings formed by the different kinds of casein paint dry without gloss, like all water-colour paints, and therefore exhibit a property which is difficult to impart to oil-paints without impairing their durability. Under the influence of the air the paint acquires a certain firmness, and does not rub off like 'lime-washes.' It is fairly durable when exposed to the air, but when the situation is one where it is exposed to wet or heavy rains (as on the weather-side of a building) these paints suffer more than oil-paints as regards the durability of them. All casein paints have the advantage of drying quickly, and being easy to work without requiring any special preparation of the surface to be made, drying without a gloss on brickwork, plaster, wood, canvas, etc., and without stopping the pores of brickwork."

For further information concerning these "cold-water paints" the reader is referred to the work "Casein," published by Messrs. Scott, Greenwood & Co.; it is a translation from a German work on casein and contains particulars gathered up from various sources.

Recipe 177.—"**Marble Lime" Colour for Outside Work.**

The following ingredients are passed through a colour sifting and mixing machine:—

100 parts (by weight) of casein, soluble in alkali
100 parts (by weight) of caustic lime from marble
800 parts (by weight) of levigated chalk
1 part (by weight) of borax
2 to $2\frac{1}{2}$ parts of ultramarine (for white only).

All should be finely powdered.

The caustic lime ($CaOH_2$) is obtained in a fine white powder, by slaking lumps of pure calcined marble lime with one-third of their own weight of water in a porcelain vessel; the water and lime combine to form calcium hydrate with liberation of heat, and a faint alkaline reaction. The resulting slaked lime should be kept in tightly closed vessels or perfectly air-tight ones.

As regards coloured limewashes, the colouring matter can be mixed while the paint is being made, or else just before use, only the earthy colours or "lime-proof" colours being used, such as the following, which are fast to lime:—Antimony yellow, barium yellow, barium white, ivory black, chrome green, chrome orange, colcothar, green earth, cadmium yellow, cobalt blue, cobalt green, Mars brown, Naples yellow, ochre, Paris black, Scheinfurth green, terra di siena, ultramarine, umbers, Vandyke brown and zinc white.

If the pigments are added at the time of manufacture, the weight of the levigated chalk must be reduced to that of the pigment used. For instance—

Casein solution in alkali... ...	10 parts
Caustic lime	10 ,,
Levigated chalk	40 ,,
Ochre	40 ,,

Borax, as before; ultramarine, nil.

An Old Method of Making Casein Paints.

The curd of sour milk is boiled for about a quarter of an hour in a well enamelled or glazed vessel and then transferred to a source where it is washed with cold water until perfectly free from acidity, after which it is wrapped in a cloth and pressed until only a little moisture is left. In this condition it is mixed with one-quarter its weight of burnt lime, previously slaked with a three-fold weight of water, the colouring matter mixed or ground with oil, the water being next added. The resulting paint may be applied to stone surfaces, or zinc, but if intended for use on wood it should be first mixed with 10 per cent. of linseed oil. If too much, the paint can be thinned with oil or water.

The following two recipes for casein paints will serve as a guide to their preparation :—

Recipe 178.—**Casein Paint.**

All parts by weight.

144 parts of casein
7 parts of slaked lime
280 parts of Spanish white
2 parts of earthy pigment
160 parts of water.

Recipe 179.—**Casein Paint.**

Skim milk	$\frac{1}{2}$ gallon
Freshly slaked lime ...	6 oz.
Linseed oil or poppy oil	4 oz.
Spanish white	$3\frac{3}{4}$ lb.

Casein Enamel Paints.

To prepare these paints, casein is intimately mixed with enamel colours—merely glass fluxes coloured with metallic oxides (like those preparations used in porcelain painting), the whole being ground in water. The product does not dry with the dull surface of the ordinary casein paints, but has a gloss nearly resembling that of oil paints.

Recipe 180.—**Cold-water Paint in Powder Form.**

In making this class of paint the proportions must be selected in such a manner that the mixture shall contain 80 parts of dry casein to every $2\frac{1}{2}$ parts of dry slaked lime (or caustic soda or potash). For further recipes for casein paints and compounds the reader is referred to the translated work on "Casein" above referred to.

Recipe 181.—**Casein Paints for Woodwork and Iron.**

Casein paints made from "casein varnish" and various colouring matters. The "varnish" is a solution of casein in some alkaline solvent, such as borax, lime, soda carbonate, or other alkali (see section on "Notes on Materials"). All parts by weight.

	Casein Varnish.		Ground in Oil.
(1) Black ...	50 parts	...	15 parts black
(2) Yellow ...	50 ,,	...	25 ,, chrome yellow
(3) Chalk white	50 ,,	...	30 ,, chalk
(4) White lead	50 ,,	...	50 ,, white lead
(5) Red ...	50 ,,	...	50 ,, vermilion
(6) Or else ...	100 ,,	...	50 ,, colcothar
(7) Blue ...	40 ,,	...	50 ,, Berlin blue
(8) Green ...	50 ,,	...	50 ,, chrome green
(9) Ochre ...	50 ,,	...	50 ,, ochre.

Recipe 182.—**Quick-drying Casein Paints.**

"When casein is mixed with such volatile fluids as turpentine, benzine, petroleum, etc., "dissociated" casein acquires the property of drying very quickly. Hence, by preparing a solution of casein, along with oil or balsam, and thinning it down with petroleum, a product is obtained which is highly elastic, as well as quick drying. For example, a mixture of 8 parts of such a medium with about 10 parts of zinc-white, lithophone, etc., forms a very useful light paint for outdoor use, or for use on woodwork indoors, or on metal. It is worth noting that the addition of benzol, or the like, causes the particles of paint to penetrate deeply into wood and the firm joints in ironwork, without stopping the circulation of air. This protects the iron from rusting (Query.—H.C.S.), and the antiseptic effect of the petroleum preserves wood from rotting. Oil-paint is soon spoiled in appearance when exposed to ammoniacal fumes, but they have no effect on "petroleum-casein" paints. The latter dry quickly, and do not darken in course of time, neither does the smell of petroleum hang about very long. Petroleum may be replaced in these paints by benzol, naphtha, turps, and etheral oils, like oil of spikenard, lavender, etc. When the paint is to be used for outdoor work, or timber or brickwork, an addition of linseed oil is desirable, and the paint should be thinned down considerably, so as to allow the particles to penetrate deep into the underlying material. In places exposed to atmospheric influences, or to damp walls, these quick-drying paints will be found very advantageous."[1]

Recipe 183.—**Adherent Whitewash for Wood and Metal.**

Add 1 lb. of sugar to every 15 lb. of lime used in making the wash. It adheres so firmly as to require scraping off when desired to be removed.

Recipe 184.—**A Cheap Whitewash.**

A cheap whitewash that will not peel off or crack is made by adding 1 part common salt to 3 parts stone lime. This wash is useful for granaries, sheds, and wherever it is difficult to fix a scaffold, in which case it can be effected by means of a hose-pipe attached to a hand fire-engine.

Recipe 185.—**A Fireproof Compo for Woodwork, etc.**

Process.—Slake freshly burnt lime and add as much water as will reduce it to the consistency of cream, and to every 10 gallons of this liquid add 2 lbs. of alum, 24 oz. of sub-carbonate of potash or commercial potash, 1 lb. of salt, and 1 lb. of plaster. Each of the above are added separately, and in the order named, being carefully stirred. The whole is then passed through a fine sieve. When required for use, it is heated to boiling point and applied in a hot condition. On old walls, the addition of a small quantity of fine sand will tend to strengthen the crumbling wall.

Recipe 186.—**A Washable Distemper Wash.**

Process.—Mix 3 parts silicious rock powdered, 3 parts crushed marble or sandstone, 2 parts porcelain clay, 2 parts warm freshly slaked lime, and make into a wash with water in the usual way. Any colour usable with lime can be used for tinting purposes. By frequently wetting this coating it will

[1] The above particulars are taken from the work on "Casein" above referred to, but the present writer has had no opportunity of testing the truth of the dicta given in the above.

become solid like stone on the surface. The coating should be laid on thick.

Recipe 187.—**To make Whitewash.**

Process.—Take 6 lb. of whiting and cover it with clean cold water, let it stand for six hours, mix it with 1 quart of best "double" size, then leave it in a warm place until it becomes like a jelly, then dilute with water until of the consistency of cream; 1 lb. of this jelly will cover 6 superficial yards. As "size" is an animal substance that quickly decomposes and becomes offensive, "Algin," instead of the ordinary size could be used for making whitewash.

Recipe 188.—**Compo for Stone, Stucco, Plaster Walls, Brickwork, etc.**

To prepare the mixture, soak 2 oz. of good light-coloured glue for twelve hours in cold water, and dissolve it with constant stirring in thick milk of lime (prepared from 1 lb. of caustic lime) heated to the boiling point. To the boiling plaster stir in linseed oil until it ceases to mix; about $8\frac{3}{4}$ oz. of oil is sufficient for the above proportions; too much oil is corrected by the addition of lime paste. Mix the above with any colour not affected by lime, and dilute with water if necessary. For yellow, brown, or brown-red colours, boil in the ground colour $\frac{1}{4}$ its volume of a solution of shellac and borax. This makes an excellent paint for woodwork. The mixture is easily applied, covers well, and forms a durable combination with any colours, as any desired shade can be produced with the addition of proper colours. When dry it can be varnished.

Recipe 189.—**Cheap Paint for Brickwork.**

Process.—Slake freshly burnt lime to a powder in the usual way and then sift the powder through a sieve, and to every 100 parts of this powder add sufficient water to make a thin milk of lime, and boil it in a copper boiler, add 1 pint of bichromate of potash, make a thin solution of sulphate of lime with water, and stir it in the boiling mixture. Sugar of lead, or the nitrate or hydrochlorate of lead, can be substituted for the sulphate; add cold water to the mass and put it through a fine sieve, or drain it off through linen or cloth bags, and press the residue that remains in the bag; after sufficient pressing, break into pieces and dry in the air.

Recipe 190.—**Lustrous Coating for Walls of Rooms.**

Process.—Mix oxide of zinc with ordinary milk of lime, and apply the mixture in the same manner as whitewash; when dry, lay on a coat of solution of chloride of zinc. This combines with the oxide and forms a solid coating with a lustrous surface.

Recipe 191.—**Cheap Cement for Outdoor Work.**

Process.—Boil 1 lb. of clear linseed oil with $4\frac{1}{2}$ oz. of rosin and 3 oz. of litharge until the wooden spatula used for stirring becomes brown; give the walls two or three coats of this compound on a warm day.

Recipe 192.—**Casein and Lime Washes for Walls.**

Process.—Boil for a quarter of an hour in an earthenware vessel 1 lb. of soft curd from fresh milk in 3 lbs. of water, pass the mass through a colander, wash it with cold water and press out the water in a linen cloth. To 1 part of the curd add $\frac{1}{4}$ part of the slaked lime and $\frac{3}{4}$ parts of water. The "fat" lime thus produced is rubbed up in oil or water with the various colouring pigments to form a paint. This compound thus prepared is useful for stone, plaster, brick, or even metal surfaces. It dries quickly.

Recipe 193.—**Compo for Polishing Plaster.**

Process.—Dissolve 1 oz. of pure "curd" soap in 50 fluid oz. of clean water, and dissolve by heating in a glazed pot; then add $1\frac{1}{4}$ oz. of white beeswax, cut into thin slices; when this is all uniformly melted it is fit for use. The article to be polished is then dipped in the liquid, and when taken out allowed to stand for about three minutes, stir up the mixture and again dip the article in it; then cover it up in a dry place free from dust for six or seven days, after which all surplus must be wiped off with some soft rag or cotton wool, and the article rubbed until it exhibits a polished surface.

Recipe 194.—**Another Polishing Process for Plaster Casts.**

Process.—Take 2 parts of stearin
2 parts of Venetian soap
1 part of pearlash.

Grate the stearin and soap, and mix it with 30 parts of a solution of caustic potash, add the pearlash dissolved in a little clean water and boil for five minutes, stir well, and mix with more lye until it is quite liquid. Before use give a few days' rest, keeping it covered up; the plaster figure should be clean and dry, and then coated with the above compound by means of a soft brush or sponge until the plaster figure will shrink no more; then allow it to stand, and well lay the mixture on the cast with a brush; then with a piece of flannel, dipped in melted stearin, rub the object.

Recipe 195.—**Glycerine and Litharge Cement.**

Process.—This cement is one that is of great use in a variety of cases. The proportions of either ingredient vary according to the nature of the cement to be prepared. For a soft cement most glycerine is used; several other oxides besides litharge may be mixed with the cement. It sets quickly, attains great hardness, and does not shrink. It has been used for producing blocks and plates for printing and for photographic process. It is especially adapted for moulding where great delicacy of line is required. Many other purposes this cement can be used for, as for example, for chemical apparatus it has great advantages, because it is unaffected by chlorine, hydrochloric acid, sulphur vapour, sulphuric acid, nitric acid, and indeed, resists most corrosive vapours. These cements also withstand the solvent action of alcohol, ether, bi-sulphide of carbon, and all hydro-carbon fluids. It hardens in from ten to thirty minutes if mixed of the consistence of thick dough. It sets under water as quickly as in air. Moreover, it stands a very high temperature, higher than any other cement; the compo may be alone used for moulds for electrotyping and for casting metal work. For this purpose glycerine must be stirred with the litharge until a mixture of the proper consistence is obtained. The article to be copied must be smeared with the glycerine before the mixture is pressed on it, and plenty of time must be given to it to set. When used for casting moulds, add about 5 per cent. of brickdust to the mixture. The writer has found that, when a mixture of litharge and glycerine is added to a solution of gelatine, it forms an excellent compound which makes a useful cement for leather belts and bands for machinery, and leather goods in general, whether they be greasy or not.

Recipe 196.—**A Compo for Modelling.**

Mix 200 parts of gypsum and 100 parts of the best wheat flour, and stir the mixture carefully into 300 parts of melted white wax, not too hot.

Recipe 197.—**Universal Modelling Compo.**

Melt carefully over a moderate fire 2 lb. of yellow wax and 4½ oz. of Venice turpentine, 2 oz. of lard, and 2¼ lb. of bole, and mix thoroughly; then gradually pour the mixture into a vessel with water and thoroughly knead it several times with the hands. The wax should be melted at such a temperature that no bubbles appear on the melted surface.

Recipe 198.—**A Weather-resisting White Cement.**

Mix 3 parts of fire chalk, and 1 part of kaolin, calcine the mixture at a red heat, and then regrind the compound. Use like ordinary plaster.

Recipe 199.—**Acid-proof Coating for Cement.**

Sinks, troughs, and other castings made of Portland cement, may be rendered acid-resisting by the following means:—

Make a mixture of 10 parts of vaseline and 7 parts of paraffin oil at 104° F., and lay this on the surface of the article, as hot as possible; small articles may be immersed in the hot solution. Several coatings may be applied until the cement tank is saturated. The surface should be thoroughly dry and free from dust.

Recipe 200.—**Greek Mastic**

is prepared by mixing 1 part of shell lime and 1 part of fine river sand, gauging to the proper consistence with skimmed milk; it must be well beaten.

Recipe 201.—**Cement for Water Tanks, Aquariums, Waterproofing Bath Walls.**

Ingredients.—3 parts litharge
3 parts white or silver sand
1½ parts common rosin
1½ parts plaster of Paris.

Mix them together in the dry state and gauge with as much boiled oil as will make the mass of a plastic nature; the oil should not be added until the cement is required for use, as it sets quickly.

Recipe 202.—**Fireproof Mortar for Firegrates, Furnaces.**

Mix 2 parts of quick lime with 1 part of blacksmiths' ashes and 1 part of brickdust, and gauge with water or stale beer, as required for use. The cement becomes as hard as stone.

Recipe 203.—**Waterproof Mortar,**

for floating on plaster walls; this is prepared by gauging the lime with a solution of "green vitriol" (sulphate of iron), instead of cold water. The necessary quantity of green vitriol is dissolved in warm water, the lime slaked in the usual way, and then mixed with sand.

Recipe 204.—**To harden Lime and Cement.**

Lay on the finished work with a brush a solution of either sulphate of zinc, of iron, or of copper; or the mortar may be gauged with them. In the latter case, the percentage of lime or cement in the mortar can be considerably lessened.

Recipe 205.—**Adamantine Colours.**

Portland or Roman cement, stone, brick, or wood, can be coloured to any desired shade by the use of an adamant wash such as the following:—Into a large clean tub pour 18 gallons of lime, adding as much water as will make it of the consistency of cream; stir it well, and pour in 1 gallon of linseed oil and 1 gallon of boiled oil. Separately mix 7 lb. of water and 7 lb. of yellow ochre with 2 gallons of turpentine, and pour into the large tub, and add 6 firkins of size, quite hot, and 1 lb. of alum; stir all together and pass through a hair sieve into barrels. It is then ready for use. Apply with a short brush. If the walls are old, two coats will be required.

Recipe 206.—**A Cement Wash.**

This is composed of Portland cement and water; a small percentage of putty lime is added; when a lighter tint is required, a solution of sulphate of zinc is added to give the work greater permanence. This wash is used for ordinary cement, stucco façades, plaster walls, etc.

Recipe 207.—**Sanitary Whitewash.**

Put 1 bushel of lime into a large clean tub and slake it with boiling water, cover it while slaking proceeds to keep in the steam, then strain the liquor through a fine sieve and add 3 lb. of sulphate of zinc, 1 lb. of alum, and 2 lb. of common salt; these are best dissolved in hot water.

To colour the mixture, add 3 lb. of yellow ochre; for a pearl or lead colour, add lamp or ivory black; for a fawn colour, add 6 lb. of American ochre, 3 lb. of Indian red, and 1 lb. of lampblack; for stone colour, add 8 lb. of raw umber and 4 lb. of lampblack; for terra-cotta colour, add 4 lb. of Venetian red, 2 lb. of purple brown and 2 lb. of yellow ochre.

CHAPTER III.

AGGLUTINANTS FOR USE IN THE PAPER, PRINTING, PHOTOGRAPHIC, LEATHER, AND KINDRED TRADES AND INDUSTRIES.

Recipe 208.—**Resinous Size for affixing Aluminium and Bronzing Powders.**

Ingredients and Preparation.—Mix 1 gallon of turpentine, or benzine, with ½ pint of good "body" copal varnish, apply when fairly "tacky," dust on the dry bronze powder, and when that is dry, rub off excess of powder with a piece of cloth, then varnish.

Recipe 209.—**Celluloid Cement for Book Covers, etc.**

Owing to the cleanliness of celluloid, it is now being made use of for covering books, as such covers do not become soiled so readily as cloth-covered books.

Process.—Dissolve 5 oz. of shellac in 5 oz. of spirits of camphor, and then add 20 oz. of alcohol of 90 per cent. strength. Instead of shellac, celluloid may be dissolved in 90 per cent. alcohol. As the celluloid is a material very sensitive to heat, the tool should be kept as cool as possible when working the celluloid. If it tears, heat it in water slowly raised to 90 or 100° F.

Recipe 210.—**Resinous Flour Paste for Bookbinders' Use.**

Process.—By the addition of resins to glue paste the agglutinant can be made of a quality that it will not readily dissolve in water when once it is dry, neither will such paste decompose by the absorption of moisture. The resins used are generally resin and turpentine, called "Venice" turpentine, and to get them to combine perfectly with the flour paste the mixture should be heated and stirred sufficiently long to dissolve the resinous matter and allow it to diffuse uniformly in the flour paste. In the use of a glue paste in which an alkali has been employed, the resins very readily dissolve, owing to the chemical action of the alkali in it, and form a resinate of soda ; when glue is to be used as an addition to flour-paste, the presence of an alkali is detrimental, as alkalies decompose the animal matter and destroy its adhesiveness.

Soak 1 lb. of glue in 2 gallons of cold water until soft, then heat the liquefied glue until it dissolves, and allow it to cool. Then add sufficient flour paste to make a stiff paste, pouring this paste into the hot glue solution and stirring it until the flour thickens and the mixture "puffs and blows," stir all the time and use only a water-lined vessel such as an ordinary glue-pot; next add 2 tablespoonfuls of Venice turpentine (or the same quantity of Canada balsam), and stir well. To make the flour paste, dissolve sulphate of ammonia in 3 times its weight of water, and then add wheat flour equivalent to 7 times the weight of the sulphate used, make into a smooth batter, and then pour on sufficient boiling hot caustic soda solution to thicken the flour batter. The quantity of caustic soda used should be 1 part to 6 times its weight of water. The paste compound prepared in this manner is useful for bookbinders, instead of hot glue, for affixing heavy wall-papers, and for all purposes where a stiff, strongly adhesive paste is required ; this paste is well suited for affixing wall hangings, such as "Lincrusta Walton," etc. Greater density or stiffness can be given to the compound by using a larger quantity of flour. As the flour paste is slightly alkaline, it is best to neutralise the alkalinity by adding the Venice turpentine, or balsam, to the hot glue, before mixing that with the glue solution.

In the above compound we have the adhesive properties of the gluten and albumen in the flour both brought into use by the aid of the caustic soda solution, acting in the sulphate of ammonia solution, in which the flour was made into a batter ; the resinous matter neutralises the alkalinity of the paste and helps to render it waterproof, the glue solution increases the contractile power of the flour paste, and thus increases the adhesive qualities of the compound.

Recipe 211.—**A Flour and Alum Paste for Paper, Cardboard, etc.**

This is a mixture of quite another quality to the above compound. The presence of alum in the paste tends to abstract the water in the paste, and thus make it exhibit a greater contractile power than it would without such addition, and thereby render the paste more siccative and adhesive; so much so that the water in the paste does not penetrate the paper, hence the employment of alum in common paste made for ordinary paper-hanging purposes. The alum itself will not injure the colour of wall-papers, except in the case of gilt paper. The flour paste should be made in the usual way and ½ to 1 oz. of powdered alum per lb. of flour used should be stirred in.

Recipe 212.—**Starch Paste for Photographic use.**

Process.—Put some white starch into a clean basin, break up all lumps into a powder with the bowl of a spoon and then slowly pour on boiling water and beat the starch into a soft batter with a wooden spoon or paddle, and if all the lumps are not broken down, squeeze the paste through a cheese cloth or coarse linen. If too thick, it may be thinned with more boiling water, but on no account should the paste be cooked; when cool, it should have the appearance of lard. The starch should not be made into a batter with water before pouring on the boiling water, but be in the dry state.

Recipe 213.—**Ordinary Paste for Photographic Use.**

Process.—Mix 1¾ oz. of Bermuda arrowroot with 1 oz. of cold water, then add 14 oz. of warm water, and put 80 grains of best white gelatine, ground up to a powder, in the mixture, and boil for a few minutes, then allow to cool, and add 1 oz. of methylated spirit and 6 drops of carbolic acid, reheat the mixture with constant stirring until homogeneous.

Recipe 214.—**Formula for Labelling Paste.**

Process.—First mix 1½ lb. of farina (potato starch) into a smooth batter with 30 fluid oz. of cold water.

Separately dissolve 1½ oz. of caustic soda (*i.e.*, solid sodic hydrate, NaHo) in 3½ pints of boiling water, and pour this on the farina batter, stirring all the time until it thickens. Then mix 1½ oz. of hydrochloric acid with 75 fluid oz. of cold water, pour this on the preparation and if all the paste does not dissolve in the water, put the vessel over the fire, and heat and stir until the mixture is of a uniform consistence. The acid "kills" the alkalinity of the paste, but causes it to become slightly watery if kept in a confined space. Until the acid is poured on the compound, it is a greyish mass, but very tenacious. After the addition of the acid, however, the paste gradually becomes white, and in a few days as white and smooth as lard, very much akin to a celebrated American paste which has found a place on the English market. If no acid be used, the thick, pasty, greyish mass may be dried until hard enough to be ground up to a powder, when this powder can be used as a "cold water paste" for mixing with cold or hot water, to form a paste as required for use.

Recipe 215.—**A Non-decomposable Paste.**

This can be made from farina, as follows :—

Dissolve 2½ oz. of sulphate of ammonia in 1½ pints of cold water and filter it, then pour the filtered fluid into 1½ lb. of farina, and make it into a smooth batter.

Separately dissolve 1¼ oz. of caustic soda in 3 pints of water, by boiling it, then pour the boiling water into the farina batter, and stir until thickened. Put it into a boiling hot fluid consisting of 2 quarts of water in which 2 fluid oz. of hydrochloric acid has been added, and boil up the mixture until homogeneous. Instead of mixing the thick paste with the boiling acid solution, the paste can be made of a thinner consistence by using more water to the caustic soda solution, and then mixing 1 to 1½ fluid oz. of the acid direct with the stiff paste.

There are many other agglutinative compounds in which farina, or flour, is one of the chief ingredients. (*See* Index.)

Recipe 216.—**Glue and Starch Pastes.**

The following pastes are noted for bookbinders' cloth, leatherette, "end-papers," etc.

Soak 1 lb. of white glue in twice its weight of cold water for 4 hours, and then dissolve it in a gluepot, adding the water that has not been absorbed. Separately make 1 lb. of corn starch into a smooth batter with $1\frac{1}{2}$ pints of cold water, and then pour 5 points of boiling hot water on the batter, stirring constantly until the smooth batter is cooked; then pour this paste into the glue solution, stir well and heat at the boil for 10 minutes. If the paste is required to be flexible, 8 to 10 oz. of glycerine should be added to the glue solution before stirring in the starch paste.

Recipe 217.—**A good Paste for General Use.**

Process.—Dissolve 24 oz. of glucose syrup (44° strength) in $3\frac{3}{4}$ pints of water, and warm up over a fire; then take 16 oz. wheat flower and 3 oz. of rice flower, mix by sifting together, and make into a smooth batter with some of the glucose (cooled) solution, then mix in the remainder of the glucose solution and put over the fire to boil for 5 minutes, stirring all the time, and while still hot add about 1 oz. of pure carbolic acid as an antiseptic, to prevent the glucose fermenting the compound.

Recipe 218.—**Office or Library Paste.**

Process and Ingredients.—

2 oz. of gum tragacanth ("gum dragon")
1 oz. of white dextrine
6 oz. of wheat flower
1 oz. of glycerine
4 oz. of cold water
40 oz. of boiling water.

Preparation.—Pour 16 fluid oz. of the boiling water on the gum tragacanth, stir well, and set it aside in a warm place; separately mix the wheat flour and dextrine with the cold water, stir thoroughly, and then mix this with the gum tragacanth mucilage, stir well, and then pour the batter thus made into the remainder of the boiling water, which should be kept boiling. Mix $\frac{1}{4}$ oz. salicylic acid with the glycerine, and then stir this into the boiling paste, and cook the whole for 5 or 6 minutes, then pour the paste into jars, and keep covered with a piece of bladder or oilskin. Keep the jar well covered when not in use. The addition of 2 oz. of gum arabic and 3 fluid oz. of glycerine renders the paste suitable for affixing labels to glass and other smooth surfaces, also for use on wood or leather or metal.

Recipe 219.—**A Liquid Glue.**

This is useful for many purposes, as, for example, affixing leatherette to strawboard, millboard, etc. These glues are made by rendering ordinary glue non-gelatinizing, which can be done by several means, as, for instance, by the addition of oxalic, nitric, or hydrochloric acids to the glue solution.

Process.—Dissolve 1 oz. of oxalic acid in 1 quart of water, and then soak 14 oz. of gelatine in the acid solution and heat the mixture for 5 to 6 hours at the temperature of boiling water, then stir up the mixture, pour it out into a glazed pan, and neutralise the acidity by adding chalk, in small quantities, until all effervescence ceases on adding the chalk; stir well, and allow to settle, then pour off the fluid from the sediment, and evaporate the fluid at a moderate heat until as thick as thin treacle. The glue thus prepared does not congeal or solidify; it is very free from colour, and very tenacious.

Recipe 220.—**Ordinary Liquid Glue.**

One of the simplest forms of "liquid" glue is to add sufficient malt vinegar to an ordinary solution of glue, until it remains thickly fluid; then add a small quantity of oxalic acid, or nitric acid, warm up, and when it is cooled, it will remain fluid and tenacious, and form a very good substitute for gum arabic, except that, being of an acid nature, it cannot be used on coloured paper, or coloured labels, or other coloured material, but it forms a good mucilage for labelling tin-ware.

Recipe 221.—**Glue for Rough-surfaced Materials.**

This glue has great contractile powers, and therefore forms a good adhesive for many materials, which ordinary glue does not.

Process.—Soak $\frac{1}{4}$ lb. of gelatine in 1 pint of cold water until soft, then dilute with 2 oz. of water, to which has been added 1 quart of liquid ammonia; add this fluid to the soaked gelatine, and boil up the mixture for 4 or 5 minutes; after cooling, add ½ drachm of carbolic acid, or oil of cloves.

Recipe 222.—Bookbinders' Glue.

Put 8 oz. of water into a gluepot, and then add 12 oz. of glue, and heat the mixture until the glue is dissolved; then add 8 oz. of "curd" soap, cut up into small slices, and when all are dissolved, add 6 oz. of powdered alum.

Recipe 223.—Liquid Glue for Bookbinders.

Process.—Soak 10 lb. of glue in 1½ gallons of water, in which 8 oz. of nitric acid has been mixed. When the glue is softened, put in 8 oz. of sulphate of lead, to neutralise the acid, and heat the mixture until the glue is dissolved. A similar compound is sometimes sold as "Russian" glue.

Recipe 224.—A Glue proof against Moisture.

Process.—Soak good glue in cold water for 10 hours, then draw off unabsorbed water, and boil the swollen glue into a jelly, separately take some isinglass, equal to one-sixth of the weight of glue taken, and macerate for 12 hours in ordinary whisky, and rub this also into a paste; then put an earthenware "pipkin" over a fire, and put in a little of the glue-jelly and isinglass paste, stirring after each addition to mix them well; finally, add a little linseed oil varnish, and strain the compound through a cloth.

Recipe 225.—Glue Cement for preparing Cork Papers for Packing Purposes.

Process.—Macerate 20 lb. of glue in sufficient cold water for 10 hours, and also 1 lb. of gelatine; pour off the superfluous water, and melt the glue and gelatine in a gluepot, stir in 3 lb. of treacle, and coat the paper with the compound while hot, and, before it cools, cover the coated surface with rasped cork in coarse powder, and allow the paper to dry by hanging it over a line, coated side underneath. This paper is very useful for packing glass bottles, and is preferable to corrugated paper, as it resists pressure.

Recipe 226.—**A Glue Mucilage.**

Process.—Mix equal volumes of water and strong malt-vinegar, to which add 25 per cent. of its bulk of alcohol; steep the glue in this fluid mixture, in the proportion of 1 part of glue and 2 parts of the liquid (both parts by weight). When the glue is softened throughout, melt it in the remainder of the liquid, by gently heating in a gluepot, and add the smallest quantity of a solution of alum.

Recipe 227.—**A Glue insoluble in Water.**

Process.—(1) Prepare a solution of glue in the usual way, by soaking the glue and dissolving in a gluepot, then stir in a little tannic acid, and use while hot.

(2) Make a solution of glue in the usual way, and add a small quantity of bi-chromate of potash—not too much, about one-fiftieth of the amount of glue—to the glue used. The glue thus made will harden when exposed to the light, and be insoluble in water or moisture.

(3) Soak glue in water until soft, but not swollen enough to lose its form, then drain from the water, and put the glue into a gluepot, with sufficient raw linseed oil to cover it, and dissolve the glue by heating it over a slow fire until it is jellified.

(4) Mix a handful of quicklime with 4 oz. of raw linseed oil, boil the mixture until quite thick, and mix this with a hot solution of glue.

(5) Melt softened glue in a gluepot, and mix 10 parts of it with 5 parts of linseed oil varnish, add 1 part of litharge, and use while hot.

Recipe 228.—**A Compound Glue for Labelling, Bookbinding, etc.**

Process.—Stir up 5 lb. of farina in 5 pints of cold water, add 4 oz. of nitric acid, and stand the mixture in a warm place, stirring frequently for 48 hours, then boil the mixture until it forms a thick and transparent substance, dilute with water if necessary, and filter through a thick cloth. Separately prepare the following compound:—Dissolve 5 oz. of gum arabic, and 1 lb. of glue size, in 5 pints of water, add 2 oz. of nitric acid, and heat the mixture to the boiling point. Then mix this compound with the starch paste (*i.e.* farina), when a liquid results which does not moisten, and dries on paper with a gloss. This agglutinant is useful in many trades, such as for labelling, bookbinding, cardboard box making, etc.

Recipe 229.—**Liquid Glues.**

(1) Soak 50 oz. of Russian glue with 50 oz. of warm water until soft, then add $2\frac{3}{4}$ to 3 oz. of nitric acid, and 3 oz. of sulphate of lead, and heat up together and stir well.

(2) Soak 100 oz. of cabinet makers' glue and 100 oz. of clear gelatine in cold water for an hour or two, then drain off the water, and put the softened glue into 25 fluid oz. of alcohol, to which 2 oz. of powdered rosin and 2 oz. of acetic acid of 20 per cent. strength has been added, and heat the mixture in a gluepot for 6 hours. This prolonged heating is necessary to prevent the glue gelatinising.

(3) Soak 100 oz. of glue in cold water for a few hours, then put the glue and whatever water has not been absorbed in a gluepot, and pour on 16 oz. of nitric acid, commercial strength, and boil the mixture for several hours.

(4) Break up 3 oz. of glue into small pieces, and soak it in 12 to 15 oz. of saccharate of lime, then heat the mixture; when cold it does not gelatinise. The consistence of the liquid is determined by the amount of saccharate of lime employed.

(5) Soak 2 oz. of gelatine in 4 oz. of cold water, then add 2 oz. "glacial" acetic acid, and melt together; this compound is a waterproof cement for china, glass, etc.

Recipe 230.—**Gelatine or Glue Paste.**

Process.—(1) Soak 4 lb. of common glue in 16 lb. of cold water until it is soft, then dissolve it by heat, in a gluepot, and while hot, stir in a batter, made by mixing 2 lb. of wheat flour in 1 pint of cold water; pour this batter on slowly, and stir all the time, then heat the mixture until it reaches the boiling point, and when thickened, remove it from the fire; while cooling, stir in 3 oz. of silicate of soda, and as a preservative, add 1 oz. of essential oil of cloves.

This paste is a stiff, gelatinous, very tenacious one. It is useful for bookbinders' purposes, instead of using hot glue. As the paste can be used cold or hot, it will stick almost anything, and is especially useful for heavy wall-hangings, such as Lincrusta-Walton, floor-cloth, etc.

(2) Soak 4 lb. of glue in ¾ gallon of cold water, for 15 hours, then melt the mixture in a gluepot, adding 5¾ gallons of boiling hot water. In a separate vessel, mix 30 lb. of starch powder, with 2 gallons of cold water, to a batter, and continue the stirring until the starch is cooked when poured in the boiling hot solution; then add 2 drachms carbolic acid. This paste is useful for leather work, as in the bookbinders' trades, bootmakers', etc.

(3) Soak good glue in vinegar for 5 hours, then melt it; separately mix starch powder, or wheat-flour, equal in weight to the flour, in cold water, into a batter, and boil over a water bath; when cooked, mix it with the glue solution and stir well.

(4) Rub up 7 oz. of Bermuda arrowroot in 4 oz. of cold water to a smooth batter, then add, separately soaked, 5 drachms of best gelatine or Russian glue, in 50 oz. of water, and when soft, gently warm it; then pour the arrowroot batter into the warm fluid, and raise it to the boiling point; stir well until the arrowroot is cooked, then allow to cool, and before quite cold, carefully and slowly pour in 4 oz. of methylated spirit, then add 1 scruple of carbolic acid, and put up in well-corked, wide-mouthed bottles. This paste is excellent for office use, or for mounting photographs, as it is neither acid nor alkaline, and will keep sweet indefinitely.

Recipe 231.—**Paste for Stereotypers' Matrices.**

Process.—Dissolve 2 oz. of French glue in sufficient vinegar, by soaking and heating, then add 1 quart of hot water, in which 1 oz. of alum has been dissolved. Separately mix 1 lb. of starch in cold water to a batter, and when the glue solution is at the boiling point, stir in the starch batter, and boil for half-an-hour, then stir until cold. To a pint of the paste, add 1 oz. of spirits of wine, and add sufficient water to make the whole spread well.

Recipe 232.—**Glue Mucilage.**

Process.—Soak 8 oz. of glue in 8 oz. of cold water, until all the water has been absorbed, then melt the glue in a glue-pot, and add $2\frac{1}{2}$ fluid oz. of commercial nitric acid, stir well, but avoid inhaling the fumes of the acid, then allow to cool, and keep in well-stoppered bottles. The mixture remains liquid and agglutinative, but it slowly liquefies, and loses its adhesiveness after some time.

The following compound, however, is not liable to slow decomposition:—

Recipe 233.—**Solidified Liquid Glue.**

Soak glue in water until soft, then pour off all unabsorbed water, and melt the glue by heating in sufficient acetic acid to dissolve the glue to the thickness of syrup. When cold, the mixture is a stiff jelly, but remelts to a liquid on warming it.

Recipe 234.—**Paste for Scrap-books.**

Process.—Mix 1 oz. of rice starch with 5 fluid oz. of cold water, separately soak 3 drachms of gelatine in a gluepot, together with all water not absorbed, and when boiling hot stir in the starch batter, and heat until the mixture becomes thick and glossy, then add a few drops of oil of cloves as a preservative.

All pastes made with cereals and glue require a preservative, owing to the decomposable nature of the animal matter.

Recipe 235.—**Solid Paste for Strawboard, etc.**

Process.—Dissolve 1 oz. of French glue in its own weight of water by soaking and heating; then add a solution of

1 oz. of shellac in 6 oz. of alcohol, and stir well until the mixture is cold. Separately mix 35 oz. of dextrine in 5 oz. of alcohol and 25 oz. of water, and stand the vessel in a basin of hot water until a clear solution of a brown colour is obtained: then mix the dextrine solution with the glue solution, and pour out the mixture into moulds, such as shallow trays. When set, cut up into sheets or sticks; when wanted for use, melt the stick over a flame just as sealing wax is melted, or else in a saucer over a flame. This cement is very tenacious, and will stick almost anything together.

Recipe 236.—**Special Paste for labelling Tinware, Tinned-plate, etc.**

Process.—Put sufficient acetic acid into a wide-mouthed bottle to fill about two-thirds, and then put in as much isinglass as the bottle will hold, and stand in a warm place until the isinglass has dissolved; when cold, it should form a jelly. For use, the contents of the bottle are warmed by standing in a vessel of hot water. The cork or stopper should be dipped in melted paraffin wax to prevent it sticking.

Recipe 237.—**Paste for filling Pads for Stamping Inks.**

Process.—(1) Soak 4 lb. of glue in cold water for 1 hour, then dissolve it in a gluepot and add 2 lb. of glycerine, 4 oz. of sugar, and sufficient aniline dye (soluble in water) to colour, then stir in 8 oz. of raw linseed oil. This should be used hot as a branding compo; it is usually put into a flat tin box, with a piece of felt, or baize, over it.

(2) Soak in cold water, and dissolve by heating, 1 lb. of glue; add 4 oz. of glycerine, about 2 tablespoonfuls of glucose syrup, and one-tenth of an ounce of tannic acid; then heat the mixture to the boiling point and set it aside for an hour or two. Before quite cold put up in pads of cloth, or fine felt.

Recipe 238.—**Mountant for Photographers' Use.**

Process.—(1) Soak 1 oz. of gelatine in cold water for 1 hour or more, then drain off the water, and steep the softened gelatine in

10 oz. of alcohol in a bottle, add ½ to 1 oz. of glycerine, according to whether the gelatine is hard or soft, then stand the bottle in a water bath, with an occasional stir up, until the gelatine has dissolved. When wanted for use, remelt by heating.

(2) Soak 4 oz. of "Nelson's" gelatine in 16 oz. of cold water, then dissolve by heating, and add 1 oz. of glycerine and 5 oz. of alcohol. Use as in last recipe.

(3) Soak 1 oz. of gelatine in 90 oz. of water; separately mix 10 oz. of arrowroot with 1 oz. of cold water, then mix the two, and heat at the boiling temperature for 4 or 5 minutes, afterwards add 1 oz. of alcohol and a few drops of carbolic acid.

Gelatine mountants have the advantage of not considerably stretching either mount or print, and are especially useful when prints have to be mounted on thin cards as book illustrations. In the above few formulæ, the alcohol is used mainly as an antiseptic, and is not present in sufficient quantity to have much influence as a preservative.

The following formula does not cause cockling up of the print:—

(4) Mix together 1 lb. of thick, well-boiled, cornflour paste, with 7 oz. of glucose syrup, ½ oz. "curd" soap (powdered), 5 oz. powdered dextrine, 1 drachm of borax, and a few drops of oil of cloves; heat together over a water bath, and if required thinner, add fresh skimmed milk. Use warm, and as thick as possible.

Recipe 239.—**Glue Cement for Transfer Working (such as Hectograph Copying).**

(*a*) *Transparent.*

Process.—Mix 1 oz. of best fish glue in 5 oz. of water, 1 oz. of gelatine, and ¼ oz. of salicylic acid, then melt the mixture over a water bath, and pour it into shallow pans, or trays, to set.

(*b*) *Opaque.*

Process.—Take the above ingredients (as in (*a*)), in the same proportions, and when melted, stir in about 1 lb. of finest kaolin ("china clay"), and run into shallow trays as before.

N.B.—The inks to use with these compounds are the aniline dyes soluble in water, with the addition of a little glycerine and alcohol.

Recipe 240.—Paste for Making "Flong."

Process.—Soak 7 oz. of glue in 1 pint of cold water for some time, and then melt the glue in a gluepot, together with any unabsorbed water; separately soak ¾ lb. of fine whiting in 1 quart of cold water for an hour, and then stir up and add 9 oz. of wheat flour to the whiting solution, and make the mixture into a batter; then pour the batter into the glue solution, and heat and stir well until it boils, when the paste is ready for making the "flong," which is carried out as follows:—

Spread a sheet of fine tissue paper on a level surface, coat this with paste, and then lay a sheet of good blotting paper on the top (say 23 lb. to the ream); cover this sheet of blotting paper on top again, and repeat this with a third sheet, then finally put on a sheet of stout manilla, or "brown" paper. For use, the tissue side of the flong is laid on the type which it is desired to take an impression of, and then the moist flong is forced into the interstices of the type by beating the topmost side with a flat, hard brush, using the brush so that the bristles strike the type fairly vertically. Some stereotypers use a special long-handled knife, instead of a brush.

Recipe 241.—Substitute for Gum Arabic Mucilage.

Process.—Dissolve 4 lb. of white sugar in 9½ pints of cold water, by heating the solution to boiling point, then stir in 1 lb. of slaked lime, stir well and give the mixture a few days' rest, covered up, but occasionally stir it up; when it has settled, pour off the thick fluid from the excess of lime. The saccharate of lime thus obtained forms a useful adhesive that dries with a gloss, and is also useful as an ingredient to mix with gum arabic to cheapen the mucilage made therefrom.

Recipe 242.—Waterproof Compo for Paper, Sail Cloth, etc.

Ingredients and Preparation.—Boil 100 lb. of tar for 3 hours, then dissolve in it a quantity of rosin soap, and pour 8 gallons of water into the mixture, stir carefully, and let the mixture boil up; then carefully make a batter, by mixing 100 lb. of potato-flour in 60 gallons of water; next mix 15 gallons of water into the hot tar, and then pour the two compounds into the potato batter, stirring constantly. For use, 24 parts of the mixture are mixed with 20 parts of paper-pulp, and the pulp made into paper in the usual way, one side of the paper being painted black, and varnished; when dry, it is waterproof, and forms a good wrapping-up paper for packing goods for sea voyages, or packages liable to be exposed to damp or moisture, etc.

Recipe 243.—**Hectograph Compositions.**

(1) *Transparent.*

Ingredients and Preparation.—Soak gelatine in cold water, sufficient to cover it an inch or so, for 10 hours, then drain off all surplus water, and put the softened gelatine in a gluepot, and, instead of using plain water in the outer vessel of the pot, make a solution of common salt (2 oz. of salt to the pint of water), and use that for heating the contents in the inner vessel, as such a solution will become superheated (*i.e.*, become hotter than the temperature of boiling water). Then put 6 or 7 oz. of glycerine with the gelatine, and heat the gluepot until the salt water reaches the temperature of 200° F. Keep up the temperature for 1 hour, and carefully stir the glue mixture from time to time, but be careful that no air bubbles, or froth, are formed; then add 20 drops of oil of cloves to prevent the gelatine from decomposing. When the gelatine is properly cooked, put it into shallow trays, which are placed on a perfectly level surface; cover the tray with a sheet of paper, glass, or metal, so that no dust can settle on the gelatine, and allow it to rest for 8 hours, when the compo will be ready for taking a copy of any written matter that has been done with an aniline ink; when taking the first copy, however, dip a sponge in cold water, squeeze it out, and just pass it over the gelatine surface; allow the gelatine to become nearly dry before taking the copy. Unless this precaution be observed, the gelatine surface will be ruined because the gelatine will stick to the paper, unless it is damped first.

To take a copy of any written matter, proceed as follows:

Allow the ink to become perfectly dry on the document before attempting to take a copy, then lay the paper, written side down, on the gelatine surface, and rub over the surface gently with the hand so that every part of the paper is brought into contact with the gelatine; let the document remain on the gelatine about a minute, and then remove the sheet of writing, and the ink from the writing will become more or less absorbed into the gelatine surface, from which a copy of the writing can be obtained by laying a sheet of clean writing paper on the gelatine surface, and pressing it as with the original writing. If the ink, however, becomes well absorbed, a dozen or two copies will be readily obtainable; so as not to blur the writing, lift up one corner of the sheet of written matter, and pull it off the gelatine with a clean sweep of the hand, pulling diagonally. When the gelatine will yield no more legible copies, sponge the surface with cold water until no traces of ink remain on the gelatine, and allow the gelatine to dry before using again in a similar way. The washing of the gelatine will not be necessary if the gelatine be left to dry for two or three days, as the ink will be absorbed, and thus not interfere with writing on a new transfer.

As the gelatine surface wastes away in use, it becomes uneven, when it can be restored by reheating the gelatine over a water bath, and allowing it to cool as before. If the gelatine refuses to congeal on cooling, that shows too much glycerine has been used for the quality or quantity of gelatine employed.

(2) *Opaque.*

Ingredients and Preparation.—Proceed as directed in last recipe to incorporate 180 parts of gelatine, 375 parts of water, 375 parts of glycerine, and 50 parts of kaolin.

Recipe 244.—**Ordinary Composition.**

(1) Proceed as for opaque with 100 parts of gelatine, and 100 parts of dextrine, 100 parts of glycerine and barium sulphate q.s.

(2) A cheap compo consists of: 100 parts of good size, 50 parts of glycerine, 25 parts of barium sulphate, and 375 parts of water

(3) Use 100 parts of glue, 500 parts of glycerine, 25 parts kaolin and barium sulphate, 374 parts of water.

All the above compounds can be made in thick sheets by pouring the melted compo into a dish until cold, and then removing it from the vessel.

Recipe 245.—**Composition in Sheets.**

(1) Soak 4 oz. of best white glue in a mixture of 5 oz. of water and 3 oz. of a saturated solution of sulphate of ammonia until the glue is soft; then warm the glue until it melts, and add 3 oz. of granulated sugar and 8 oz. of glycerine, stir well and allow it to come to the boiling point; spread this solution with a brush upon white blotting paper until the paper is thoroughly soaked through; allow it to dry for a few days, when the sheet will be ready for use.

(2) For a cheap Composition.

Soak 2 oz. of good glue or gelatine in cold water for 10 hours, then pour off the excess of water and melt the glue by warming in a gluepot, then add 20 to 24 oz. of glycerine, 8 to 12 oz. of fine barium sulphate, and 2 parts of dextrine solution; mix thoroughly by constant stirring, then pour the mixture into shallow pans and allow it to cool. In warm weather less glycerine should be used.

To remove exhausted ink from the gelatine compo, a little hydrochloric acid may be added to the water in which the sponge is dipped.

Recipe 246.—**Composition for Moist Pads for Rubber Stamps.**

These compositions are coloured with a suitable ink, put into metal boxes, and the top covered with a piece of close textured felt or other suitable material, such as cloth; for use, the top of the pad is wetted with water until the felt becomes saturated with the colour in the composition, and is readily imparted to the rubber stamp when the letter is pressed on; the composition is so constructed that it remains moist for a long time, and only requires moistening occasionally. A good composition is made by soaking 1 oz. of gelatine in 1 oz. of cold water, melting it in a gluepot, adding 6 oz. of glycerine and 6 oz. of colouring matter, stirring well, and then putting into the metal box and covering with cloth.

For a black colour, mix together 1 oz. of gelatine, soaked and melted in 2 oz. of water, then add 3 oz. of aniline black soluble in water, 10 oz. of glycerine, 1 oz. of absolute alcohol in which 1 oz. of Venetian or Castile soap has been dissolved, and ¼ oz. of salicylic acid. Instead of aniline black, extract of logwood can be used as the colouring matter.

For a red, blue, or violet colour use 1 oz. of gelatine, 2 oz. of the desired colour, 1 oz. of absolute alcohol, 10 oz. of glycerine, 1 oz. of Venetian soap, and ½ oz. salicylic acid.

If the cushion becomes exhausted on non-gelatinising, a mixture of 15 oz. of alcohol and 15 oz. of glycerine should be made, and the mixture coloured with 2 to 4 drachms of a suitable aniline colour, then the solution poured on the cushion, and rubbed well in with a brush, for a matt, or non-glossy surface.

Composition for Photographic Backgrounds.—Mix a hot strong solution of common soap with any ordinary oil paint, and spread this on the canvas or other surface used. The background dries with a dull surface and does not crack.

Recipe 247.—**Composition for Razor Strops.**

Mix flour emery and glass dust with paper pulp, and make into sheets in the usual way; glue this to a strip of wood.

Recipe 248.—**Composition for Waterproof Paper.**

(1) For packing articles.

Melt together 2 oz. of black pitch, 2 oz. of beeswax, 6 oz. of tar, and 6 oz. of resin, and coat one side of stout brown paper with the compound and dry it.

(2) Razor-stropping paper.

Preparation.—Make into a stiff paste, with sufficient water, 1 oz. of powdered "putty powder" (levigated oxide of tin), ¼ oz. of oxalic acid reduced to powder, 1 scruple of gum arabic in powder; spread this composition over stout parchment paper cut into strips about 2 inches wide, or the compo may be laid on leather-board for making into razor strops for "setting" the edge of razors.

Recipe 249.—**Composition for Printers' Rollers.**

Ingredients and Preparation.—(1) Take equal parts of good glue and glycerine, soak the glue in cold water for 5 hours, then melt it in a gluepot and gradually stir in the glycerine, continue the heating until the excess of water has been driven off, not ceasing to stir all the time; then pour out the mixture into brass or bronze moulds (which have been well oiled), in the middle of which there is a core round which the composition can be cast.

(2) *Preparation.*—Soak 2 lb. of transparent glue in cold water sufficient to cover it a couple of inches; in 24 hours all the water should be absorbed; then melt the softened glue in a steam-jacketed vessel and heat it until the glue begins to rise; then add 7 lb. of treacle that has been made quite hot, and continue the stirring for ½ hour longer; then remove the vessel from the fire and allow the mixture to slightly cool, pour it out into well-oiled moulds, and stand these moulds in a vessel containing cold water for 8 to 10 hours.

Some makers use 3 or 4 times the above quantity of treacle and less water. In such a case the glue is only soaked for 1 to 1½ hours, and then removed from the water and laid on a board all night, then melted without any more water being added, 2 hours' heating of the mixture only being allowed in this case.

Sometimes resin and soap and small quantities of earthy matters are added to the above mixture, but the earthy matters are certainly not an improvement.

(3) This compo produces the "black" composition which is so durable and elastic, pure indiarubber only being used.

Preparation.—Soak in cold water, and drain when softened, 10½ lb. of best glue, and melt it in a water bath or steam-lined vessel; then pour in 2½ gallons of black treacle or honey, and when that has become incorporated add 1 lb. of pure indiarubber that has been dissolved in sufficient hot oil of turpentine; afterwards add, in the order named :—

2 oz. of Venice turpentine
12 oz. of glycerine, and
4 oz. of vinegar;

stir well between each addition. This composition may be cast by the addition of 20 per cent. new material, whereas the simple compound of glue and treacle only will not recast.

Recipe 250.—**Composition for Lithographic Rollers.**

Preparation.—Soften 4 oz. of glue in cold water for a few hours, then melt it in a gluepot, stir in 4 oz. of syrup (treacle), then 6 oz. nitrate of potash, powdered, then 6 oz. of sugar and 18 oz. of water, stir well, and add 2 oz. of chrome yellow and 2 oz. oil of almonds. Continue heating and stirring until homogeneous, then pour the fluid mass into moulds round about a core ½ inch less in diameter than the mould; when cool, remove from the mould, and put for 18 hours in a solution of 2 oz. of sulphate of alumina and 2 oz. of potash, dissolved in 1 pint of water; then dry in the oven for 4 or 5 days.

Recipe 251.—**Composition for Artificial Leatherboard.**

Process.—In this compo, leather scraps are shredded and then mixed with strong liquid ammonia, which forms a gelatinous mass. It is soluble in water, and has no elasticity until it is mixed with indiarubber dissolved in bisulphide of carbon, and well kneaded; the mass thus formed will become waterproof. It is then ready for being moulded or compressed so as to form heels for boots, or rolled out into sheets for "inner soles." The proportions of the several ingredients are: for heels, 25 parts of rubber dissolved in 80 parts of ammonia, and 80 parts of leather scraps; for soles, 25 parts of rubber (in solution), 67 parts of ammonia, and 67 parts of leather shavings. The composition can also be used for making leatherboard for box making.

Recipe 252.—**Composition for Artificial School Slates.**

Coat the surface of stout leatherboard, or millboard, with a compound prepared as follows :—

First smooth the surface with fine sandpaper, and then give a coat of glue size, then give two coatings of shellac varnish which has been prepared by moistening lampblack with "grain" alcohol, and sufficient of this colouring matter being stirred into the shellac varnish to colour it. When the second coat is dry, go over the surface lightly with sandpaper, or else rub down with pumice stone and water; then mix the following quantities of ingredients :—

$\frac{1}{2}$ lb. of orange shellac
$1\frac{1}{2}$ oz. of lampblack
$\frac{1}{2}$ oz. of ultramarine blue
4 oz. of washed flour of emery, and
4 oz. of very fine pumice stone;

stir well, and if too thick, add more alcohol; give two coats of the compound in rapid succession. When the surface is dry, it can be written on with soft slate pencils, or with chalk.

Recipe 253.—**Composition for "Carton-Pierre" Ornaments.**

Preparation.—Soak glue in cold water for a few hours and then drain off unabsorbed water; put 13 parts of the softened glue in a gluepot and melt it, then add :—

4 parts of powdered litharge
8 parts of dry whitelead
1 part plaster of Paris
10 parts very fine sawdust

The composition thus prepared is ready for use, and may be run into moulds (previously oiled, to prevent adherence), and when dry enough can be removed without breaking; it is dried in warm air.

Recipe 254.—**Artificial Leather Composition for Lithographic Rollers.**

Ingredients and Preparation.—Soften 20 lb. of glue in 5 lb. of cold water, and then melt the glue in the usual way, adding any unabsorbed water; when melted, put in 3 lb. of sugar which has been dissolved in the least possible quantity of water, then add 20 lb. of syrup (treacle), stir well, and then put in 3 lb. of nitrate of potash (powdered) and 1 lb. of oil of almonds; stir up well and pour round a core not less by half an inch in diameter than the mould. When the mass in the mould is cold, remove it and steep for 10 hours in a solution composed of 1 lb. of sulphate of alumina and 1 lb. of potash in 10 lb. of water; when taken out, dip it into a solution of formaldehyde of 40 per cent. strength for a few minutes; the mass can be made in sheets to form artificial leather; dry in the air for a few days.

Recipe 255.—**Porous Mass for Blotting Pads.**

Process.—Mix 7 lb. of plaster of Paris with 1 lb. of potato starch ("farina"), and mix with a little cold water, then pour the mass into shallow trays; when hard, the blotter is ready for use.

Recipe 256.—**"Slating" Composition for School Slates, etc.**

Process.—Melt together 1 lb. of pure Para rubber and 3 lb. of sulphur, powdered, and then stir in 16 oz. of good pumice-stone and 20 lb. of powdered animal charcoal; when the mixture is homogeneous, pour it out on to a flat surface, and when cooled to a plastic condition, roll it up into thin sheets and cut it into the desired shape and size. Make these sheets into piles as follows: lay down a sheet of the plastic mass, and then one of paper, then on this a layer of the above composition, then one of paper, then compo, and so on, until a dozen or more sheets have been laid on each other; then put the pile under pressure for a short time; next put it in an oven and heat therein for 2½ hours at a temperature of 266° to 285° F. When they are removed from the oven, each part, with the paper covering on both sides, is lightly compressed by passing it through two plates or rollers heated by steam, and then again subjected to the above temperature for 2 hours; when cool, the sheets are rubbed with pumice stone and are then ready for use.

Recipe 257.—**Composition for sharpening Slate Pencils.**

Process.—Soak 5 lb. of glue in cold water until soft, then drain the softened glue and dissolve it in 1 lb. of linseed oil by heating it therein in a gluepot, with constant stirring; then stir up 1 lb. of cement with water and sufficient fine sand to make a plastic mass or dough, stir this into the glue mass, and spread this composition on boards of wood, which are fixed to the walls so that they project a few inches; the school children can rub their slate or lead pencils sharp on this.

Recipe 258.—**Composition for "Slate" or "Black" Boards.**

Process.—Reduce slate to a very fine powder and rub up with water on a stone, allow it to dry, then rub it up again with a roller and mix it into a paste with glue-water, and boil the whole over a gentle fire. Then spread this mixture, in a uniform layer, on a board, and let it dry; then repeat the process until the coating has acquired a sufficient thickness, then pumice-stone its surface lightly, and apply an infusion of gall-nuts.

Recipe 259.—**Composition for Adhesive or Sticking Plaster.**

Process.—Put 5 oz. of litharge and 8 oz. of water into a copper pan, mix well, then add 12 oz. of olive oil, and boil it up, with constant stirring, for 4 to 5 hours, adding 1 oz. of white vinegar (acetic acid); continue the heating for 20 to 30 minutes, and then spread this composition on muslin or fine linen.

Recipe 260.—**Composition for "Court Plaster."**

(1) *Process.*—Put into a covered vessel, such as an enamelled saucepan, 1 oz. of genuine isinglass and 10 fluid oz. of water, and dissolve by slowly heating the fluid; strain the solution, and when only lukewarm add to it, gradually but quickly, a mixture formed of 2 fluid oz. of rectified spirit and 2 fluid oz. of tincture of benzoin, and while this mixture is still warm, spread it with a brush or other suitable spreader on the surface of silk or sarsanet, stretched on a frame, and repeat the coating as soon as the first is dry, do this 6 or 12 times; finally, when quite

dry and hard, give the prepared surface a finishing coat with a solution of 1 oz. of Chio turpentine dissolved in 2 fluid oz. of tincture of benzoin, tincture of balsam, of tolu, or of styrax (any of these may be used instead of the benzoin tincture). A few drops of ambergris or of musk may be added to increase the fragrance of the compound. In applying the first few coats of the composition, be careful that they do not soak into the fibre so as to appear on the right side of the fabric, as that would spoil the appearance of the material; the secret lies in not applying the compound too hot to the fibre, but only sufficiently warm to remain liquid.

(2) Apply to the surface of the silk, stretched on a frame, a thin solution of flour paste, allow to dry, and then give it a coat, three times in succession, of thin gelatine size, warm, which has been prepared with a suitable tincture or perfume.

(3) Put into a covered jar 1 oz. of isinglass and 2½ oz. of water, and keep the jar in a warm place until the isinglass has swollen and absorbed all the water and become quite soft, then heat it to a uniform semi-fluid mass, and strain it by squeezing it through muslin; add 3¼ fluid oz. of proof spirit, stir the mixture constantly in a covered vessel to a gentle heat, then give 4 applications of the fluid to the oiled silk stretched out on a board. The isinglass mixture can be japanned with a little aromatic tincture.

Recipe 261.—**Composition for burnishing Photographs.**

(1) Dissolve 1 oz. of paraffin wax in 10 oz. of benzine, and separately rub up in water ½ oz. of ammonia with just sufficient alcohol to prevent it sticking to the pestle when grinding; then mix the wax solution with the other solution, shake well for use, apply to the photograph with a piece of flannel or rag, and burnish with it in the usual way with a roller.

(2) Lubricant for hot burnishing photographs.

Dissolve 1 part of Castile soap with 100 parts of alcohol, and then dissolve therein 1 part of white wax.

(3) Dissolve 4 grains of Castile soap in 1 oz. of absolute

alcohol, rub this over the surface of the print, allow to dry, then burnish.

Recipe 262.—**Ordinary Burnishing Solution.**

Dissolve 4 grains of Castile soap in 1 oz. of absolute alcohol, rub this over the surface of the print, allow to dry, then burnish.

Recipe 263.—**Composition for making Ink Pencils.**

(1) Mix 1 oz. of manganese dioxide finely powdered with 16 of thoroughly dried ultramarine, add together a solution of nitrate of silver dissolved in 10 of distilled water, rub up the mass and knead it thoroughly, and cut up the dried mass into sticks.

(2) Mix different aniline dyes, such as magenta or methyl violet, with graphite and kaolin, make the mixture into a paste with cold water, and pass it through a sieve or filtering bag so as to divide the mass into slender sticks, which are used in filling the wooden part of the pencils, this part or sheath which is in two pieces, is then glued together in the usual way.

Recipe 264.—**Indelible Pencils.**

(1) Pencils to be used for marking linen, are prepared by reducing nitrate of silver to a fine powder, and then adding just sufficient pure carbon black to give it a black colour and sufficient thick solution of gum arabic in the water to make the powder coherent; rub the ingredients well together, form them into thin sticks and dry.

(2) Make into a stiff paste 5 oz. of soft water, 8 oz. of kaolin, 2 oz. of finely powdered magnesia, 3 oz. of silver nitrate powdered. It is best to mix the powders together by sifting them through a sieve several times before making into a paste; a more intimate incorporation thus occurs. When perfectly dry the mass is pressed into the grooves in the wood to form pencils.

Recipe 265.—**Composition similar to Faber's Pencils.**

Very soft.—Composed of 50 parts of arabic, 375 parts of graphite, 12·5 kaolin.

Soft.—34 parts of graphite, 24 parts of kaolin.

Hard.—30 parts of graphite, 40 parts of kaolin.

Very hard.—25 parts of graphite, 50 parts of kaolin.

These materials are powdered, carefully mixed and afterwards made into a paste with cold water; when the paste is perfectly homogeneous it is passed through a wire sieve which divides it into shapes of a suitable dimension, then dried in an ordinary manner, and afterwards fitted to wooden sheaths.

Recipe 266.—**Composition for Pencils to write on Glass.**

(1) Mix, by heating together, 1 oz. of lampblack, 4 oz. of white wax and 1 oz. of talc.

(2) Mix 4 oz. of zinc white, 2 oz. of white wax, 1 oz. of tallow white.

(3) Mix 1 oz. of Prussian blue, 2 oz. of white wax.

(4) Mix 3 oz. of Prussian blue, 1 oz. of gum arabic, 2 oz. of talc dark blue.

(5) Mix 1 oz. of chrome yellow, 2 oz. of wax.

The tallow and wax are warmed together, and then the colouring matter stirred in and allowed to cool until it has acquired the proper consistence to be transferred to the press, the materials are treated and shaped in a similar manner to that in which graphite is treated in making writing lead pencils.

Recipe 267.—**Composition for Papier-Maché.**

This material, which was very much in vogue in the early Victorian period for table tops, trays, fire screens, etc., is made from old paper and other cellular materials made into a paste by grinding with milk of lime with the addition of a little dextrine or starch. The pulp is then pressed into form, coated with linseed oil, baked at a high temperature, and finally varnished or japanned. Sometimes kaolin, chalk and other mineral substances are mixed with the paper pulp, sometimes the material is made by mixing a part of pulp with recently slaked lime. The materials may be rendered more or less waterproof by the addition of sulphate of iron, quicklime and glue, or white of egg, and by the addition of borax and phosphate of soda.

Papier-maché snuff boxes, etc., are prepared by pasting or glueing paper together, and submitting to pressure by which the composition acquires the hardness of board. When such articles are dry they are perfectly waterproof.

Papier-maché floor coverings.—Before the introduction of linoleums, a floor covering was prepared from paper pulp, the process being carried out as follows:—The floor boards were thoroughly cleaned and all cracks and crevices filled up with putty made by soaking newspaper in a paste made of wheat flour, water, and ground alum in the proportion of 1 pound of flour to 3 quarts of water, a tablespoonful of ground alum being stirred into the flour paste and the paper pulp mixed with it.

This paste was spread over the floor boards, and on top of it a thickness of manilla was placed; sometimes a second layer of such was used, there being a layer of paste between the first and second layer. The whole was allowed to become perfectly dry, then another coating of paste was spread, which was covered with a layer of stout paper to impart a pattern to the surface. When the whole was dry it was given two coats of size, made by dissolving ½ pound of white glue in ½ gallon of hot water, and when that had dried, the surface was varnished with hard oil varnish.

Recipe 268.—**Papier-Maché Compounds.**

The following particulars are taken from an article on the production of this material which was given in the "British and Colonial Printer":—

The name "papier-maché" signifies a masticated, chewed, or minced preparation of paper, or paper pulp, with a mixture of various crude mineral and animal or vegetable substances, the same being more or less finely connected by various materials. The principal admixture to the paper fibre, for the purpose of loading and filling, consisting of various proportions of earthy or mineral matters, such as chalk, clay, lime, gypsum, barytes, and of mineral materials, as ochre, umber, red chalk, coal dust, lampblack, fine sawdust, etc., and excellent results have been obtained of late years by plain and saponified rosin (resinates).

The substances forming the bulk of papier-maché, are combined, according to requirements, with various adhesive materials, amongst them being glue, gelatine, casein, flour and gum arabic, dextrine, Iceland moss, or similar gelatinous bodies, resins, or wax. All these ingredients may be prepared and conglomerated and agglutinated in an indefinite variety, in accordance with the quality of articles to be made.

The following is a list of the various formulæ used for making papier-maché.

(1) Boil and stir into a uniform mass 24 parts of paper pulp and 40 parts of clay which has been previously rubbed into a paste with its own weight of water, and 24 parts of a fluid solution, made by dissolving 4 parts of solid casein in 20 parts of weak liquid ammonia.

(2) Boil and stir together as above,

12 parts of water
6 parts of dry pulp
8 parts of chalk, and
1 part of glue.

Ditto.

(3) Use 2 parts of water
2 parts of clay or chalk
2 parts of pulp
1 part of starch solution (*i.e.*, starch paste).

(4) Take 2 lb. of paper pulp, boil it in 4 to 6 lb. of water with 1½ lb. of finely powdered talcum, 1½ lb. of rye flour, ½ lb. of unslaked lime: boil 1 lb. of starch in 8 lb. of water, pour boiling starch water on the mixture and stir it into an even paste. Let the matter rest for a few days, then pour off the excess liquid, and allow the matter to rest again for several days. The dough may be pressed into any shape, and will become so hard that it can be turned, on the lathe, into pipes, handles, etc.

(5) Use 1 part of paper pulp, 2 parts of rosin size (dissolved in soda solution, and precipitated by an acid, washed, dried, and

dissolved in linseed oil, or other solvent, *i.e.*, soda resinate), 1 part of china clay, or common loam, and 3 to 4 parts of water; boil and stir until of a uniform mass.

(6) Use 2 lb. of pot-cheese, made of skimmed milk
1 lb. of dry resin
½ lb. of soda ash
1 to 2 lb. of paper pulp
2 lb. of water. Boil 1 hour, straining as usual.

(7) Use 2 lb. of fine white sulphite pulp, ½ lb. of china clay, diluted with 5 lb. of water. Separately stir ½ lb. of starch in 1 lb. of water, and add it to the liquid clay mixture. A pulp of similar composition is used for architectural ornaments.

The glue is prepared for use by soaking it in 4 times its weight of cold water, for 10 to 12 hours, and then melting it by boiling in a gluepot.

The casein is prepared by mixing 10 parts of dry casein with 40 parts of water, adding 1 part of soda ash, and boiling until dissolved.

In the case of "pot-cheese," 4 lb. of it is equal to 1 lb. of the dried casein.

Instead of soda ash, or washing soda, 40 parts of casein may be dissolved in water containing 15 parts of boracic acid, which will prevent decomposition. Casein and resinous compounds are very tenacious and agglutinative.

The paper fibre, or pulp, is obtainable from manufacturers for ordinary purposes. Good wood pulp, and for better grades, the so-called "sulphite" consisting of pure wood cellulose, is all that may be required. For making papier-maché goods on a large scale, a beating engine is almost indispensable, for the purpose of disintegrating these felted sheets into single or loose fibre of suitable dimensions.

Rosin soap is a commercial article (chemically known as "resinate of soda.") It can be easily made as follows: Put 100 oz. of water (5 pints) into a jacketed kettle, or gluepot, with 112 oz. of soda ash, and boil until the latter is dissolved, then gradually adding, stirring all the time to prevent the formation of lumps, 100 oz. of crushed rosin. As the carbonic acid gas escapes from the soda, it will rise through the fluid, causing the mixture to swell up, and a lot of foam will be formed. To prevent the fluid boiling over, remove the vessel, so as to reduce the heat, or stir the fluid with a stick; then continue the boiling until the matter assumes a more quiet and settled condition, finally appearing in a transparent state, of the natural colour of rosin. When there is not much pressure required, plaster of Paris is used for forming the moulds and patterns. The preparation of the plaster for casting is carried out as follows:

Partly fill a flat pan with water, into which pour the plaster of Paris gradually through a fine sieve, until the gypsum appears to be sufficiently saturated, stirring only enough to produce a flowing liquid. Use this at once, as it becomes solid very soon, and therefore unworkable. Never pour the water into the plaster, otherwise you will find lumps of an uneven texture, because the plaster of Paris has been deprived of some of its water of crystallisation by calcination of the native gypsum, or sulphate of calcium, of which the plaster consists, and when plaster comes in contact with water it readily combines therewith and forms a non-crystalline form in long acicular crystals, which are interlaced and form a hard mass.

The pattern of which you want to form a mould should be coated with olive oil, or a solution of soap and water to which some oil may be added, before casting the plaster.

To cast the pattern, place the pattern on a table, and round it build a wall of wood, pasteboard, or of gypsum, so that a basin will be formed of suitable depth preventing the gypsum flowing away, or a light wooden box, or even a cardboard box, such as drapers use, of a suitable size, may be used in which to place the pattern.

Patterns of faces, or of bell-shaped articles, have to be made in two or more parts. For that purpose, either cut the pattern into two, or paste strips of paper round the middle. Two moulds are now made, obtained by first oiling the pattern, and by pouring the gypsum gradually over the surface in a thin stream, to avoid the forming of bubbles. Some patterns, not having sufficient depth, or having undercut parts, require to be made in various sections, so shaped as to allow them to be lifted from the original. Before casting a papier-maché solution into a plaster of Paris mould, the latter should be coated with a solution of shellac in alcohol. The rapid drying of the wet plaster causes inconvenience; but that process can be prolonged by preparing a boiled saturated solution of borax in water and by adding 1 part thereof to 4 to 12 parts of the gypsum water, whereby the drying of the plaster is prolonged, according to the proportions adopted. Various means are employed for hardening and strengthening the plaster cast; coarse paper, fibre, shreds of canvas, iron filings, wire, strips of calico, etc., are often interspersed.

To the paper in water, a thin solution of glue is added, while a solution of alum has good results, and a small percentage of slaked lime works well (*see* Working of Plaster of Paris). One part of alum, dissolved in 10 parts of water, will harden the plaster cast, when brushed on it; while, if the cast be steeped in the fluid for several weeks, it becomes as hard as pottery.

The application of boiled linseed oil to the plaster cast renders it impervious, and the oil should be applied with an addition of a solution of shellac in alcohol; dipping the casts in a bath of melted paraffin wax, produces an imitation of alabaster.

The painting and varnishing of papier-maché goods is carried out in various ways. In some cases a cheap water-colour may be used, in others, resin varnish may be sufficient, or a coating of a resinous substance in alcohol, or of copal varnish. Asphaltum or japan varnish is also used, and this can be dried cold, or baked in hot-air ovens.

Recipe 269.—**Paint for Papier-maché.**

An excellent water-colour is made by first soaking 100 parts of white china clay in 80 parts of water during several hours, then stir this cream well and add a proportion of 19 parts of casein, dissolved by boiling, in 75 parts of water in which

2 parts of soda ash has been dissolved; stir and strain the mixture through a fine sieve, apply the solution with a soft brush on the warm sheets.

Recipe 270.—**Lacquers or Varnishes for Papier-maché.**

Suitable coating compounds are prepared as follows. Put in a bottle or tin can, and stand in a warm place, the ingredients mentioned in the recipes given below.

(1) 3 oz. of shellac
2 oz. of lampblack
½ pint of alcohol, or methylated spirit.

(2) 2 oz. of resin
3 oz. of carbon black
10 oz. of alcohol.

(3) 17 oz. of shellac
9 oz. of resin
8 oz. of dragon's blood
5 pints of turpentine.

(4) 16 oz. of shellac
5 oz. of sandarach resin
3 oz. of mastic resin
130 oz. of alcohol.

(5) 10 oz. of sandarach resin
3 oz. of mastic resin
2 oz. of venice turpentine
5 oz. of alcohol.

(6) 6 oz. of shellac
10 oz. of gamboge
1 oz. of gypsum
50 oz. of alcohol.

This last forms a good varnish but is expensive.

N.B.—Many other suitable formulæ for varnishes will be found in the author's book, "The Practical Polish and Varnish Maker."

Recipe 271.—**Celluloid Cements for Plaster Casts.**

Process.—Cut up some celluloid and put it into a wide mouthed bottle or gluepot, pour on sufficient sulphuric ether to cover the pieces of celluloid, cork up tightly and shake the bottle well, and do so frequently until all the celluloid has dissolved; then decant the clear liquid into another bottle, and use the gummy portion that has settled at the bottom of the first bottle as a cement. It will dry quickly, and is insoluble in either hot or cold water.

Recipe 272.—**Waterproof Paper for Walls that are to be varnished.**

Process.—Dissolve $\frac{3}{4}$ lb. of crystallised carbonate of soda and $\frac{1}{4}$ lb. of borax in 5 gallons of water, separately dissolve 1 lb. of window glass resin in 8 oz. of benzine, and stir the fluid into the soda alkali solution, boil until the resin has dissolved. For use, 1 lb. of the mixture is mixed with $3\frac{3}{4}$ gallons of water, and then this solution mixed with 4 gallons of water, to which has been added 2 lb. of glue dissolved in it by heating, then the whole mixture is boiled for $\frac{1}{2}$ hour and strained for use.

Recipe 273.—**Waterproof Composition for Paper Bags, Envelopes, etc.**

Process.—Mix 4 lb. of starch in sufficient cold water to make a smooth thick batter, separately dissolve 2 lb. of resin in a lye composed of 25 oz. of potash dissolved in 5 pints of water, and pour the starch batter into this while boiling, stir the starch thoroughly until cooked, then pour on 25 oz. of boiled linseed oil and heat the mixture until it is homogeneous, then coat one side of book muslin with the composition, laying sheets of paper on the coated side of the muslin, and pass the two between rollers to cause adherence between the muslin and paper, and at the same time remove all superfluous agglutinant. Dry the paper at 106° F., when the paper is ready to be made into bags, envelopes, etc., which are untearable.

Recipe 274.—**Waterproof Composition for Paper.**

Process.—Soak 100 oz. of lime in water, and dissolve 100 oz. of soda in water, then boil up the soda solution and add sufficient milk of lime (*i.e.*, of the lime water) to make it caustic. Separately melt 27 oz. of resin, and ½ oz. of gamboge together by heating, and when melted, pour it into the soda lye until no more resin is dissolved; then allow the mass of soda resinate that is formed, to cool and congeal to a solid mass. For use, dissolve 1 oz. of the compound in 10 oz. of water and steep the paper in it, and then pass through a 10 per cent. solution of alum water, and dry the paper.

Recipe 275.—**To prepare Rubber for printing on.**

Process.—Sprinkle the rubber with farina before vulcanizing it, when it can be printed on with printing inks in the usual way.

Recipe 276.—**Casein Composition for sizing Paper and other Materials.**

Process.—Take the curd from milk (*see* Casein), and press it through rollers revolving towards each other, so as to press out all fluid, and then convert it into a coarse powder by quick drying and pulverizing or triturating, then rub up the powder with 1 part of tungstate of soda; this compound, when mixed with dyewood colours gives various tints. By steeping cotton or linen in this compound, and then drying and passing through a solution of logwood, a violet-coloured tint is produced; by passing through acid, or solution of mineral salts, various colours are obtained on the fibre.

Recipe 277.—**A "pegamoising" Composition.**

Process.—Take casein that does not contain much buttermilk, and curdle it by the addition of a little hydrochloric acid, and then wash the curd rapidly with water until all acid reactions cease (this is ascertained by dipping slips of blue "litmus" paper in the wash-water; when the colour of the paper remains unchanged it indicates that all acid has been washed away). Then press and dry the curd, and mix it with sodium tungstate in a boiling oven or water bath until the casein is dissolved, when a few drops of oil of cloves should be added as a preservative. This compound is soluble in water in all proportions, but when once dry becomes practically waterproof, and can be used for coating (*i.e.*, "pegamoising") wall-papers and other material to render them waterproof and glossy; a little glycerine, added to the compound, renders it flexible.

Recipe 278.—**Composition for preparing Carbon Paper.**

Process.—Melt 10 oz. of lard and 1 oz. of wax, and mix with a sufficient quantity of carbon black to saturate unglazed paper with the fluid while hot, and press between rollers to remove excess of the compo.

Recipe 279.—**Compound for preparing Copying, or Manifold Paper.**

Process.—Mix 40 parts of Berlin blue with 80 parts of olive oil, to which 1 part of glycerine has been added. Mix these ingredients together, and then leave the compound exposed to a temperature of 40° to 50° C. for a week, then grind the mass as fine as possible in a paint mill; separately melt ½ part of yellow wax with 7½ parts of ligroine, and mix with the 3 parts of the above blue mixture, mixing slowly at a temperature of 30° to 40° F. so as to give a mass of the consistence of honey. Apply it to the paper with a brush, and afterwards spread it evenly over the paper by means of a badger's-hair brush until the surface is slightly polished, then dry the sheets of paper on a table heated by steam—a few minutes suffices for the operation—when the sheets of paper are ready to be packed for sale.

The above gives a black copying paper, but for all black paper aniline black alone should be used.

Recipe 280.—**Agglutinant to prepare Draughtsmen's Paper.**

Dissolve 1 oz. of gum dragon in 10 oz. of water, and strain the thick mucilage through muslin, sponge over the paper with the gum dragon mucilage as evenly as possible; when dry, oil or water colours can be used on it for colouring plans, etc.

Recipe 281.—**Emery Cloth.**

Paper is taken and coated on the one side with a thin solution of glue, and before the glue congeals, emery powder of various grades is sifted on it, and the paper then hung up to dry, cut into sheets, and packed ready for sale, after being stamped with the name of the maker. Unless the emery powder is very uniformly sifted on, the coating on the paper may not give uniform results as regards its abrading properties, and to secure uniformity mix 30 to 50 per cent. of emery powder with the paper pulp that is used in making cardboard; then pour out the pulped mass into cakes of 1 to 10 inches thick, and then press these cakes. A block of this composition will adapt itself to the form of article to be abraded, and will be serviceable until completely worn out.

Recipe 282.—**Composition for non-poisonous Fly Papers.**

Digest for 12 hours 8 oz. of quassia chips in 1 quart of water, then strain and boil down to 1 pint; separately boil the chips with 1 pint more of water, and evaporate until only ½ pint remains, then mix the two infusions, and dissolve in the fluid 4 oz. of sugar; steep bibulous paper in this fluid, and dry it.

Recipe 283.—**"Catch-'em-alive-O!" Fly Papers.**

Process.—Steep the sheet in a mixture of linseed oil and turpentine (equal parts), then dry, and afterwards coat one side with a solution of resin dissolved in oil of turpentine, or 1 lb. of resin and 10 oz. of linseed oil melted together, and spread on paper; lard, or colza oil (lamp oil) may be used instead of linseed oil, or the addition of honey to the mixture may be made to prevent it drying too quick.

Recipe 284.—**Glass Paper for Cabinet Makers.**

Process.—This paper is made in a way similar to emery cloth, thus: stout paper is coated on one side with a glue solution, on which is dusted, in half-a-dozen degrees of fineness, powdered glass-dust, obtained by pulverizing bottles and elutriating the powder, which is sifted through wire sieves made of wire cloth in cylindrical form like the 'bolts' of flour mills. The cloth has from 16 to 90 wires to the inch.

Recipe 285.—**Iridiscent Coating for Paper.**

Ingredients and Preparation.—Boil together—

$6\frac{3}{4}$ oz. of gall-nuts, powdered
$4\frac{1}{4}$ oz. of sulphate of iron
$\frac{3}{4}$ oz. of sulphate of indigo
18 grains of gum arabic

Strain the mixture through a cloth, and brush it over the paper, then expose it to the fumes of liquid ammonia.

Recipe 286.—**Composition for preparing Lithographic Paper.**

Process.—(1) First give the paper a coating of sheep's-foot jelly (sheep's feet boiled in water until the fluid jellifies on cooling), then allow it to dry, afterwards give a coating of cold white starch paste, and upon this a coating of gamboge.

(2) Make a starch paste in the usual way, separately dissolve gum arabic and alum in sufficient water, and mix these ingredients into a stiff paste, in the proportion of 6 parts of starch paste, 2 parts of gum arabic, and 1 part of alum; coat strong, unglazed paper with this compound, applying the mixture hot with a flat, smooth brush. The paper is then suitable for being written on with lithographic ink. The paper is best dried by passing it through warm rollers.

cf. 466 *Recipe* 287.—**Composition for preparing Luminous Paper.**

Process.—Dry thoroughly, and mix by grinding 3 oz. of bi-chromate of potash, 37 oz. of calcium sulphate (gypsum), 3 oz. of gelatine; mix 1 part of the powder with $1\frac{1}{2}$ parts of boiling water to a thick paste, and give one or two coats to the paper to be made luminous. The longer the coated surface has been exposed to the light, especially sunlight, the longer will the paper remain luminous when taken to a dark room.

Recipe 288.—**Preservative Paper for wrapping up Meat and Foodstuffs.**

Process.—Melt 12 oz. of stearic acid at a moderate heat, then put in 5 oz. of carbolic acid, and 12½ oz. of paraffin wax, incorporate by heating and stirring, then allow to cool, but continue the stirring until the mixture is solid. The paper to be converted into a preservative paper is piled in sheets, the top sheet warmed by passing a hot flat-iron over it, then a coating of the above compound is rubbed over the hot paper until the composition is melted and saturates the paper, then the sheet is removed and put to dry.

Recipe 289.—**Composition for preparing Transfer Papers.**

Process.—(1) Rub into thin white paper a mixture of 6 parts of lard and 1 part of beeswax, melted together by heat, with sufficient fine carbon black to give it a good colour. Apply the composition warm, and not too much of it, to the paper.

(2) This is made under exactly the same conditions; the compo consisting of 2 oz. of tallow, 1½ oz. of powdered graphite (plumbago or "blacklead"), 5 fluid oz. of linseed oil, and sufficient lampblack to produce a creamy consistence.

(3) **Composition for preparing Lithographic Transfer Paper.**

Process.—Dissolve ½ oz. of gum dragon in cold water to form a thick mucilage, then strain it through blotting paper (the gum will take several days to soak through), and add 1 oz. of glue and 1 oz. of gamboge; then take 4 oz. of French chalk, ½ oz. of plaster of Paris, 1 oz. of starch, reduce all these to fine powder, and sift through a fine sieve; then grind up the mixture with the gum fluid and gamboge combined, adding sufficient water to give it the consistency of oil, and apply with a brush to the thin sized paper.

Recipe 290.—**Composition for rendering Paper transparent.**

Process.—Put 2 oz. of lead turnings into 1 pint of linseed oil, together with 10 oz. of oxide of zinc and 1 oz. of Venice turpentine, and boil the whole slowly for about 8 hours, then allow to cool, stir well and put in the following: 10 oz. of white copal resin, $2\frac{1}{2}$ oz. of sandarach resin, and heat until dissolved; then saturate the paper with this compound, remove the surplus varnish by brushing, and then dry the sheet of paper by passing it through hot rollers.

Recipe 291.—**Composition for rendering Drawing Paper transparent.**

Process.—Dissolve pure castor oil in two or three times its weight of absolute alcohol, mix well and sponge the paper with the fluid; as the alcohol evaporates it will leave the "fixed" oil in the pores, which will render the paper so transparent, that it can be used for tracings with either lead pencil or Indian ink. After the tracings are done, the castor oil can be extracted from the paper by soaking it in absolute alcohol, drying off, and repeating the application, until the oil is exhausted (extracted), when the paper will resume its original opaqueness. The ink should be water and moisture proof.

Casein as an Agglutinant and Sizing Material for Paper.

Practically speaking, the employment of casein in paper making is only in its infancy, as the full capabilities of this substance are not yet developed. Owing to the permanent nature of casein it should be a much more suitable article than resin, glue, and other sizing bodies now so frequently used; particularly so is this the case, because casein is a substance that is not decomposed by alkalies, as glue is; it, in fact, is a body which depends on alkalies for its solution, so that it is very well suited for mixing with paper pulp for the production of different kinds of papers. As a material for making coating compounds for "art" papers, the writer has made many experiments with good results, as many of the solutions of casein that can be made with various solvents give coating compositions that are adherent, flexible, take a polished and smooth, and, if desired, a tinted surface, while the ink impression is very good.

A few such solutions are given in the section on "Casein: its Physical and Chemical Properties." There is also a useful book on "Casein," published by Messrs. Scott, Greenwood & Co., which is a translation from a German work on the subject; that book contains much of useful data concerning the capabilities of casein in the paper industries. It is not within the scope of this book to treat of casein in detail; all that can be done is to give the processes by which casein can be made into solutions suited for the paper maker.

CHAPTER IV.

AGGLUTINATIVE COMPOUNDS USED IN THE TEXTILE AND LEATHER INDUSTRIES.

THE "dressings," "sizings," and other agglutinants used for the finishing of textile materials are usually composed of resin, glue, size, and glycerine compounds, while in the leather trades they consist of flour pastes, glue sizings, shellac solutions and various other compounds. The formulæ given in this chapter will be found to be such as will serve as a guide for the production of any special kind of cement or agglutinant.

As the cements, etc., are so very diverse in their natures, it would be impracticable to classify them.

Recipe 292.—**Wax for waxing Threads to be woven.**

Melt $2\frac{1}{2}$ oz. of beeswax, add $\frac{1}{2}$ oz. of powdered "soapstone," and then stir in 2 oz. of graphite.

Recipe 293.—**Waterproofing Compound for Fish Lines.**

Mix, by melting together, beeswax and shoemakers' wax, a greater quantity of the latter in cold weather, the reverse in hot weather.

Recipe 294.—**Shoemakers' Wax.**

Process.—This wax is made by melting together the best Swedish pitch and tallow in a vessel placed over a slow fire; the quantity of tallow is best determined by experiment. Roll the mass into balls, and keep them plastic by steeping in water. The right kind of pitch is of a brown colour when broken. For further formulæ for these waxes, see the Author's book, "The Leather Worker's Manual."

Recipe 295.—**Curriers' Paste for the Flesh Side of "Waxed" Calf and "Split" Leathers.**

Ingredients and Preparation.—Make a batter with 3 quarts of flour and 1 gallon of cold water; cut up $2\frac{1}{2}$ lb. of mutton tallow, 3 oz. of beeswax and 3 oz. of resin powdered, and stir all these ingredients into the flour batter, separately soak 1 lb. of glue in 3 gallons of cold water, and then melt the glue in the water by heating in a gluepot, then pour the boiling hot glue solution into the flour mixture, or else pour the water into the boiling glue fluid and let the mixture boil for a quarter of an hour, then put in 6 oz. of Castile soap cut up in shreds, stirring them in while the mixture is at the boil. When the whole is of a homogeneous nature, it is ready for use. It is applied cold to the flesh side of the leather with a sponge, and the pasted surface is finished by an application of a compound consisting of 1 part of the above paste mixed with 3 parts of gum dragon mucilage to the consistence of thick cream.

Recipe 296.—**Flour Paste for "Upper" Leather.**

Ingredients and Preparation.—Make $\frac{1}{2}$ gallon of flour into a thick batter with sufficient cold water, then heat it until it boils, and while boiling hot put in 1 lb. of hard brown soap cut up in shreds, $\frac{3}{4}$ lb. of mutton tallow, and $\frac{1}{2}$ oz. of beeswax cut up small; continue the heating of the mixture at the boil until the ingredients have dissolved. The paste is then ready for use and should be spread on the leather with a brush, and when dry smoothed down with a "slicker," or under a rolling or glazing machine.

Recipe 297.—**Size Paste for Curriers' Use.**

Ingredients and Preparation.—Soak 1 lb. of good glue or gelatine in cold water until it will not absorb any more water without breaking, then draw off unabsorbed water, and melt the softened glue in a gluepot, at the boiling temperature, and while boiling hot stir in 1 oz. of mutton tallow; then dilute with sufficient hot water to make the compound of a suitable consistence for use. This paste is usually laid on the leather with a sponge.

Recipe 298.—A Flour Paste for "Split" Leather.

This is made with similar materials and in the same manner as the last, but only $\frac{1}{2}$ lb. of common tallow should be used and 1 lb. of mutton tallow; the compound being of a jelly-like consistence when cold.

Recipe 299.—Curriers' Size.

Ingredients and Preparation.—Put $1\frac{1}{2}$ gallons of glue size into a gluepot or steam-jacketed kettle, and raise to the boil, then put in $1\frac{1}{2}$ pints of soft soap, or 3 pints of "stuffing" grease, and mix well.

Recipe 300.—Scar Paste for Leather Dressers.

This is used for covering up scratches, warble marks, etc., in the "grain" side of leather to be blackened or what is technically called "smutted."

Ingredients and Preparation.—Soak 5 oz. of gelatine in 1 quart of cold water, and then dissolve it by heating; separately dissolve 4 oz. of logwood extract (solid), $\frac{1}{4}$ oz. of bi-chromate of potash, $\frac{1}{4}$ oz. carbonate of potash, and 1 drachm of sulphate of potash in 2 quarts of cold water, and stir this into the gelatine solution and raise to the boil.

Recipe 301.—Shoemakers' Paste.

For pasting the canvas linings to the uppers or stiffeners.—(1) Dissolve 1 oz. of alum in 1 gallon of tepid water, then add sufficient rye or wheat flour to the solution to make a batter of the consistence of cream, being careful to break up all lumps of flour; put this batter into a vessel over a water bath or in a steam-jacketed vessel, and allow it to boil, then sprinkle into it 1 oz. of yellow rosin, finely powdered, and stir the mixture until it becomes a stiff paste; when cool put into stone jars and cover over with a lid to prevent the air drying the surface.

(2) Soak 2 oz. of good glue in $5\frac{1}{2}$ pints of cold water for 12 hours, then put the softened glue (and any unabsorbed water)

into a gluepot and heat it until the glue has melted, then add 3 to 4 gallons of hot or cold water (the better the quality of glue the more water it will absorb); separately make a smooth batter by rubbing up 15 lb. of starch in one gallon of cold water, boil up the glue and while boiling hot slowly pour in the starch batter, stirring all the time, then mix in sufficient carbolic acid to prevent the mass souring or turning mouldy (*i.e.* fermenting); 1 to 2 oz. of either of these antiseptic bodies will be sufficient.

Recipe 302.—**Paste for Sole Leather.**

Mix sufficient rye flour with 1 gallon of cold water to make a smooth batter of a creamy consistence, or boil the batter in a steam-jacketed vessel, and then add 1 gallon of gum dragon mucilage: separately mix 8 oz. of American isinglass, 1 quart of boiling water, and stir it until it has dissolved, and allow the mixture to cool; then mix in 2 oz. of oxalic acid and 2 oz. of gamboge in powder, 1½ lb. of pipeclay powdered with sufficient water to make a thick cream, and mix this compound with the flour paste; stir well and let it rest for a few days before using.

This compound is used for coating the soles of boots to give them a smooth finished appearance, a polish being effected by slicking the soles.

Recipe 303.—**Glue Cement for affixing Fabrics to Metal (such as Plush, Velvet, Cloth, etc.).**

Process.—Cleanse the metal of all grease with some soda, water and soap, dry with a cloth, then cement the metal with the juice of onions, and press on the surface some fairly strong, clean white paper, smoothing it out so that there are no wrinkles. When the paper has dried it will adhere firmly, and stand being coated with ordinary hot glue. The plush, or other fabric, must be pressed fairly into the glue before it sets.

Recipe 304.—**Glue Cement for Leather Articles.**

Ingredients and Preparation.—Mix 8 ox. of rye whisky with 8 oz. of water, and mix this with 2 oz. of starch and make into a batter; separately soak $\frac{3}{4}$ oz. of glue in 1 oz. of water until soft, then melt the glue and add to it 1 fluid oz. of oil of turpentine; stir well, and while the solution is near boiling heat, pour in the starch batter, and stir thoroughly until the whole is mixed.

Recipe 305.—**A useful Cement for fixing Leather to Metal.**

Process.—Soak glue in its own weight of cold water for 24 hours, and then dissolve it by heat in the usual way; meanwhile, digest for 6 hours 1 oz. of crushed gall-nuts in 8 oz. of boiling water and stir, and, to cement the leather to the rough metal surface (it should have been roughened with a file), dab the leather with a sponge dipped in the gall solution, apply the glue to the metal surface, lay on the leather, and press it until the cement is dry.

Recipe 306.—**Glue for fixing Leather to any Surface.**

Process.—Mix 5 fluid oz. of malt vinegar with 1 pint of hot glue solution, and then dissolve in it $\frac{1}{2}$ oz. of isinglass, and heat and stir until well mixed.

Recipe 307.—**Glue Size for bronzing Cloth.**

Process.—Mix a little honey with a thick solution of glue, and when well mixed, reduce to a suitable consistence with a thinner glue solution. Apply this size to the fabric where required, and then dust on the "bronzing powder" or lay on gold-leaf.

Recipe 308.—**Composition for imparting to Textiles a Leather-like Surface.**

Ingredients and Preparation.—(1) Soak 1 lb. of gelatine in cold water for 5 hours, then draw off the surplus water and melt the softened gelatine in a gluepot, add 5 oz. of glycerine and any suitable aniline dye, or colouring matter, and enough Para rubber (shredded small) to give elasticity, and sufficient boiled oil to render the whole sufficiently flexible; then spread the composition on linen, while hot, and put through an embossing machine. To print the pattern desired, next treat the surface with a solution of alum, or sulphate of zinc, sulphate of copper, or sulphate of iron. These salts render the composition insoluble in water; a finish may be given by varnishing or bronzing.

(2) Boil linseed oil with quicklime and borax; this forms a liquid which, on cooling, becomes a thick paste. It is then mixed with cork and more quicklime.

Recipe 309.—**Composition for preparing Artists' Canvas.**

Process.—Mix together by sifting 1 part of dry white lead, 3 parts of dry whiting, and a small portion of litharge, 6 parts of sulphate of zinc for driers, and a small quantity of colouring matter to give a suitable tint, then mix the whole into a paste with equal parts of raw and boiled linseed oil. The compound thus prepared is spread on the canvas as follows: The canvas is stretched on frame and sized with weak glue size to which a small quantity of sulphate of zinc has been added. When this size is dry, it is "stippled" all over with some drier and raw linseed oil, as thin as possible, not saturated; when nearly dry, the white lead and whiting composition is mixed very smooth by passing it through a cone paint mill, and spread on the canvas with a large palette knife, and "hatched" over with a large "sash" tool, drawing it across one way and then another at right angles until the face presents a scratched appearance; then it is left to dry, and afterwards made more or less smooth by sandpapering.

Owing to the chemical changes which white lead sets up in many paints, it would be better to dispense with the white lead (which is a carbonate of lead mixed with hydrate of lead), and use sulphate of lead instead, or else 3 parts of oxysulphide of zinc and one part of oxide of zinc, the other ingredients being those mentioned above.

Recipe 310.—**Black Composition for Carriage Aprons.**

Ingredients and Preparation.—Soften 2 lb. of glue in water, then melt it in a gluepot, separately cut up and melt 4 lb. of white soap in as little water as possible and stir it into the glue solution, and then add 1 lb. of yellow wax and 1 lb. of neat's foot oil. When all these have been mixed, add sufficient lampblack to colour the compound.

Recipe 311.—**Composition for Peaks of Motor Caps.**

Process.—Mix in a suitable vessel 4 lb. of wax, 2 lb. of catechu, 1 lb. of resin, and 2 oz. of boneblack. Stir and heat until well mixed, and apply the warm mixture to cloth or other suitable material by means of a brush. Let it dry thoroughly and repeat the coating several times, allowing each coating to become entirely dry before applying the next; then lacquer the composition with any lacquer suitable for leather.

Recipe 312.—**Compo for coating Canvas for Photograph Backgrounds.**

Process.—Tack some closely woven packing canvas on a suitable framework, and give it 2 or 3 coats of the following composition:—Soak ½ lb. of common gelatine, or glue, in 1 gallon cold water, and then melt the glue in the water by heating it, stir in 2 oz. of treacle and 4 oz. of powdered whiting; after drying, smooth off with sandpaper, next give a coating of ordinary white lead in oil, and then thin with turpentine; then add a little lampblack rubbed up in a little turpentine, to tone down the glaring white colour, or this may be dabbed on with a woollen cloth; finally give a coat of "flatting" paint to produce a "matt" or dull appearance.

Recipe 313.—**Wax for Shoemakers' Use.**

Process.—Melt 4 lb. of resin in a boiler over a moderate fire, and gradually add 4 lb. of prepared heavy resin oil and 4 lb. of purified coal-tar oil, free from creosote, and continue the heating of the mixture until a sample when taken out can be kneaded and drawn between the fingers. Then let the mixture cool, and while in a liquid state add a mixture consisting of 2 lb. of chrome yellow and 2 lb. of powdered chalk which has been mixed by sifting; mix the whole thoroughly, and when cool enough to be plastic, cut up into suitable sized pieces or press in moulds for sale.

Recipe 314.—Composition for Surgical Purposes.

Soak stiff pasteboard in water and soften it by heating; if very stiff it may be softened by steeping it in an alkaline solution, and drying; then saturate the softened board with a solution of shellac, resin and turpentine, and if necessary give a final coat of gutta-percha cement.

Recipe 315.—Waterproof and fireproof Dressings for Textiles.

(1) Fireproof and suitable for textiles.

In 5 pints of boiling water dissolve 8 oz. of ammonia sulphate, 2½ oz. of carbonate of ammonia, and 3 oz. of boracic acid, and then add 2 oz. of starch which has been rubbed up in cold water. Instead of the starch ½ oz. of dextrine may be used. For use the compound is heated to 85° F. and the fabric steeped in it until saturated; then the material is wrung out and dried sufficiently for use.

(2) (a) For theatrical scenery, wood, etc.

In 5 parts of water dissolve 15 oz. of chloride of ammonia, 5 oz. of boracic acid, 1½ oz. of gelatine and 50 oz. of glue, and sufficient powdered talc to give the mass the consistency of paste; heat the compound to 120° to 140° F., apply it to the back of the canvas with a brush, or it may be applied to the sides of the textile before the scene is painted on.

(b) In 5 parts of water dissolve 3 oz. of boracic acid, 1 oz. of salammoniac, ½ oz. of chloride of ammonia, 5 oz. feldspar, 1 oz. of gelatine and 50 oz. of starch paste. Apply with a brush.

Recipe 316.—Casein Liquid to preserve the Colour of Aniline Dyed Leather.

Mix 2 fluid oz. of liquid ammonia with 70 oz. of water heated to 166° F., then add 1½ drachms of casein, and boil the liquid until the casein has dissolved; allow to cool and decant the fluid clear of any sediment, and apply the clear fluid with a sponge or brush to the dyed leather.

Recipe 317.—**Egg Mucilage to render the Surface of Dyed Leather Flexible.**

Mix 3 oz. of egg yolk with 1 fluid oz. of glycerine, and rub the skin with this mixture; let it half dry, and then rub well with a piece of clean woollen rag.

Recipe 318.—**Waterproofing Compounds for Textiles and Woven Fabrics, Paper, etc.**

(1) For general purposes.

Dissolve 1 lb. of pure gutta percha in 10 lb. of oil of turpentine or benzole, filter the solution and therein mix with 10 lb. of linseed oil varnish, and apply with a brush.

(2) This is useful for cardboard, etc.

Dissolve 1 part of white wax shavings in 10 to 100 times its weight of collodion, according to the consistency required.

(3) For coarse textiles, such as canvas.

Reduce to fine powder 2 oz. of white bole and 15 oz. of silver-litharge, mix this with 50 parts of calcined lampblack, and make the mixture into a paste with sufficient linseed oil varnish.

(4) This is useful for sacking, sail-cloth, etc.

Dissolve 1 lb. of resin in 20 oz. of coal tar oil and filter the solution; steep the textile in this for 5 days, and then rub it up with litharge or lime. Then dissolve 1 lb. of resin in 4 lb. of coal tar oil, dip the textile in the mixture several times, and rub it over again with litharge or lime.

(5) This is suited for fine fabrics.

Dissolve 1 lb. of glue and 1 lb. of neutral lime in 20 lb. of boiling water, and then add gradually $1\frac{1}{2}$ drachms of alum. Then boil the solution for 15 minutes, let the resulting milky fluid cool off to 120° F., and immerse the tissues until they are thoroughly penetrated, then hang them up to dry without wringing them; when dry, the tissue should be washed, dried and mangled.

Recipe 319.—**Elastic waterproof Composition for Rubber Goods.**

Dissolve 4 oz. of gutta percha in 17 fluid oz. of ether, and mix this solution with 15 oz. of castor oil and 1 oz. of any organic colouring substance. The quantity of oil used determines the flexibility of the coating. The compound is applied to the goods in the same way as "rubber solution."

Recipe 320.—**Collodion Varnish as a waterproofing Solvent.**

Mix together 63 oz. of ether and 10 oz. of alcohol, and dissolve in the mixture 25 oz. of gun-cotton; then add 2 oz. of castor oil and apply several layers to the fabric. This compound can also be mixed with linseed oil varnish or with oil of turpentine varnish.

Recipe 321.—**Waterproof Composition for imitation Leather, etc.**

The textile used is that called "moleskin," both sides of which are coated with a compound prepared by mixing 3 parts of burnt umber and 6 parts of lampblack with 100 parts of drying-oil, and liquefying the mixture with oil of turpentine. When dry, the cloth is passed between rollers; several layers of the above compound are applied, and when the last is dry, the cloth is coated with a varnish composed of the same ingredients, but with a larger amount of oil of turpentine. When the varnish is dry, the surface is polished with pumice stone, and finally coated with a finishing varnish made of 100 parts of linseed oil which has been heated with 3 parts of litharge, 3 parts of umber, 3 parts of Berlin blue, and 2 parts of caoutchouc. The cloth is finally dried for 48 to 60 hours at a temperature of 120° F.

Recipe 322.—**Waterproofing Composition for Textiles, Leather, Paper, etc.**

Melt 4 lb. of Burgundy pitch in an iron boiler, and then add 100 lb. of good quality white or yellow wax, and 6 lb. of English varnish. The wax and varnish are melted separately along with 5 lb. of anhydrous sulphate of iron and 2 oz. of essence of thyme; then both compounds are mixed together, and kept at a moderate heat until the compound is liquid and homogeneous. The materials to be waterproofed are immersed in the mixture, and then all excess of the compound removed by passing the material through heated rollers. In rendering leather waterproof the composition is applied to the flesh side (inner or under side) with a brush, until the leather has a firm and hard surface.

Recipe 323.—**Waterproofing Composition for Woollen Goods.**

In one vessel boil 25 parts of Castile soap and 2,400 parts of water; in a second vessel, dissolve 33 parts of alum in a similar quantity of water; heat both solutions to about 185° F, and then pass the fabric through the soap bath and next through the alum bath, repeating the operation several times, and dry in the air. The alum solution decomposes the soap solution and forms alumina sebate, which is insoluble in water; as the sebate forms in the fibre of the fabric, the latter will be rendered repellent to water. The process can also be applied to canvas and other materials.

Recipe 324.—**Rubber waterproofing Compound for various Materials.**

(1) Mix together 30 oz. of alumina with 10 of a concentrated solution of Para rubber in oil of turpentine, and apply this on one side of the fabric to be waterproofed, giving several applications, each successive coat being thinner than the previous one. If the compound penetrates to the under side of the textile, clean it with alcohol.

Recipe 325.—**Waterproof Composition for Cotton and Linen Goods.**

Dissolve 7 oz. of stearic acid in $6\frac{1}{2}$ pints of spirits of wine, pour the solution upon $13\frac{1}{4}$ lb. of powdered alum, and submit the mixture to a temperature of 98° F. For use, dissolve 1 part of the compound in 100 parts of water, and steep the fabric in the fluid, then dry; for silk fabrics, 200 parts of water should be used to 1 pint of the powder.

Recipe 326.—**Waterproof Compound for Boot and Shoe Leathers.**

Dissolve 1 lb. of carbonate of soda in 5 pints of water, and then dissolve 50 parts of resin in the lye ; separately soak 25 oz. of glue in water for 5 hours ; then draw off unabsorbed water, and melt the glue by heating in a gluepot, add 15 oz. of isinglass, and when that has dissolved stir in 15 oz. of linseed oil. In a third vessel melt 125 oz. of gutta percha, and add 1 gallon of tar oil and 50 fluid oz. of oil of turpentine; then mix the resin solution with the oil compound, and next mix in the gutta percha solution; heat, and stir until all the ingredients are well incorporated.

Recipe 327.—**Waterproofing Compound for Textiles and Fabrics.**

Mix 20 oz. of alum with 4 oz. of crushed flax seed (*i.e.*, linseed meal), and pour on the mixture 14 oz. of alcohol, stir well, and then set aside to settle; then pour off the fluid from the sediment, and form this thick mass into blocks for use; 1 part of the block is dissolved in twice its weight of water, and the fabric steeped therein and dried.

Recipe 328.—**Waterproofing Compound for Silks.**

Dissolve 1 lb. of purified potash in 10 lb. of water, separately put 20 lb. of shellac, 20 lb. of white glue (after being soaked in water to soften), and 20 lb. of ordinary soap, cut up in small pieces, in a boiler, and when these ingredients begin to liquefy pour in the potash lye; then, when all are incorporated, add a little more soap, dissolved in water, and apply the compound with a brush to the "wrong" side of the silk.

Recipe 329.—**Waterproofing Compound for Sailcloth.**

First "shrink" the cloth by steeping it in water and drying it, then coat it with the following compound: boil 72 parts of linseed oil for 2 or 3 hours, with 6 parts of sulphate of zinc, allow to cool, and then mix with 60 parts of oil of turpentine, in which a sufficient quantity of lampblack has been ground, to give a colour to the mixture. After coating the sailcloth with this compound dry it in the sun, and in 8 or 10 days give a second application.

Recipe 330.—**Rubber Compound for general waterproofing purposes.**

Put into a glazed vessel, over a water-bath, 50 oz. of pure rubber cut up fine, 2 oz. of Venice turpentine, and 66½ oz. of paraffin oil; let these ingredients slowly incorporate at a temperature of 98½° F. for 12 hours; then add 66½ oz. of oil of turpentine, mix thoroughly by stirring, and leave the mixture at rest in a warm temperature for 10 days; then add 58 oz. more of oil of turpentine and allow another 14 days' rest, the product will then be ready for use by applying with a brush. The fabric is then dried at 120° F.

Recipe 331.—**Waterproofing Compound for Linen.**

Dissolve 1 oz. of neutral sulphate of alumina in 10 oz. of water, and steep the linen in the solution, then stir it into a compound made by dissolving 1 oz. of resin and 1 oz. of soda in 10 oz. of water, and again steep the linen in this solution. Next prepare a resinate of soda by dissolving 1 oz. of resin and 1 oz. of soda in 10 oz. of boiling water; precipitate the resin by adding 1 oz. of common salt, and collect the precipitate and dissolve it by heating in 30 oz. of boiling water along with 1 oz. of curd soap; then dip the linen in the resinous soap solution, and finally drain and dry it.

Recipe 332.—**Rubber Cement for Felt Hats.**

Dissolve ¾ lb. of carbonate of potash in 10 quarts of water in a saucepan, place it over a fire and bring the water to the boiling point; then add 9 lb. of shellac, and continue the boiling until the shellac has dissolved. Allow this to become cold, and for use dip the felt hats in the fluid and hang up to dry, but before they are quite dry dip the hats in a weak solution of acetic acid so as to neutralise the potash and cause the shellac to set; then coat the shellac with a thin layer of liquid gutta percha.

Recipe 333.—**Rubber or Gutta Percha Cement for Bootmakers.**

Put into a saucepan the following ingredients and stand them over a gentle fire (such as a gas stove), stirring occasionally until they are dissolved:—

4 lb. of gutta percha, 1 lb. of Para rubber, ½ lb. of black pitch, ½ lb. of "ruby" shellac, 8 oz. of olive or linseed oil. For use, a little of the cement is melted by heat and made hot for forming a waterproof cement for patches on rubber boots and shoes.

Recipe 334.—**Gutta Percha Cement for Cloth.**

Take a thin sheet of gutta percha and place it between the layers of cloth to be cemented, and press with a hot iron. This will soften and partly melt the gutta percha, and cause it to attach itself to the cloth.

Recipe 335.—**Gutta Percha Cement for Leather Articles.**

(1) Put 10 fluid oz. of bi-sulphide of carbon into a bottle, and add sufficient gutta percha, cut up small, to make a tough, thickly-flowing fluid when the solids have all dissolved. To use this paste remove all grease from the surface of the leather (the grease is best removed by sprinkling a little bi-carbonate of soda, carbonate of ammonia, or borax on the surface to be cleansed, laying a cloth over this, and then placing a hot iron on the top and keeping it there for a short time, so as to cause the alkali to kill the grease); then spread the above compound (cement) on the surfaces to be joined, clap them together, and keep under pressure until the cement is hard and firm.

(2) Dissolve sufficient gutta percha by slow digestion in sufficient bi-sulphide of carbon to make the mixture of a consistency of syrup, then the cement is ready for use. This cement is spread on the leather so as to fill the pores, then the joint is heated and the parts hammered until the cement is cold.

(3) Heat together at a gentle heat in a suitable vessel 1 lb. of gutta percha cut up in chips, ¼ lb. of India rubber, 2 oz. of

black pitch, 1 oz. of shellac, and 2 oz. of linseed oil, until homogeneous ; allow to cool, and for use remelt by heating, and apply hot to the leather to be joined.

(4) Melt together equal weights of gutta percha and resin, and apply hot to the leather to be joined keeping under pressure until cold.

Recipe 336.—**Cementing Compounds for Bandages for Fractured Limbs.**

(1) Mix ground rice and plaster of Paris to form a cement, and apply this round the broken limb.

(2) Soak Bristol board in water until soft, shape this to suit the limb, and then bind it round with lint steeped in stiff boiled starch. Such a cementing material takes a long time to dry off, and is generally dried by placing bags of hot salt over the starched bandage, or else heated bricks alongside of the limb.

(3) Steep pasteboard or Bristol board in water and soften it by heating, and if very stiff steep it in an alkaline solution, and dry it ; then stiffen the band with a solution of shellac, resin and turpentine, apply a thick coating, and, if necessary, further coat with liquid gutta percha.

Recipe 337.—**Rubber Cement for India Rubber Goloshes, Shoes, etc.**

Dissolve 1 oz. of rubber in 20 fluid oz. of chloroform, separately melt 1 oz. of rubber with ½ oz. of resin ; then add ¼ oz. of venice turpentine and 4 oz. of oil of turpentine ; then mix both solutions. For use, a piece of linen, canvas, or other fabric is dipped in the cement and laid on the hole to be mended, the surrounding edges of which should be smeared with the cement.

Recipe 338.—**Gutta Percha Composition for artificial Leather.**

Mix by heating 6½ lb. of gutta percha, 2 lb. of sulphur, 2 lb. of raw cotton, 21 oz. of zinc white, 3½ oz. of catechu, and

$8\frac{3}{4}$ oz. of antimony oxide, and "vulcanise" the mass by means of a steam-heated vessel.

Recipe 339.—**Sizing Compositions for Fabrics, Textiles, etc.**

(1) For cotton fabrics—

Mix 5000 parts of flour with water, and heat the mixture, then stir in 59 parts of tallow, and paraffin to the extent of $\frac{1}{2}$ to 2 per cent. of the mixture; heat the whole and mix well by stirring; a little carbonate of soda may be added to the mixture.

(2) Thoroughly soak 60 oz. of glue in cold water, then melt it in a gluepot, and add 40 oz. of dextrine, 50 oz. of sulphate of calcium, 50 oz. of glycerine, $\frac{1}{2}$ oz. of chloride of lime, 50 oz. of starch, 50 oz. of spermaceti wax, 20 oz. of stearine, and 50 oz. of starch syrup (glucose) and 1 oz. of caustic soda. Mix these ingredients thoroughly. A good method of incorporating them is to dissolve the softened glue in a portion of the glycerine by heating, and with the remainder of the glycerine to make a batter with 50 oz. of glucose; heat it to boiling along with the soda caustic, dissolve the stearin and spermaceti in the hot starch paste, then pour on the melted glue, and add the lime chloride and calcium salt; as a preservative, $\frac{1}{4}$ oz. of carbolic acid may be added.

Recipe 340.—**Glucose Sizing for Cotton Print.**

(1) *Ingredients.*—137 oz. of water
5 oz. of wheat flour
15 oz. of potato starch
$\frac{1}{2}$ oz. of corn-nut oil.

The flour and water is applied to the fabric by covered rollers, then it is dried over drums, and strongly but uniformly moistened, the fabric being wound up tight at the same time; it remains on the rollers for 10 to 12 hours, when it is unwound, folded, and pressed.

(2) Mix $\frac{3}{4}$ oz. of powdered gum dragon (tragacanth), with spirits of wine, and work it into a homogeneous compound; then

digest this in 480 parts of water over a moderate fire, without allowing it to boil, until a liquid slimy compound is formed, which should be strained through a sieve; next boil 180 oz. of potato starch with 50 parts of water, and add to the boiling mixture $7\frac{1}{2}$ oz. of alum, previously dissolved in hot water; then add the gum dragon, slowly stirring it, but it must not be boiled with the starch.

Recipe 341.—**Glaze Dressing for white Cotton Fabrics.**

Mix together 100 to 200 oz. of potato starch, and 50 to 60 oz. of wheat flour, with 1,700 oz. of weak logwood decoction; heat this till boiling, and then add 10 oz. of palm oil, 5 oz. of yellow wax, and 5 oz. of tallow to the compound, then 3 to 4 drachms of bi-chromate of potash in powder, and finally add 45 oz. of resin solution, and $22\frac{1}{2}$ oz. of potato starch paste (*i.e.*, potato starch boiled in water). The resin solution is prepared by dissolving resin in a solution of carbonate of soda. Mix the whole together and use hot.

Recipe 342.—**Artificial Gum as a Sizing for Fabrics.**

Mix together 20 parts of white starch, 100 parts of potato starch, 20 parts of sago, and 8 parts of crushed malt, with cold water equal to six times the weight of the mixture, and heat the compound to 80° F. over a waterbath until a gummy compound is formed (one hour will generally be sufficient); test the compound from time to time with iodine, when a blue colour indicates that the compound is not completely formed, because the starch has not become transformed into gum so long as any blue colour is produced. When the compound shows a reddish violet colour, reduce the temperature of the gum mixture to 212° F. by shutting off the steam, a steam-jacketed vessel being used to cook the starch; allow the solution to stand for 1 hour, then filter through woollen cloths and concentrate the liquid by putting it into a vessel heated by steam pipes to expel the moisture. The compound may be dried until it can be pulverised and kept for use in that condition.

Recipe 343.—**Sizing Dressings for Fabrics.**

(1) Dissolve by heating 100 parts of gelatine in 20 parts of glycerine and 70 parts of dextrine, then add 21 parts of sulphate of zinc.

(2) Dissolve 10 parts of grape-sugar (glucose) in water q. s., 15 parts of sulphate of magnesia, and $1\frac{1}{2}$ parts of nitrate of potash; add 5 parts of glycerine, and dilute with water to register 6° Bé.

(3) Dissolve 100 parts of chloride of magnesia in sufficient water to dissolve 100 parts of starch, filter the solution, add 1 part of hydrochloric acid, then boil it, and pour it on the starch made into a batter with a little cold water, and bring the mixture to the boiling point; then allow it to cool to 195° F., and keep it at that temperature for 1 hour, when it is neutralized by adding sufficient clarified lime-water, and again boiling the mixture and pouring it out into vessels to congeal, if not required for use at once.

(4) Dissolve 10 oz. of carbonate of soda in 1,000 oz. of glycerine of 2° Bé, and then soften 10 oz. of gelatine in the fluid by soaking the gelatine and boiling it; then put in the solution one-tenth of an ounce of alum and a small quantity of borax. To impart a pleasant aroma to the size, dissolve 1 oz. of oil of peppermint, 10 oz. of oil of lavender, and 2 oz. of camphor, in 1 quart of rectified spirits of wine, and add 1 fluid oz. of this perfume to the above sizing compound.

(5) Mix a solution of dextrine with 36 to 40 per cent. of sulphate of magnesia.

The following formulæ are suitable dressings for white fabrics:—

(6) Dissolve 6 oz. of gelatine in 1 pint of water mixed with 2 oz. of glycerine.

(7) Mix 2 parts of starch with 3 parts of glycerine.

(8) Mix 3 oz. of kaolin (china clay) with 5 oz. of calcium sulphate (gypsum), and make into a paste with 2 oz. of glycerine.

(9) Mix 8 oz. of kaolin, 7 oz. of dextrine and 4 oz. of glycerine to form a paste which is suited for sizing purposes.

(10) In 30 parts of water dissolve 5 parts of dextrine, and 1 part of sulphate of alumina, and add 12 parts of glycerine, dissolve 5 parts of dry glue in 50 parts of glycerine of 20° Bé, and add with a solution of 5 parts of soda. A small percentage of carbolic acid prevents decomposition of the size.

Recipe 344.—**Size for woollen Goods.**

Mix 1 part of liquid ammonia with 10 parts of water, and then dissolve 1 part of resin by boiling in the mixture; pass through a cloth filtering bag, and then add half the quantity, by weight, of fat oil, and next add glycerine equal in weight to that of the mixture, and reduce with 5 per cent. of water. This compound is also a very good one as a solvent for aniline colours, being capable of dissolving a large quantity of them and at a lower temperature than alcohol. It is also capable of dissolving albumen, and is therefore very useful for colour printing.

Recipe 345.—**A Sizing suited for Cottons or Woollens.**

Liquefy 100 parts of flour in sufficient water over a water bath, and then add 20 parts of glycerine and 5 parts of potash bi-chromate solution.

Recipe 346.—**Glazing or Dressing for black Fabrics.**

Mix 1,700 parts of logwood extract with 100 to 120 parts of potato starch, and 50 to 60 parts of wheat flour; heat and stir the mixture until the starch thickens, then add 10 parts of palm oil and 5 parts of yellow wax, 13½ parts of acetate of iron solution ("iron liquor"), 2½ parts of sulphate of iron solution ("green copperas solution"), and 2½ parts of sulphate of copper (solution of "blue copperas"): both these latter solutions should be saturated ones. When all is well incorporated, add ⅖ to ½ part of potash bichromate in powder and 1⅓ part of sulphate of copper in powder; finally, stir in a mixture of 65 parts of an alkaline solution of resin in 22½ parts of potato syrup (*i.e.* potato starch mixed with water and boiled to form a syrup).

Recipe 347.—**Glaze Dressing on Blue and Green Fabrics.**

Prepare a compound as above, consisting of the same quantities of potato starch, wheat flour, and resin and potato syrup, in 170 parts of water, and when the mixture is half cold compound it with $1\frac{1}{2}$ parts of tartaric acid dissolved in water, and finally darken it to the required extent to produce the tint desired with indigo, carmine, or, still better, with solutions of potassium sulphate.

Recipe 348.—**Glazing Dressing for Crimson Muslin Fabrics.**

Mix together 570 oz. of water with 1,700 oz. of Brazil-wood decoction, and add 100 parts of potato starch and 50 parts of wheat flour; when half cold add 2 to $2\frac{1}{2}$ oz. of tartaric acid, and fine the compound with a decoction of 137 to 140 oz. of vinegar; use "fat resin" (soda resinate), *i.e.* resin dissolved in a solution of carbonate of soda and syrup, in the same proportions as directed for black fabrics (*vide supra*).

Recipe 349.—**Glaze Dressing for Rose-coloured Fabrics.**

The ingredients are 1,700 parts of water, 100 to 120 parts of potato starch, 50 to 60 parts of wheat flour, 5 to $7\frac{1}{2}$ parts of cocoanut oil (white), 5 parts of white wax and 5 parts of stearin; when these are incorporated add $1\frac{1}{2}$ to 2 oz. of tartaric acid dissolved in water, and 115 to 135 oz. of good vinegar.

Recipe 350.—**Sizing for String and Bootlaces.**

Boil $\frac{3}{5}$ oz. of borax and $3\frac{1}{2}$ oz. of shellac in 1,000 oz. of water, and thicken the solution with starch, gelatine, or isinglass by mixing the shellac solution in equal bulks with the starch or gelatine solution. Bleached shellac should be used for white laces.

Recipe 351.—**Sizing for half-bleached Linen.**

Boil, by introducing steam, 5 parts of wheat flour, 2½ parts of potato starch, 4½ parts of "Utrecht" white (a white earth like kaolin), ½ pint of light glue solution, until 80 parts of the sizing are obtained.

Recipe 352.—**Sizing for Fine Holland Uniol.**

Boil up together, by introducing steam to the compound, 100 parts of wheat starch, 25 parts of potato starch, 12½ parts of mineral white, 5 parts of stearin, 1½ parts of white wax and ⅘ part of crystallised carbonate of soda, then colour slightly by the aid of a little ultramarine.

Recipe 353.—**Sizing for Table Linen, Damask, etc.**

Prepare as in the last recipe, 50 parts of white starch and 8 parts of potato starch, 5 parts of white glue, 2½ parts of white wax, 2½ parts of stearin, 1½ parts of white soap, and 12½ parts of crystallised carbonate of soda.

Recipe 354.—**Sizing for Fine Straw.**

In 5 quarts of alcohol of 95 per cent. dissolve 100 oz. of sandarach resin, and then add 20 fluid oz. of oil of turpentine, and allow the mixture to digest for 10 days. Give two applications of the liquor on both sides of the straw.

Recipe 355.—**A good all-round Size for Linen and Cotton Fabrics.**

Mix 16 oz. of potato starch with 76 oz. of cold water, and then pour into the starch solution 8 fluid oz. of a boiling hot solution of caustic soda of 25° Bé.

Recipe 356.—**Composition for preparing Oilcloth.**

Soften in water, and then melt by heating, 32 parts of gelatine, with it mix ½ part of borax, and then work in 16 parts of linseed oil varnish and allow the mixture to congeal. Then mix the jelly-like mass with 30 parts of mineral matter, such as chalk, etc., that has been made into a paste thick, with kaolin. Reduce the mixture with naphtha, and apply the compound to the textile stretched on a suitable framework. When the ground mass is sufficiently dry give an application of a compound prepared by mixing 75 parts of kaolin (mixed to a paste with water) with 35 parts of linseed oil varnish, and reduce the compound with naphtha, finally applying the paint or colouring matter desired for forming the pattern.

Recipe 357.—**Casein Solution for Sizing Purposes.**

Dissolve pure casein in a saturated solution of borax, and concentrate the solution. It possesses great adhesiveness, and is a useful mucilage in place of liquid glue or gum arabic ; 1 of borax and 12 of water are the best proportions to use.

Starches.

The relative values of starches as stiffening compounds, are as follows. Taking the stiffening power of standard rice starch as 100, we have two other grades of rice starch whose stiffening powers are 95 and 91 respectively. Dry maize starch (cornflour starch) is 85, rye starch 80, acorn starch 80, wheat starch 80, barley starch 78, Bermuda arrowroot 75, Natal starch 68, pure potato starch 68, potato farina 65. The effect of alkali on most starches, is that the stiffening and agglutinative powers are increased (*vide* Flour Pastes). The addition of waxes also increases the glossinness of starch pastes when subjected to heat; gum arabic also can be added, whereas the action of nitric acid on starch is to convert it into a gummy body, British or dextrine being made by the action of nitric acid on rice starch. The most general employment of starches is in compounding sizings and dressings for textiles and in colouring and laundrying body linen.

Recipe 358.—**Laundry Starch.**

Rub up 1 lb. of potato starch with sufficient cold water to make a suitable batter a little thicker than cream, then add

12 tablespoonfuls of loaf sugar powdered and 12 tablespoonfuls of dextrine; put sufficient soluble indigo to tinge the mixture, and 3 to 4 oz. of paraffin wax cut up small, then pour on the mixture 1 pint of boiling water, and put into a vessel (such as a gluepot), boil it for not more than ½ hour, giving it an occasional stir; finally, strain the hot starch paste through fine linen before using it.

Recipe 359.—**Starch Gloss.**

Dissolve 2½ oz. of gum arabic in 1 pint of hot water, separately dissolve 2½ oz. of borax in 1½ pints of hot water, and add 2½ oz. of spermaceti wax, boil the mixture, and stir until the wax has dissolved and formed a emulsion; then add 6¾ oz. of glycerine, mix in the gum solution, and heat and then stir the mass until it is homogeneous. For use, a tablespoonful of the mixture is added to 6¾ oz. of boiling starch paste made in the usual way, and a few drops of essential oil (preferably oil of lavender) to impart an agreeable perfume.

Recipe 360.—**Liquid Starch Glaze.**

Separately dissolve 1 oz. of borax and 1 oz. of gum arabic in 10 oz. of hot water, then melt together 1 oz. of borax and 1 oz. of spermaceti, and melt in the borax solvent to form an emulsion of the wax, heating the mixture in a saucepan to effect this. Then add 10 drops of oil of cloves, and add the gum solution. For use, add 1 teaspoonful of the mixture to 1 part of boiled starch made in the usual way. Instead of using the glaze with starch, it may be rubbed lightly over the linen with a piece of soft flannel, after which the linen should be rubbed with a piece of clean flannel and the surface polished by ironing.

Recipe 361.—**Liquid Starch Gloss.**

Make a solution of borax in cold water, and then mix 2 fluid oz. of the solution with 1 oz. of gum tragacanth mucilage; for use, stir into a pint of boiled starch made in the usual way.

Recipe 362.—A Fireproof Starch.

This is made by dissolving one tablespoonful of sulphate of zinc in a quart of boiling water, and mixing starch powder with the fluid, and making into a paste with water in usual way.

Recipe 363.—Soluble Resin Composition.

According to a German patent, colophony, which is insoluble in water, and resin, which only dissolves to the extent of about 6 per cent. in water at the ordinary temperature, can be converted into a mixture, the constituents of which are much more soluble than in the original condition. Thus, for example, the solubility of borax is increased to 10 to 15 per cent., and that of resin to 5 per cent. in cold water, and to a greater extent on the application of heat; when left to cool and stored for some time, or gradually diluting with water, the liquid deposits a resinous precipitate; again, if crystallised borax be utilised along with resin, a solid product soluble in water is obtained. The new substance, by reason of its physical properties, is of general utility as an ingredient, especially as a vehicle for paints, in dyeing and mordanting for ceramic ware, and as a dressing for textiles and paper, as a filling material for surfaces, textiles, etc. In this respect the compound obtained with resin and borax is better than that obtained by dissolving the resin in caustic soda.

Recipe 364. — Glue Paste for Curriers' Use in Smoothing the Flesh Side of Skins and Pelts.

Moisten some rye flour with a little cold water, and make it into a dough, then pour on this a boiling hot solution of size (made by dissolving 1 oz. of size per pint of water), until the mixture becomes of a uniform texture, using enough water to make the compound not quite so stiff as the dough used for puddings or pastry. Well stir the dough for 5 or 10 minutes, then put a cloth over the pan and give it 40 hours' rest. For use, this paste is brushed over the flesh side of the leather with a stiff brush or a "railike," and smoothed down by "slicking" with a copper "slicker," or else by smoothing the pasted leather under a rolling machine.

CHAPTER V.

CEMENTS, AGGLUTINANTS, AND COMPOSITIONS FOR THE METAL-WORKER, ELECTRICIAN, SCIENTIFIC INSTRUMENT MAKER, HARDWARE TRADES, ETC.

Recipe 365.—**Waterproof Cement for Glass and China.**

Soak gelatine in cold water for a few hours, then take 5 oz. of the soft gelatine, melt it in a gluepot, and add 1 oz. of acid chromate of lime in solution. This cement hardens by exposure to the light.

Recipe 366.—**Transparent Cement for Glass Vessels.**

Soak 1 oz. of isinglass in 4 oz. of water and melt it by gentle heating, then add 4 oz. of "glacial" acetic acid to make it liquid.

Recipe 367.—**Glue Cement for Labelling Smooth Surfaces, Metal, Glass, etc.**

Soak 18 oz. of common glue in cold water until soft, then draw off all unabsorbed water, melt the glue in a gluepot, and add 1 oz. of rock candy, powdered, and a solution of gum arabic, made by dissolving 3½ oz. of the gum in 2 oz. of soft water.

Recipe 368.—**Colourless Cement for Microscopists.**

Soak 1 lb. of white gelatine in 6 oz. of cold water for 24 hours, heat it to 200° F. until it is dissolved, then add 7 oz. of concentrated glycerine and stir the mixture well, then heat for 10 minutes at the boiling point; finally, filter the fluid through a plug of cotton wool placed in the neck of a funnel.

The requirements for a cement for a microscopist's use are a clear fluid that dries quickly and does not crack, but adheres tenaciously, and effectively fixes the glass covers over microscopical subjects. A solution of dammar resin, asphaltum, caoutchouc, or a mixture of the last two in a volatile solvent, are occasionally used as cements for special purposes, according to the nature of that which is to be enclosed between the glass covers, whether fluid or liquid. The object to be preserved is put in the correct position on the glass, then a ring of the agglutinant is formed round it, the covering plate is laid on, pressed down, and held in position until the cement hardens.

Benzine, petroleum, or bisulphide of carbon are solvents of dammar rubber or asphaltum. A cement made of asphaltum and rubber is best when a fluid is to be enclosed. Dammar resin forms a yellow cement, asphaltum and rubber a black one, but Canada balsam, mixed with zinc white and adding sufficient benzine to form a syrupy mass, forms a white cement; Canada balsam alone is sometimes used, but it does not dry quickly.

Recipe 369.—**Glue and Flour Paste for General Use.**

Soak 1 lb. of glue in 3 times its weight of cold water for 5 hours, then melt the glue in a gluepot until a clear solution is obtained, then dilute the glue by putting in 1½ quarts of hot water; separately mix 6 lb. of rice, or potato starch, with 2½ pints of cold water to form a smooth batter and pour the boiling hot glue solution into this, with constant stirring and heating of the whole at the boiling temperature; when nearly cold, stir in 1 scruple of carbolic acid crystals and stir well. This paste will not decompose nor turn sour, but will be very tenacious to many materials.

Recipe 370.—**Glue for making into Gelatine Foils.**

Soak 50 oz. of best white glue in cold water for 10 minutes, just to soften it, then put the glue into a gluepot and add 8 oz. of glycerine, melt the glue at a gentle heat, and dilute with a little water, if too thick. Colour the mixture with a little aniline dye that is soluble in water or glycerine, then pour out the fluid into cold metal or china trays that have a glazed surface, so as to form thin sheets of foil.

Recipe 371.—**Ever-ready Glue.**

Soak 12 oz. of glue in cold water for 2 hours, then drain off the water that has not been absorbed and melt the glue in a gluepot, and to the hot solution add 5 oz. of sugar and stir well. Take a little out and drop it on a cold plate; if it hardens on cooling it is sufficiently cooked; then pour out the fluid into shallow plates or trays, and when cold, cut up into squares or sticks. For use, the glue is dissolved in a little water, or even by holding it in the mouth for a few seconds, when it will be sufficiently softened and "sticky" to be rubbed over the surfaces to be affixed together. This kind of glue is very useful in the office, library, etc.

Recipe 372.—**Non-acid Glue.**

Mix 4 oz. of spirits of wine (or methylated spirit that has not been methylated with mineral oils) with 1 quart of soft water, and add 1 lb. of best white glue, and when the glue has softened, melt it in a gluepot together with any fluid that has not been absorbed, and then add 4 oz. of white lead. Instead of mixing the alcohol and water, the glue can be dissolved in the water by itself (without any previous soaking), and when the white lead has been added, stir in the alcohol. Put into bottles while hot. The compound solidifies when cold, but is remelted by standing the bottle in a basin or cup of hot water.

Recipe 373.—**Cement to Resist Acids.**

Dissolve by heating together 1½ lb. of powdered resin and 1 oz. of linseed oil, then add 4 oz. of red ochre and 2 oz. of plaster of Paris, and mix well by stirring. This compound can be used as a putty, or for cementing the inside of acid-troughs, vats, tanks, etc.

Recipe 374.—**Cement to affix Cloth or Felt to Rollers, Metals, etc.**

Make a solution of glue in the usual way, then add sufficient tannic acid to make the glue thick and "ropy"; make the metal hot, smear it over with the glue compound, and press on the textile to be affixed to the metal.

N.B.—For affixing iron and other metals to any material, "Glutina" is one of the best cements obtainable.

Recipe 375.—**Cement for Electrical Insulation.**

Mix together in the dry state equal weights of sulphur, white lead, or plaster of Paris, all in powder, sift well together, and then make into a paste with a thin solution of glue.

Recipe 376.—**Cement for Electrical Purposes.**

Soak 1 oz. of best white glue or gelatine in 2 quarts of water for twelve hours, then dissolve the glue in a gluepot along with any unabsorbed water, and add 1 oz. of "curd" soap, and to every pint of the mixture add 3½ oz. of plaster of Paris.

If only a small quantity is required, the glue and soap solution can be prepared, and then, when the cement is wanted for use, mixed with sufficient plaster of Paris to make a thin paste, and used at once. It soon hardens, and when hard it is impenetrable to spirits, coal-tar oil, etc. (See also the cement, "Glutina," invented by the Author.)

Recipe 377.—**Non-Conducting Cement for Electrical Apparatus.**

(1) Melt together 5 oz. of resin, 1 oz. of beeswax, and stir in 1 oz. of red ochre free from earthy matter.

(2) Mix 7 oz. of black resin with 1 oz. of red ochre and 1 drachm of dried plaster of Paris, and heat the mixture to 212° F., and stir until all frothing ceases and the compound flows smoothly, then stir the mixture until cool enough for use; if wanted less brittle, ½ drachm of linseed oil may be added.

Recipe 378.—**Waterproof Cement for Insulating Tapes, Electrical Cores.**

Melt together—

8 lb. of "colophony."
2 lb. of beeswax
1 lb. of tallow.

Mix well and use hot, or as a putty when cold.

Recipe 379.—**Cement for a White Enamel for Metals, such as Clock Faces.**

Mix together, in powder, 50 oz. of dammar resin, 50 oz. of soft copal resin, 30 oz. of zinc oxide (zinc white), 1 to 2 oz. of ultramarine blue; then melt the mixture, and add 55 oz. of Venice turpentine; mix until all are well incorporated, then apply the requisite number of coats to the metal to be enamelled, and when cold, polish the surface.

Recipe 380.—**Dental Cement for stopping Decayed Teeth.**

Mix together equal parts of powdered porcelain, plaster of Paris, and steel filings, and make into a paste with thick quick-drying copal varnish.

Recipe 381.—**Cement for Wood, Ivory, Glass, etc.**

Melt together—

5 lb. of pitch
1 lb. of hard tallow, and then mix in
1 lb. of wood ashes.

This cement is useful for use as a "chuck" cement, "caulking" cracks and crevices in wood, ivory, etc.

Recipe 382.—**Wax Cement for Covering the Corks and Bungs of Casks, Bottles, Jars, etc.**

(1) Melt 13 oz. of resin with 1 oz. of beeswax, and then add 3 oz. of Venetian red, red ochre, or red lead; mix well by stirring the compound hot, and when cool and plastic, form into sticks by clamping the mass in brass or tin moulds.

(2) Melt together 3 oz. of Venice turpentine, $5\frac{1}{2}$ oz. of Venetian or red lead, stir well, and when cool, mould into sticks. This can be done by forming the mass into a cake by rolling it out with a rolling-pin, or a smooth glass bottle can be used as a roller, then cut the cake into strips, and before they harden hold them for a few seconds over a gas flame; to partially melt the surface (which will render them smooth or polished on

their outside), then stamp by impressing a metal stamp into the plastic mass bearing the maker's name if required.

(3) Melt as before 3 oz. of resin, 1 oz. of shellac, 1 oz. of Venice turpentine, and add colouring matter to suit the requirements or taste of the maker.

(4) Use equal parts of resin, Burgundy pitch, and lampblack.

(5) Use 2 oz. of resin, 5 oz. of tallow, and 4 oz. of lampblack.

N.B.—These compounds are also useful in the fitting up of chemical apparatus, for electrical purposes, etc.

Recipe 383.—**Cement for Entomologists, Microscopists, etc.**

(1) Dissolve 2 oz. of balsam of Tolu and 1 oz. of Canada balsam in a saturated solution of shellac, or chloroform, adding sufficient chloroform to bring the whole into a syrupy consistence.

(2) Dissolve 1 oz. of gum dammar (dammar resin) in 1 oz. of oil of turpentine, by the aid of heat, rub up 1 drachm of zinc-white with an equal amount of oil of turpentine, adding the latter, drop by drop, to form a creamy mixture perfectly free from lumps or grit, and then mix the two fluids, which must be stirred well together and strained through fine muslin wetted with turpentine. Blue or green colouring matter (pigments) may be worked up with this if desired.

Recipe 384.—**Cement for Celluloid.**

Melt by gentle heat 2 oz. of shellac in 6 to 8 fluid oz. of spirits of wine, and add 2 oz. of spirits of camphor ; shake the whole well together.

Recipe 385.—**Cement to prevent Machine Belts Slipping.**

Melt together 5 oz. of "Gum Thus," 3 oz. of rosin, 1 oz. of rosin oil, and when well mixed to a homogeneous mass allow it to cool to 212° F., and then add 2 lb. of oil of turpentine and 10 lb. of methylated spirit. Stir well, and apply a little to the side of the belt that comes in contact with the pulley.

Recipe 386.—Modelling Wax for Dentists.

Melt, by the heat of a sand-bath, 25 oz. of soft copal varnish, and when slightly cooled mix in 25 oz. of stearin with constant stirring. When this has melted and become incorporated with the copal, add a mixture composed of 50 oz. of Tolu balsam, ½ oz. of carmine, and 2 " drops " to 1 oz. of oil of geranium, then stir the hot mass until a homogeneous product is obtained. The adherence of the compound is increased or decreased according to the amount of copal used. A little carmine may be dissolved in a small quantity of alcohol, and used in this form instead of mixing it in dry.

Recipe 387.—Modelling Wax for Ordinary Use.

(1) Melt 2 oz. of white wax, and while it is cooling, mix in 1 oz. of " flake-white."

(2) Melt by heat, and then knead thoroughly—

50 oz. of best yellow wax
7 oz. of venice turpentine
3¼ oz. of linseed oil
36 oz. of bole.

Mix thoroughly, pour the mixture gradually into a vessel containing water, and knead it several times with the hands.

When melting the wax, do not let the temperature be high enough to cause trouble. Indian red is usually added to the mass as colouring matter, but umber, or other earthy colours, may be used.

Recipe 388.—To make Wax into Sheets.

Put clear wax into an enamelled saucepan and cover it with water to within 2½ inches of the top, and slowly heat the water until the wax is melted ; then set aside until the wax is partially cold. Skim off all the air bubbles, then fill a straight bottle, smooth on the outside, with ice-cold water, soap the bottle and dip it deliberately into the solution of wax. Do this two or three times, according to the thickness the sheet of wax is to be. After the last dip, as soon as the wax hardens to whiteness, cut a line through it and remove the wax from the bottle as quickly as possible, spread it on a clean flat surface and straighten it out smooth while warm. Repeat these operations until all the wax solution is used up.

Recipe 389.—**Preparation of Wax Moulds for Casting Purposes.**

Put some common " virgin " wax into an earthenware pot, or " pipkin," and place it over a slow fire, and when it is all melted, stir in a little dry carbonate of lead (flake-white), or else blacklead (plumbago), about 1 oz. to the 1 lb. of wax used in the mixture; to prevent the mould cracking on cooling, the mixture should be re-melted several times before using it for the first time. Resin is sometimes used as an ingredient with the wax in various preparations, but when often used, decomposition, or some change, takes place, which makes the compound granulate and flexible, rendering it less useful for modelling. When resin is used, the mixture when first melted should be boiled, or nearly so, and keep at that heat until effervescence ceases; it should then be poured out upon a flat plate or marble slab to cool, after which it may be used as described.

Recipe 390.—**Liquid Sealing Wax for coating the Corks of Chemical Apparatus, etc., coating Electrical Instruments, etc.**

This is made by breaking up a stick of sealing-wax and dissolving it in methylated spirits, placed in a bottle which is stood in a warm place.

Recipe 391.—**Flexible Moulding Compound.**

Mix together and heat in a boiler, at a temperature between 100° and 200° F., with constant stirring—

10 oz. of " mineral wax " (a residuum obtained from the distillation of petroleum)
20 oz. of wood-tar
32 oz. of shellac
32 oz. of dry asbestos, powdered
32 oz. of flax (or cotton, wood, or paper).

Mix well by heating and kneading. If a very hard mass is required with the mineral wax, decrease the amount of asbestos and add about 24 oz. of good slate, or clay, free from iron.

Recipe 392.—**Insulating Compound for Electrical Wires, etc.**

Mix 66 oz. of glass, or quartz sand, or fine white sand, 34 oz. of mineral wax, 56 oz. of paraffin wax, beeswax, or spermaceti wax, and 3 pints of boiled or raw linseed oil. These proportions may be varied to suit different degrees of temperature. If exposed to heat, less wax is required.

Recipe 393.—**Compound for Modelling in Plastic Moulds.**

Mix— 2 lb. of soapstone powder
1 lb. of wheat flour, and stir the mixture into
3 lb. of wax, not too hot.

Recipe 394.—**Compound for Modelling Patterns, etc.**

Melt completely together—
2 lb. of beeswax
4½ lb. of venice turpentine
2 oz. of lard
1¾ lb. of elutriated bole.

Mix thoroughly, then gradually pour the compound into a vessel with water, and knead with the hands. When modelling with the compound do not allow any water to fall on the surface.

Recipe 395.—**Substitute for Ivory.**

Mix 5 fluid oz. of liquid ammonia with 1 quart of water, and dissolve therein 1¼ lb. of casein, then add 2½ lb. of quicklime, 15 oz. of acetate of alumina, 5 oz. of alum, 7½ oz. of sulphate of calcium, and 10 oz. of oil, adding the oil last. Mix the compound into a smooth paste and pour through rollers to form into plates of the desired thickness; these plates are either dried or pressed into metallic moulds which have been previously heated, or else the plates are reduced to powder, which is put into the moulds and subjected to great pressure. The moulded mass is then dipped in a bath composed of water to which 6 oz. of strong glue and 10 oz. of phosphoric acid has been added; they are then dried, polished, and varnished with shellac. Instead of casein, 14 lb. of alumina in 1 quart of water may be used, the other ingredients being the same.

For dark compounds $7\frac{1}{2}$ oz. to 10 oz. of tannic acid is used instead of the acetate of alumina, 5 oz. of alum, $1\frac{1}{2}$ lb. of sulphate of calcium, 10 oz. of oil, adding the oil last; mix the compound into a smooth paste, and pour through rollers to form into plates of the required thickness; these plates are either dried or pressed into metallic moulds which have been previously heated, or else the plates are reduced to powder, which is put into the moulds and subjected to great pressure. The moulded mass is then dipped in a bath composed of 5 parts of water to which 6 oz. of strong glue and 10 oz. of phosphoric acid has been added; they are then dried, polished, and varnished with shellac. Instead of casein, 14 lb. of alumina in 1 quart of water may be used, the other ingredients being the same.

Recipe 396.—**Composition for Knife-boards, Razor-strops, etc.**

(1) Mix together and apply to the surface on which the knife or razor is to be sharpened—2 oz. of the finest emery flour, 1 oz. of spermaceti wax.

(2) Mix equal parts of jewellers' rouge, plumbago, and suet.

(3) Mix— $1\frac{1}{2}$ oz. of putty powder
$1\frac{1}{2}$ oz. of jewellers' rouge
$\frac{3}{4}$ lb. of scales of iron
$4\frac{1}{4}$ oz. of levigated turkey stone
$2\frac{1}{4}$ oz. of ox suet.

(4) Put equal parts of dried sulphate of iron and common salt into a covered clay crucible, and calcine the mixture until it becomes of a dull red colour, then reduce to fine powder if there are any lumps. Mix the red oxide of iron thus produced with lard or tallow.

Recipe 397.—**Composition for Rendering Corks or Bungs impervious to Air or Water.**

Boil the corks in water, and then while hot dip them into a solution composed of 1 part of egg or blood albumen dissolved in 200 parts of water, and after removal compound 1 part of tannic acid and ½ pint of salicylic acid with 200 parts of water; this will chemically react on the albumen and convert it into a leather-like body (tannate of albumen) in the pores, and thus render the corks impervious to air or water, at the same time they retain their buoyancy and are antiseptic.

Recipe 398.—**Compound for preparing School Slates, Blackboards, etc., or renovating those already in use.**

Mix together—1½ oz. of lampblack
2 oz. of ultramarine blue
4 oz. of tripoli powder
6 oz. of finely powdered pumice stone.

All the ingredients should be in powder and in the dry state. Make this mixture into a fluid mass with 5 parts of 95 per cent. grain-alcohol in which 8 oz. of shellac has been dissolved. To facilitate the incorporation of the lampblack and blue powder, they are best rubbed up to a paste with a little alcohol before adding to the shellac solution; the mixture, after being made a day or two, should be shaken up, and then put through a wire sieve of 120 meshes to the inch. Apply to the surface of the board quickly with a flat varnish brush.

Recipe 399.—**Compound for Carbon Plates for Electrical Batteries.**

Select some clean bright coke and pulverise it to a fine powder and mix it with a small proportion of finely ground bituminous coal, and run the mixture into a mould; put the mould in an iron box and heat it to redness in a "muffle" furnace for several hours; when cool, but not cold, soak it in thin treacle and bake as before.

Recipe 400.—**Composition for Carbon Filters.**

(1) Grind up 6 parts of coke very small, but not to a powder, 2 parts of animal charcoal, 1 part of wood charcoal and 1 part of fire clay; make the mass into a paste with sufficient treacle to form a plastic compound, then mould into shape and dry in a warm temperature.

(2) Take 1 part of coke, powdered, 2 parts of animal charcoal, 2 parts of wood charcoal, 4 parts of short asbestos. Mix all these ingredients, and then knead them into a dough with an equal weight of thick treacle, mould into shape and dry.

Recipe 401.—**Composition for Filling Holes in Castings.**

(1) Mix 6 parts of dry clay with 1½ parts of a saturated solution of borax, and use this as a putty by pressing it into the holes and smoothing off afterwards.

(2) Make a paste of powdered binoxide of manganese and a strong solution of silicate of soda.

Recipe 402.—**Moulding Composition for Pilasters, Dados, Cornices, etc.**

(1) Knead into a plastic mass with a strong solution of hot glue—

½ part of whiting, coarse
6 parts of finely sifted whiting
1½ parts of linseed oil-cake.

(2) Soak 26 oz. of glue in twice its weight of water for 5 hours, then melt the glue, and while boiling hot stir in 8 oz. of powdered litharge, 16 oz. of white lead, 2 oz. of fine hard sawdust, and 1½ lb. of plaster of Paris, dry, and work the whole into a plastic mass, and put it in hard wood moulds which have been previously oiled to prevent adhesiveness.

(3) Mix plaster of Paris with sawdust, and make it into a paste with warm glue water.

Recipe 403.—**Hard Plastic Compound for Patterns.**

(1) Soften 12 lb. of glue by soaking it in sufficient cold water to cover it, then heat the glue in a gluepot until it is dissolved; in a separate vessel melt 7 lb. of resin, ½ lb. of pitch, and stir in 2½ pints of raw linseed oil, then pour this mixture into the glue (or *vice versa*), stir well and add sufficient whiting to thicken the mass into a dough. Only so much should be made at a time

as is required for use, for it soon becomes hard, and then can only be brought into a plastic condition by steaming the mass.

(2) Soak 1 lb. of glue in 1 gallon of cold water, and then put the softened glue and all unabsorbed water into a gluepot, and melt the glue. In a separate vessel melt together 2 lb. of resin, 1 gill of venice turpentine, and add 1 pint of raw linseed oil, then mix this compound with the glue solution, and continue the heating and stirring until all the water has evaporated, then gradually add sufficient whiting to make the mass of the consistency of soft putty. When cold the compound is hard, but it becomes plastic by warming, and can be moulded to any shape or stamped into patterns by pressure. It is useful for moulding picture frames, ornaments, and similar articles.

Recipe 404.—**Plastic Compound to imitate Rubber.**

Soak $8\frac{1}{2}$ lb. of good glue in soft water for 5 or 10 hours, then draw off unabsorbed water, and melt it at a gentle heat in a gluepot, but do not cook it (*i.e.*, raise it to the boiling point); now stir in 2 gallons of strong syrup (sugar and water) and heat the mixture at the boil for $\frac{1}{2}$ an hour, stirring occasionally and skimming off all impurities that rise to the surface, then add 1 pint of glycerine and 2 oz. of venice turpentine just before removing the mixture from the fire, and pour out slowly into moulds that have a polished or oiled surface. For use the compound is melted by slowly heating it in a steam or water-lined vessel, and mineral matters such as silica, barytes are mixed with it according to the nature of the compound to be imitated.

Recipe 405.—**Composition for Toys.**

(1) Make into a paste with water 5 parts of argillaceous slate in powder, 2 parts of rag paper waste, and 3 parts of fresh plaster, and put the mass into moulds which have previously been lined with finely ground slate, powdered plaster, or fat; a fairly thick coat will form in a few minutes, when the residue of the mixture is poured out of the mould; the mixture hardens very rapidly and is unshrinkable.

By dipping the casts in melted paraffin or wax, they are rendered insoluble in water, or the composition casts can be japanned by first giving a coat of quick drying boiled oil, and when this has become dry apply the japan as paint or enamel.

(2) Mix 5 parts of softened whiting with 1 part of medium hot glue, and add a little venice turpentine to lessen the brittleness. The compound can be moulded into figures, etc. When dry it is as hard as stone.

Recipe 406.—**Moulds for Alloys for Fusible Articles.**

Mix into a paste with cold water equal weights of plaster of Paris and pumice stone. This compound is also useful for casting articles to be brazed or soldered.

Recipe 407.—**To keep Moulding Clay moist.**

Knead the clay with glycerine and work thoroughly with the hands into a dough, moisten the model frequently at intervals of two or three days, and keep covered with an old piece of rubber cloth to prevent evaporation of the moisture.

Recipe 408.—**Composition for Horn Substitute.**

Mix starch with a little cold water to form a batter, and then heat the batter at a temperature of 212° to 263° F., when it will be converted into an elastic mass which can be dried and worked into buttons, etc. Magnesia and various colouring matters can be added to the batter before drying, then colour the mass.

Recipe 409.—**Compound for making Incombustible Torches.**

Make into a stiff dough—

3 lb. of alumina
1 lb. of bauxite
4 lb. of sawdust, and
1 lb. of wheat-chaff.

Mix with sufficient water to mould the mass into any desired shape, then enclose this core with a coat made of—

3 lb. of alumina
1 lb. bauxite, and
2 lb. of sawdust.

Puncture the jacket with holes to provide a draught to the core. A small saucer of hot clay, impervious to petroleum, is placed around the foot of the torch, to catch any falling drops of petroleum with which the torch is saturated before being ignited. A small cylinder of the same kind of clay, bored with small holes, is inserted in the centre of the torch for the reception of the handle. When entirely dry the torch is submitted to a red heat for 16 hours, whereby the sawdust and wheat-chaff are completely consumed, leaving the mass full of pores and adapted for a greedy absorption of oil. When the torch is entirely dry, and is to be used, it is soaked in petroleum and paraffin wax and ignited, it will burn for a long time. Such torches form convenient "flares" or "signals."

Recipe 410.—**Zeodolite Composition for coating Sulphuric Acid Tanks.**

Melt 19 parts of sulphur, and stir in 2 parts of pulverised fragments of stone-ware or glass (broken pottery), and when thoroughly mixed, pour into moulds to form tanks, or else lay it on the outside of wooden tanks by means of a trowel. This composition forms a good substitute for sheet-lead in constructing sulphuric acid chambers, as it resists the corrosive action of the most concentrated acid. Moreover, the acid is also free from contamination which lead sets up. The composition is not affected by boiling water, as it does not melt at a temperature of less than 250°. This composition is also a good substitute for asphaltum, and as an hydraulic cement for stoneware. It can be made into slabs or panels for the construction of large tanks or troughs.

Recipe 411.—**Plastic Composition for coating Iron Balls, Rivets, etc., for protecting them from Rust.**

Rivets and bolts used in ships, and other metal constructions, when placed *in situ*, will rapidly rust unless protected from moisture. If once the rust is formed, it will penetrate the iron and corrode it into holes. To protect them from rust while kept in stock, it is usual in many foundries to dip them in melted asphaltum, pitch, or a compound of boiled oil and wax. The latter is not a good method, as it makes only a partially protective coating, the oil often decomposing into its fatty acids, which attack the iron and cause a formation of rust beneath the coating, whatever compound is used must be capable of being melted by heat when the rivets are used, because many rivets are used red-hot. The writer has found that a very good protective coating for preserving rivets and bolts from rust is formed by dipping them into a bath composed of melted sulphur to which 1 to 2 per cent. of tallow gas has been added, with some graphite or red oxide of iron added as colouring matter; the tallow combines with the hot sulphur and prevents it drying to a hard, chippy coating, and at the same time the composition is one that is not attacked by acids, alkalies, etc.

Recipe 412.—**Composition as a Substitute for Meerschaum.**

Cut carbonate of magnesia into small pieces, place them for a few days in a hot solution of silicate of potash, and then dry them. Repeat the operation several times, using, instead of silicate of potash, hot solution of soda silicate, and finally expose the pieces to the air for a few months. In 6 or 7 weeks' time the piece treated will be hard enough to work and use in close imitation of the genuine meerschaum.

Recipe 413.—**Composition for Handles.**

Soften 2 lb. of catechu in a suitable solvent, and knead it with 1 lb. of magnesia, 1 lb. of coal tar, 1 lb. of roll sulphur, and $8\frac{3}{4}$ oz. of flour of sulphur, keep the mixture warm while kneading it, and pour the homogeneous mixture into moulds and heat it to a temperature of 250° to 285° F.

Recipe 414.—**Composition for imitating Gutta Percha.**

(1) Melt together 2 lb. of colophony and 3 lb. of pitch of asphaltum until they are dissolved, then mix 6 lb. of slaked lime (calcium hydrate) with 3 lb. of water and the colophony compound and heat the mass with constant stirring. When all are

well melted add 12 lb. of gutta percha, and then add 1 lb. of alum mixed to a paste with water. As soon as this is equally distributed in the mixture, remove the excess of water, and bring the whole to the boiling point. If any more water separates, remove it, then knead the composition with fresh water, and finally pass it through rollers. To make the composition thoroughly waterproof, 5 per cent. of pure rubber should be added.

(2) Mix together 8 lb. of pitch, 4 lb. of resin oil, 6 lb. of calcium hydrate (slaked lime), 16 lb. of gutta percha.

(3) Mix together by heating, 2 lb. of pitch, 6 lb. of calcium hydrate, 16 lb. of gutta percha.

(4) Mix by heating, 16 lb. of gutta percha, 6 lb. of calcium hydrate and 2 lb. of coal-tar.

All the above compounds are really adulterated gutta percha, but often sold as the genuine article; but when sold for what they are, they form useful compounds when gutta percha alone would be too expensive.

Recipe 415.—**Composition for Gelatine Moulds for Casting Purposes.**

(1) Soak 1½ oz. of gelatine in cold water for 5 hours, drain off unabsorbed water, and melt the softened gelatine in a gluepot, add 3 oz. of hot treacle. Then add ½ to 1 oz. of alum in fine powder; this will render the compound insoluble in water. Pour out the fluid into moulds, and when hard, remove the moulds and brush it over with a solution of bichromate of potash, and expose the surface to sunlight. This will render the surface hard and impervious to moisture, or even hot water.

(2) Dissolve 1½ lb. of gelatine in 5 pints of hot water, and then add 1½ oz. of tannic acid and ½ oz. of "sugar-candy." When the candy has melted the compound is ready for use.

Supposing a statue is to be composed in plaster: A mould of it is first taken in the above compound, and then from the compound a plaster cast is made. The moulding compound is used thus: stout threads of silk are laid on the surface which is to be covered with moulding "compo." The ends of these threads extend beyond where the compo will lie, and the object of this is to enable the moulding compo to be cut in pieces, so that the mould can be lifted off without breaking it. It will require some little judgment to place these threads in the correct position, because if the compo falls into any undercut portion it will be difficult to remove the figure from the mould, unless the threads have been suitably placed. The article from which it is desired to make a model should be placed in a cardboard box or other suitable receptacle, the threads suitably arranged and the moulding compo poured all over the portion from which the cast is to be made; pour sufficient of the composition to form a moulding of a suitable thickness, and allow it to cool, then cut the mould in pieces by drawing the threads through it in suitable directions; silk thread, being strong, should be used, because if the thread breaks while it is cutting through the mould it renders its removal very awkward; cutting of the mould with a knife will destroy it. Lift off each piece of the mould and then carefully arrange them together in the proper order in another receptacle; oil the interior of the mould, and pour the plaster into it. When the plaster is set the mould can be removed by melting it by heat.

N.B.—"Compo" is an abbreviation for "compound."

Recipe 416.—**Amber Varnish Cement.**

Fuse small fragments of amber in an iron pot, and when it becomes semi-fluid pour an equal weight of hot raw linseed oil on the amber, and heat the mixture; stir well until the amber and oil are mixed.

Recipe 417.—**Composition for enamelling the Surface of Cardboard.**

Mix 25 oz. of perfectly dry kaolin with 6 oz. of melted paraffin wax. When cool, make the mass into a powder and work it into a paste in a paint mill with hot water, then apply the "paint" to the cardboard, and, when dry, put through a burnishing machine.

Recipe 418.—**Composition impenetrable to Hydrocarbon Fluids.**

Petroleum, naphtha, coal-tar, benzine, etc., will penetrate and ooze through wooden vessels, and also creep up the sides ot metal ones. Paint is useless to prevent the exudation of such fluids. The writer's "Glutina Cement" completely prevents such fluids escaping. A new product was recently patented for the same purpose, from the description of which we glean that the compound is prepared as follows:—Per-sulphate of iron is dissolved in water, and glycerine mixed with it, then tannic acid and soda crystals are added, and the whole well mixed together: separately, ordinary glue and "pickers' glue" are mixed and liquefied by heat in the usual way (in a gluepot), and after being well mixed are added to the iron and glycerine solution, and the whole is kept well skimmed whilst being heated to nearly the boiling point, then it is cooled to about 170° F., and the scum that arises removed, and the compound, while hot, is put into barrels, the bung closed, and the barrels rolled about to cause the fluid compound to attach itself to the interior of the barrel; the air in the barrel becomes heated by the hot compound, and exerts a certain pressure, which forces the composition into the pores and joints of the wood; then the bung is removed, and the residue of the fluid is allowed to run out. The proportions of the several ingredients may be varied, but the following are stated to give good results:—

640	parts of pickers' glue
210	parts of protosulphate of iron
57	parts of tannic acid
5	parts of soda crystals
1000	parts of water.

"Pickers' glue" is an extract obtained from the coniferous and quercus plants by the action of heat under pressure. The writer has not tested the process, so cannot comment on its merits, but it is certainly a very complex compound.

Recipe 419.—**Composition for the Striking Surface of "Safety" Matches.**

Mix together 9 oz. of iron pyrites powdered and sifted fine, 3 oz. of finely powdered glue, and 1 oz. of glue dissolved in just enough water to effect solution.

Recipe 420.—**Waterglass Cement for Glass and China.**

(1) Mix together, by sifting as quickly as possible, 10 parts of elutriated glass powder, 20 parts ditto of powdered fluorspar, 60 oz. of solution of waterglass, and use at once, as it sets very hard in a few minutes.

(2) Mix 8 oz. of pyrolusite, 10 oz. of zinc oxide, and 2 oz. of waterglass. This cement hardens in a very short time, and is especially adapted for cementing the joints of pipes exposed to red heat, because when once fused it forms a glass-like mass of great adhesive power, and makes a very clean joint.

Gutta-Percha and Rubber Compounds.

Recipe 421.—**Liquid Gutta Percha.**

Cut up 1 oz. of gutta percha into thin slices, and put it into a bottle with 6 fluid oz. of chloroform, and when the gutta percha becomes dissolved, add 1 oz. of carbonate of lead mixed with 2 fluid oz. of chloroform, shake up well, and let it rest until the solids have dissolved, then pour off the clear fluid from the dregs, and keep it in a well-stoppered bottle, the stopper of which has been steeped in boiling paraffin wax; the liquid gutta percha may be diluted with more chloroform if desired thinner.

Recipe 422.—**Light Coloured Gutta Percha Compound.**

Melt 6 oz. of gutta percha in a saucepan, then add 2 oz. of bone or ivory dust and 1 oz. of pipeclay; knead all well together.

Recipe 423.—**Insulating Composition for Electric Cable Cores.**

(1) Mix together by heating—

1 part of Stockholm tar
1 part of resin
3 parts of gutta percha.

Mix well, and use for cementing the sheaths of cables.

(2) Mix 65 parts of mineral pitch (ozocerite)
30 parts of sand
5 parts of tar, with the addition of a little gutta percha.

Recipe 424.—**Marine Glue as a Waterproof Coating for Tanks, Vats, etc.**

(1) Dissolve 10 oz. of caoutchouc in 6 oz. of rectified petroleum spirit by digestion, and mix this with 20 oz. of melted asphaltum, and use the mixture hot. The compound will attach itself to almost anything—wood, stone, metal, etc.

(2) Dissolve 1 lb. of rubber in benzine, by the aid of a water bath, and mix this with 2 parts of shellac, raising the heat to effect the melting of the shellac. Owing to the danger attending the vaporisation of benzine, the rubber should be dissolved at a gentle heat in a corked bottle: a thick magma of rubber results; the shellac is then mixed with this thick mass in a jar, and the mixture heated to a temperature to melt the resin, stirring it well to incorporate the whole. Chloroform or bisulphide of carbon can be used as the solvent for rubber. This compound is made ready for use by heating it to about 248° F.

(3) Dissolve 1 lb. of Para rubber in sufficient benzine or naphtha to produce a thick mass, then add 2 lb. of asphaltum, and mix the whole by heating and stirring.

(4) Cut up 10 oz. of Para rubber, put it in a linen bag and suspend it in a bottle containing 6 parts of refined petroleum, using a bottle sufficiently large to allow the bag to dip only half-way into the compound; let the rubber digest from 10 to

14 days in a warm place, then melt $1\frac{1}{4}$ lb. of asphaltum in an iron boiler, and slowly pour in the rubber solution in a thin stream; heat the mixture, whilst constantly stirring, until it is homogeneous. Then pour it out into greased moulds, when it will solidify into dark brown, or black, cakes, that do not break easily. For use, it is melted in a gluepot, so that it shall melt without burning. It should be kept melted while using, and if required very fluid should be heated to 380° F., over a gas-stove, after being melted in the gluepot. In using the cement, it is best, if possible, to heat the surfaces to be joined to 212° F., which will permit of the glue being slowly applied, whereas a cold surface will chill the cement and cause it to set before it sticks to the material. Only a thin layer of the cement is smeared on smooth surfaces, but a thicker one is required for rough surfaces, putting the cemented material under pressure. This glue is very useful for cementing together wood, metal, glass, stone, etc., and is useful for closing seams, cracks, etc., in vats, tanks, and other vessels; it may even be used as a cement or putty for same, to render them watertight.

Recipe 425.—**Waterproofing Coating for Damp Surfaces, Walls, etc.**

Put into a suitable vessel—

10 oz. of Para rubber
10 oz. of whiting
1 pint of oil of turpentine
$\frac{1}{2}$ pint of carbon bisulphide
5 oz. of resin
5 oz. of asphaltum.

Let the solids slowly digest in the fluid in a warm place, frequently stirring or shaking the mixture, then apply the compound with a brush in the usual way to the walls, after having cleaned them. If it is only the lower part of the walls that is damp, the coating should be carried about one foot higher than where the damp rises. Before the cement is dry, lay on sheets of plain paper, on which the wallpaper can be easily pasted.

For large quantities of the composition, the several ingredients should be taken in *pro ratâ* proportions to those specified.

Recipe 426.—**Cement Compound for Vulcanised Rubber.**

Heat together—

1 part of Stockholm tar
1 part of American resin
2 parts of crude rubber
4 parts of oil of turpentine.

Thin with ordinary turps if necessary; roughen the surfaces to be cemented before applying the cement.

Recipe 427.—**Compound for Coating Rubber Goods to Prevent Stickiness.**

Dissolve 1 oz. of pure rubber in 4 oz. of oil of turpentine, and then mix in ½ fluid oz. of hot sulphide of potash ("liver of sulphur"); mix well, and coat the rubber surface with it.

Recipe 428.—**Gutta Percha Cement for General Use.**

(This is akin to a celebrated "elastic glue" that is sold in sticks and cakes.)

Melt together 1 oz. of gutta-percha and 10 oz. of black pitch from turpentine, and add 1½ oz. of oil of turpentine; melt the cement for use, and use it hot.

Recipe 429.—**Flexible Gutta Percha Cement for General Use.**

Dissolve 1 oz. of gutta percha in 19 oz. of benzine, and then add 10 oz. of linseed oil varnish.

Recipe 430.—**Sheet Gutta Percha**

may be made by dissolving gutta percha in bisulphide of carbon, and pouring the fluid on to glass plates; the carbon will evaporate and leave a sheet of gutta percha on the glass. To render gutta percha plastic, steep it a few hours in benzol or naphtha until it has swollen, then soak it in hot water, when the gutta percha becomes very plastic and can be pressed into moulds, or used for the making of picture frames by pressing it on them; by dipping the mould of gutta percha in cold water it hardens, and a plaster cast (see "Compositions") can be obtained from the mould thus prepared.

Recipe 431.—**Substitute for Gutta Percha.**

Mix together by heating 18 parts of pitch, or coal tar, 9 parts of calcium hydrate, and 24 parts of gutta percha. This is useful for waterproofing textiles, etc.; hemp and other organic substances may be mixed with the melted compound to form waterproof compounds, which are useful for many purposes.

Recipe 432.—**Plastic Compound from Rubber Waste.**

Put the waste rubber into a cylindrical vat fitted with a steam coil, and heat the mixture to 570° F. until a plastic mass results; then to every 10 lb. of it add 2 oz. of palm oil, 5¾ oz. of sulphur, 3 lb. of white lead, zinc white, lime, clay or manganese.

Recipe 433.—**Gutta Percha Cement.**

Mix together 4 lb. of gutta percha, 2 lb. of bone black, and 1 oz. of white arsenic.

Recipe 434.—**Gutta Percha Insulating Compound.**

Melt 7 lb. of gutta percha by heat and add 2½ oz. of lampblack and 28 lb. of powdered emery, and mould into the required shape. Instead of lampblack, 2½ lb. of sulphur may be used, or else, instead of the emery, 6½ lb. of graphite, 1½ lb. of yellow ochre, or else 20 lb. of zinc white.

Recipe 435.—**Elastic Compound for Cracks and Fissures in Horses' Hoofs.**

Heat 2 to 2½ oz. of gutta percha to 195° to 212° F., and then knead in 1 oz. of gum ammonia, until the mixture is homogeneous; cleanse the cracks and crevices, and heat the cement until it softens; then press it into the cracks with the heated blade of a knife. When cold it becomes hard, yet elastic and waterproof, and solid enough to permit of nails being driven in it.

Recipe 436.—**Rubber and Asbestos Compound for packing Pistons, Rods, etc.**

Melt gutta percha and mix it with an equal weight of asbestos. This compound is useful for rendering piston rods steam-tight, as there is nothing in it to set up corrosion of the metal.

Recipe 437.—**Moulding Compound for Universal Use.**

Dissolve 5 oz. of glue in 15 oz. of glycerine by the aid of a steam boiler, and then melt in the hot glue 35 oz. of resin, or else yellow wax, then add sufficient mineral colouring matter, such as zinc white or other oxide, to give a suitable colour to the composition, and put the hot molten mass into moulds made of plaster of Paris, wood or metal; 30 to 35 per cent. of mineral matter is about the right proportion, and half the wax can be replaced with gutta percha. The hardness of the compound depends on the right proportion of the wax or resin and glycerine; 25 oz. of resin and 25 oz. of glycerine with 50 oz. gives a soft consistence.

Recipe 438.—**A good Substitute for Gutta Percha.**

Mix together 50 oz. of powdered copal resin, 7 oz. of sulphur, and 15 to 30 oz. of oil of turpentine, and heat the mixture at a temperature of 298° to 300° F. and thoroughly stir it, then allow to cool to 100° F., and then add a solution of casein composed of 3 oz. of casein dissolved in weak ammonia to which some alcohol and wood spirit has been added, then heat the mixture to 300° F. until it has acquired the consistence of thin syrup, which should then be mixed with an ammoniacal solution of 15 to 20 per cent. of tannic acid. The compound is then cooled in cold water, rolled out and dried.

Recipe 439.—To deodorise Rubber Goods.

Pack them in charcoal dust in a box or closed pan, and then let them remain for several hours at a temperature of 94° F.; then remove the goods and wipe off the charcoal, when the odour of the rubber will have disappeared.

Recipe 440.—To render Rubber Goods light.

Mix together equal parts of linseed oil and alcohol of 36 per cent. strength, and rub this over the rubber tubing, then stretch it and rub it until nearly dry; repeat three or four times at intervals of several days.

Recipe 441.—To soften Rubber Tubing.

Dip it in petroleum, and dry it in the air, and repeat the process; or else mix 1 part of ammonia with 4 parts of water, and dip the rubber in the solution. Old hard rubber may be softened to a certain extent by exposure to an atmosphere of bisulphide of carbon, and then to the vapour of kerosene.

Recipe 442.—To join Rubber Tubing.

Wrap a sheet of note-paper round a piece of glass tubing or glass rod of a suitable thickness, then neatly trim the ends of the tube to be joined, cover the paper with flour of powdered soapstone, slip the tubing on the paper, then gently warm the edges of the ends to be joined, press them together, and when united and cold pull the rubber tubing off the glass.

Recipe 443.—An Insulating Paper for Electricians.

Melt some paraffin wax, steep the paper in the fluid, and hang up to dry, or else mix together 1 part of Canada balsam and 2 parts of essence of turpentine, saturate the paper with the mixture, and dry before use.

Miscellaneous Recipes.

(Not otherwise classified.)

Recipe 444.—A good Grafting Wax.

This can be made by melting together—

50 lbs. of resin
10 lbs. of beeswax, and adding
1 gallon of raw linseed oil.

As soon as the resin and wax have melted, drop 1 pint of the mixture at a time into a bucket of water (cold), keeping it away from the sides of the bucket with a stick. As soon as it is cool enough, stretch it and knead with slightly greasy hands.

Recipe 445.—Liquid Grafting Wax.

This wax, when properly made, may be readily applied to outdoor grafting without the trouble of binding, and it is also a good application to wounds made in pruning:—Melt 1 lb. of resin with 1 lb. of tallow, and when mixed remove from the fire, and allow it to cool till a scum begins to form, then add 1 teaspoonful of turpentine; replace on the fire, and add 7 oz. of a mixture composed of 2 parts of alcohol and 1 of water, stir briskly, taking care that the alcohol does not become separated, as it will if too hot. Apply the composition with a brush; if it gets too hard, remelt, and add a few drops of turpentine, alcohol, and water. It hardens after application.

Recipe 446.—Grafting Wax for Trees.

(1) Melt together— 2 oz. of pitch
2 oz. of resin
1 oz. of lard
1 oz. of beeswax.

(2) Melt together equal parts of resin and beeswax, and add enough tallow to produce the proper consistency.

(3) Take—10 oz. pure resin
2 oz. of tallow
1 oz. of turpentine
1 oz. of alcohol (or methylated spirit).

Melt the resin, then add the turpentine and then the tallow; finally, add the spirit and stir until cold.

Recipe 447.—Wax for stopping Trees bleeding when pruning.

Mix together 3 parts of powdered lime and 1 part of fine charcoal, and make into a paste with sufficient hot linseed oil in which a little yellow wax has been dissolved. Lay this over the wounded limb or branch with a brush.

Recipe 448.—A Cement not affected by Petroleum, or any of its Distillants or Carbon Fluids.

Dissolve 1 oz. of caustic soda in 5 oz. of water, and then add 3 oz. of resin, and boil until the resin is dissolved, then mix this with half its weight of plaster of Paris, zinc oxide, dry white lead, or precipitated chalk.

Recipe 449.—Cement for Iron.

(Foundry Cement for filling defects in Cast Metal.)

Melt together equal parts of black pitch and resin, and add a sufficiency of fine iron filings to form a stiff mass, and allow to become cold. For use, heat the defective parts of the casting, and lay a piece of the cement on it and press it into the defective part with a hot plumber's iron.

Recipe 450.—Cement for fixing Fire-clay Bricks and Sides in Iron Stoves.

Mix together in the dry state—
10 lb. wood ashes
10 lb. clay, and
4 lb. freshly-burnt lime (quicklime).

For use, make into a stiff paste with a little water.

Recipe 451.—Cement for Metals.

Mix together in fine powder—

10 oz. of washed quartz sand
10 oz. of lime, and
8 oz. of dry casein.

Make the whole into a paste with a little water and use it at once.

Recipe 452.—Cementing Flux for Cast Iron.

The properties required for a cement for repairing cast iron are that it will fuse under the influence of strong heat, and then finally adhere to the surfaces of the metal; these qualities necessitate its having the property of being very refractory. Such a product may be obtained by finely powdering and intimately mixing together 30 parts of solid clay, 12 parts of iron, 6 parts of manganese dioxide, 3 parts of common salt, and 3 parts of borax; the mass is then moistened with water, so as to form a thick paste, when it is allowed to dry very slowly, and it is finally raised to a white heat and then thoroughly fused.

Recipe 453.—Cement for Iron Articles, repairing Cracks, etc.

Mix together in powder by sifting 3¾ lb. of cast iron filings or chips, 2 oz. of chloride of ammonium ("sal-ammoniac"), and 1 oz. of flour of sulphur; when wanted for use, make into a stiff paste with a little water, and force it into the cracks. The ammonium chloride will chemically react on the iron and the sulphur, causing the composition to become a homogeneous mass that fills the cracks and will stand fire heat.

Recipe 454.—Cement for Steam Pipes.

Mix together in the dry state in fine powder—

2 lb. of litharge
1 lb. of slaked lime, and
1 lb. of fine sand.

When wanted for use, make into a stiff paste with hot linseed oil varnish, and use while fresh and warm.

Recipe 455.—A " Gasket " for Steam Pipes.

Melt 1 lb. of rubber in 2 lb. of hot linseed oil, and add 6 lb. of pipe-clay; this cement softens by heat, but does not melt.

Recipe 456.—Cement to resist Acids.

Gently heat 100 oz. of indiarubber until it melts, then add 6 to 8 oz. of tallow; stir well, and add sufficient dry slaked lime to make it more of the consistency of soft paste, finally adding 20 oz. of red lead, and mixing well.

Recipe 457.—Cement not affected by Acid Fumes.

Mix a concentrated solution of soda and powdered glue to a paste.

Recipe 458.—Waterproof Cement for Earthenware Tiles, etc.

Calcine some oyster shells, grind them to a powder, and sift it, then mix the fine powder into a paste with "white" of egg; it sets at once. This is an expensive cement if required in large quantities; a much cheaper one made on the same lines is obtained by mixing together lime and curdled milk (casein).

Recipe 459.—Waterproof Cement for China, Porcelain, and Glass.

Make a paste of hydraulic lime and silicate of soda (soluble glass), and use it at once, as it hardens rapidly (see also "Albuminous and Isinglass Cements").

Recipe 460.—Cement for fixing Luminous Paints. 7.287

Dissolve 1 lb. of clear white gelatine in 5 pints of boiling water, and stir in 3 lb. of sulphide of calcium and 1 oz. of glycerine, and keep the mixture warm while applying the paint to the surface to be coated. The calcium sulphide is the luminous ingredient. This calcium salt should be used in very fine powder and be properly prepared by calcination, otherwise it will not remain luminous very long.

Recipe 461.—**Cement for Gardeners' and Florists' Use.**

(1) Two or three applications of the following compound to an injured trunk or stem, will prevent the exudation of "sap," or "bleeding" as it is called.

Mix together—

1 lb. sifted wood-ashes
2 lb. yellow ochre
1 lb. of dry carbonate of lead
2 lb. venice turpentine, and sufficient linseed oil to make the whole into a putty consistence.

(2) Mix 3 lb. of powdered lime, 1 lb. of powdered charcoal, and make into a paste with sufficient linseed oil; apply with a brush.

(3) Melt 5 oz. of resin, then add 1 oz. of oil of turpentine, 2 oz. of tallow, and 1 oz. of spirits of wine.

This is used as a grafting wax.

Recipe 462.—**Cement for Gutta Percha, and similar Materials.**

Melt 1 lb. of resin, and stir in 2 lb. of tar, and when that is melted add the gutta percha, and stir well; for use re-soften by heat.

Recipe 463.—**Cement for Linoleums.**

The paste usually used for fixing linoleums absorbs moisture, whereby it decomposes and destroys the canvas texture of the linoleum, and as it decomposes the paste loses its adhesiveness; the same remarks apply to the use of paste for leather substitutes and wall coverings. As a better fixative, a patent has been obtained for the following compound, which, however, the author has had no opportunity of testing, so cannot say from experience how far it fulfils its purpose. To produce 100 lb. of the cement, take—

55 parts of treacle
25 parts of resin
10 parts of copal resin
5 parts of alcohol
5 parts of primol (this substance is a product of the distillation of asphaltum; it has a black colour, and mixes in all proportions with alcohol).

The method of incorporating the above ingredients is this :—Melt the resin and copal resins, then to the melted mass add the treacle, a little at a time, until it is all incorporated, then dilute the mass with a mixture made of alcohol and primol. From the writer's experience with treacle as an ingredient of cements, the purpose of such addition is to retain the compound in the plastic condition, and so prevent it drying to a hard, varnish-like mass. As sugar, glucose, and glycerine have precisely similar effects (when mixed with animal glue), it is possible that several varieties of the above patented composition could be produced.

The following, however, is a reliable composition that can be used as a cement for linoleums, floor-cloth, etc.

Recipe 464.—**Cement for Linoleums, Floor-cloth, etc.**

Ingredients.—7 lb. of soft manila copal resin
1 oz. of rectified petroleum
1 oz. of light American resin
1 oz. of resin oil (once distilled).

Dissolve the copal resin in the spirit, separately melt the resin, and add the resin oil to the melted mixture, then boil up the mixture until it froths, then allow to cool, and mix it with 5 to 6 lb. of the copal varnish; the mixture thus made can be thinned with more spirits if required.

Recipe 465.—**Composition for imitating Tortoise-shell.**

(1) Mix equal quantities of red lead and quicklime with soap lees, and lay it on the horn articles which are to be made to represent the shell, using a small brush so as to lay it on in spots to imitate the mottle marks of the real article. When dry, repeat the operation two or three times.

(2) Another process is to grind 1 oz. of litharge and 1½ oz. of quicklime together, with sufficient liquid carbonate of potash to make the mixture of the consistency of paint, then lay the composition on the horn in a manner likely to imitate the real shell, in three or four hours it will have produced the desired

effect; then wash off with water, and if the stain is not deep enough repeat the operation.

(3) The cementing of real tortoise-shell is effected by slightly warming the edges of the shell and pressing them together until cold.

Recipe 466.—**Composition for Dolls' Heads.**

Mix 50 oz. of clay, dried and powdered, into a paste, which is composed of 20 oz. of paper pulp and 30 oz. of plaster of Paris, and water q.s. The plastic mass is then ready for use.

Recipe 467.—**Composition for Artificial Coral.**

Melt 1 lb. of resin and mix with it 4 oz. of vermilion, and dip small twigs into the hot semi-fluid mixture and draw them out and allow to dry, or else paint the hot mixture on the twigs; then hold the coated twigs over a slow fire (charcoal is best), and twist them round, so as to cause the coating to assume a smooth surface; by using white lead, instead of vermilion, white coral can be imitated; other colouring matter can also be used. By adding a little venice turpentine to the resin it is rendered less brittle and not so chippy.

Recipe 468.—**Composition for Artificial Ivory.**

(1) Make an ammoniacal solution of shellac by digesting 4 oz. of shellac in 1 lb. of liquid ammonia, put the mixture into a revolving cylinder, and let the cylinder revolve for 5 hours at a temperature of 100° F. The shellac will be dissolved and a thin syrup formed; then add to this syrup 2 oz. of zinc white, mix thoroughly, and put through a colour mill, then place the compound in a warm place to draw off the ammonia, and use the resulting mass for moulding the figures of ornaments required by pressing it in suitable moulds.

(2) Dissolve 1 lb. of pure rubber in 16 lb. of chloroform, and mix the solution with pure gaseous ammonia, then distil off the chloroform at a temperature of 185° F., mix the warm residue with phosphate of lime or carbonate of zinc, press it into moulds,

and let it cool. The zinc carbonate produces the whitest and finest imitation of any, but the phosphate compound resembles the colour of natural ivory, as it contains a sufficient amount of the solid base substance (phosphate of lime), while the indiarubber serves in place of the gelatine, which cements it together; the compound thus prepared can only be distinguished from ivory by means of the microscope; the artificial compound shows an inorganic structure, whereas the slices of natural ivory exhibit the peculiar bony structure due to organic formation.

(3) Mix 2 oz. of white shellac (freshly bleached), 16 oz. of ivory dust, 9 oz. of acetate of lead, and 10 oz. camphor, fuse the ingredients together in a closed vessel, then allow to cool, reduce to powder, moisten with turpentine and press into moulds to form into the object desired.

(4) The following account of making an artificial substitute for ivory is from a French source; the bones of sheep and goats, and the whole of white skins, such as kid, deer, etc., are utilised. The bones are macerated for 10 to 15 hours in a solution of chloride of lime, and afterwards washed in clean water and allowed to dry. When dry, all scraps of leather, etc., are picked out and put into a specially constructed vessel and dissolved by steam, so as to form a fluid mass to which is added 2½ per cent. of alum. The foam is skimmed off as it rises to the top until the mass is clear and transparent. Any convenient colouring matter is then added, and while the mass is still warm it is strained through cloth of appreciable thickness, and received in a cooler and allowed to cool until it has acquired a certain consistence, so that it can be poured out on the canvas without passing through it. It is then drained on frames in the air and forms sheets of convenient thickness. Next, it is necessary to harden it, which is accomplished by keeping it for 8 or 10 hours in an alum bath that has been used before. The quantity of colouring matter necessary for the operation amounts to 50 per cent. by weight of the gelatine sheets; when they have acquired sufficient hardness they are washed in cold water and let dry in a frame at first. It is then turned or carved in the usual way.

Recipe 469.—**To render real Ivory flexible.**

(1) Steep in a solution of phosphoric acid having a specific gravity of 1·130, until the ivory practically loses its opacity, then wash the ivory in cold water and dry; the ivory thus treated is softened and can be subjected to pressure, but it hardens again by prolonged exposure to the air, although it is rendered readily plastic by immersion in hot water.

(2) Another process of softening real ivory is to steep it for several days in a mixture of 1 oz. of nitric acid and 5 oz. of water.

Recipe 470.—**A Substitute for Coloured Ivory.**

Melt together over a gentle fire in an iron pot—

1 part of pitch
2 parts of gutta percha
5 parts of orange shellac
6 parts of dry carbonate of lead.

Stir until a perfectly homogeneous mixture is obtained, then turn out the mixture into a cool vessel and colour it with aniline dyes mixed with dilute alcohol solution of shellac.

Recipe 471.—**Composition for Ivory Substitute.**

Grind to powder 60 parts of charcoal obtained from seaweed which has been previously heated with sulphuric acid and dried, and mix it with 10 parts of liquid glue, 5 parts of gutta percha, and 2½ parts rubber; the latter substances should be mixed with coal tar to render them gelatinous. Then add 10 parts of coal tar, 5 parts of pulverised sulphur, 2 parts of powdered alum, and 5 parts of powdered rosin to the mixture when heated to 300° F.; when cooled, a substance is obtained which is equal in many respects to genuine ivory.

Recipe 472.—**Composition to match Whalebone, etc.**

Melt at a gentle heat 2 lb. of catechu with 8¾ oz. of solid sulphur, 7 oz. of shellac, 9 oz. of magnesia, and 8 oz. of flour of sulphur; mix well, and when cooled cut it into suitable-sized pieces, which should then be heated in an oven at 250° to 300° F.

Recipe 473.—**Compound for Sizing Fabrics.**

In 20 parts of glycerine, dissolve by heating 10 parts of gelatine and 70 parts of dextrine, and then add 21 parts of sulphate of zinc.

Recipe 474.—**Composition for Dressing Textiles.**

Dissolve in water sufficient to effect solution—

10 parts of glucose (grape-sugar)
15 parts of sulphate of magnesia
$1\frac{1}{2}$ parts of potash nitrate (saltpetre)
5 parts of glycerine.

Dilute with water to register 6° Bé.

Recipe 475.—**Preservative Composition for Wood.**

Mix—

40 parts of lime
5 parts of rosin
4 parts of linseed oil varnish, and add
1 part of cupric oxide
1 part of sulphuric acid.

When applied hot with a brush it becomes as hard as stone, and is waterproof.

Recipe 476.—**Composition for preparing Disinfecting Paper, for wrapping up Meat and other Food-stuffs, for laying amongst Furs, etc.**

Melt 9 oz. of paraffin wax with $7\frac{1}{2}$ oz. of stearin, and then stir in 3 oz. of carbolic acid and dip the paper in this hot fluid, then hang up to dry, or else apply the hot fluid to the paper by means of a brush. Paper so prepared will prevent food decomposing, or furs and such like articles being attacked by moths.

Recipe 477.—**Cement for filling Holes, Cracks, etc., in Building Stones.**

Mix together in the dry state equal weights of fine sand and slaked lime, and then add dry casein, in powder, to the extent of 12 per cent. of the weight of the mixture.

Solders for Special Purposes.

Recipe 478.—**For Aluminium.**

(1) 8 parts of alumina
92 parts of zinc.

(2) 12 parts of alumina
88 parts of zinc.

(3) 15 parts of alumina
88 parts of zinc.

(4) 20 parts of alumina
80 parts of zinc.

In each case melt the alumina first, then gradually add the zinc, finally put in some fat, and stir the mixture with an iron rod and pour out the mass into moulds.

Recipe 479.—**For Flux.**

(1) Use 3 parts of copaiba balsam, 1 part of venice turpentine, a few drops of lemon juice.

Dip the soldering iron into the same flux.

(2) 2 parts of silver, 2 parts of tin, 1 part of zinc, 2 of lead.

Recipe 480.—**Argentine Solder (readily fusible).**

17½ parts of copper, 28 parts of zinc, 4 parts of nickel.

Recipe 481.—**Black Solder.**

16 parts of copper
24 parts of zinc
1 part of tin
20 parts of brass
6 parts of tin
1 part of zinc.

Recipe 482.—**Brass or Copper Yellow Solder.**

(1) Equal parts of copper and zinc.

(2) Copper, 32 parts; zinc, 29 parts; tin, 1 part.

(3) Zinc, 2 parts; copper, 1 part, and borax q.s.

All kinds of brass may be soldered with Bath metal solder (75 parts of copper, 21 parts of zinc) or soft spelter, using borax as a flux. A good plan is to spread on a little borax and water, and lay on a bit of tinfoil or thin leaf, then heat until the tinfoil melts and runs, and then coat the surface. Work previously tinned in this way can then be soldered readily and easily.

Recipe 483.—To solder Sheet Brass.

For soldering with a solder bit, use a solder made of 2 parts of tin and 1 part of lead; melt, mix, and cast in small bars.

For flux, dissolve zinc in hydrochloric acid (spirits of salts) until no more will dissolve, then add about one-tenth its bulk of sal-ammoniac, and dilute with $\frac{1}{4}$ bulk of water. Wet the surface to be soldered with the solution, using a piece of wood or copper wire for the purpose, then by rubbing the surface with the tinned portion of the copper "bit" a coating of tin will be imparted. Put both surfaces thus prepared together, and heat by applying the copper bit and a little solder to the outside of the seam. The soldering bit should be well "tinned" on the top, which may be done by heating the iron hot enough to freely melt pure tin. Rub a piece of sal-ammoniac on a slate, tile, or brick. Then rub the copper part on the brick with tin or solder in contact; the "tinning" of the upper part of the bit is essential for effecting the soldering.

Recipe 484.—To solder Brass to Platinum.

Put a piece of thin brass wire in a handle and flatten and file the end like the point of a soldering bit; dip the end in soldering fluid, and holding it in the flame of a lamp or gas-burner, run a little solder on it; now, having put the fluid on the platinum, which will require to be supported with a pair of fine tongs, place it near the flame, but not in it, at the same time heating the brass wire in the flame with the other hand, and as soon as the solder melts it will run on the platinum; only a very little should be used, and care taken that the solder does not run to the other side. Having applied the soldering fluid or resin to the brass, hold the two together in any convenient manner, and warm them in the flame till the solder runs. It is best to use resin for electrical work, unless the work can be separated and cleaned thoroughly.

Recipe 485.—**Solder for Iron and Brass.**

If the metals are not to be subjected to extreme heat after they are soldered together, the following method will prove successful if carried out as explained below. First make the iron clean and bright, then afterwards tin it by means of a little tin solder, and a small portion of clean resin as a flux. The iron should be kept well warmed while tinning it; when tinned clean the brass as bright and free from dust as possible, then afterwards tin it over with the same solder, using resin as a flux, then if convenient place the two pieces of metal to be soldered in a vice, place a small piece of solder between with a little resin, use the blowpipe; as the blowpipe flame becomes warmer between the two pieces of metal, the vice should be drawn together so as to ensure a close joint; when set the joint will be firm and strong.

Recipe 486.—**To solder Platinum and Gold.**

It is necessary that a small quantity of fine gold (18 carat gold) should be sweated until the surface of the metal is at nearly a white heat, so that the gold shall stick to the platinum; ordinary gold solder will adhere firmly to the face obtained in this manner. Hard solder acts partly, fusing and combining with the surface to be joined; platinum alone will not fuse or combine with any solder at a temperature anything like the fusing point of ordinary gold solder.

Recipe 487.—**To solder German Silver.**

Kill some pieces of clean zinc with spirits of salts, then clean the surface to be soldered by scraping clean and cover with the spirits of salts fluid, then lay on a piece of pewter solder to the joint, and melt with the blowpipe. For German silver goods a good solder is made by equal parts of silver and zinc, using borax as a flux.

Recipe 488.—**To solder Steel Joints.**

Use a solder composed of 3 parts of brass, 1½ parts of copper, and 28½ parts of silver. If the solder made will not run on iron or steel very well, lay on a thick paste of borax and perform the soldering operation quickly.

Recipe 489.—**To solder Zinc and Galvanised Iron.**

Dilute commercial hydrochloric acid with one-third its bulk of soft water and use this as a flux instead of resin. Keep the soldering iron well heated.

Miscellaneous Soldering Compounds.

Recipe 490.—**To Solder Iron and Steel.**

Fuse 2 parts of lead and 1 part of zinc.

Recipe 491.—**Fusible Solder for closing Steam Holes in Tinned Goods.**

Mix by fusing together—

10 parts of lead
16 parts of tin
1 part bismuth.

Melt the lead first, then add the tin, and finally stir in the bismuth; this makes a very soft solder.

Recipe 492.—**Solder for Brazing Steel.**

12 parts silver
2 parts brass
1 part copper.

Recipe 493.—**White Solder for Britannia Metal.**

(1) 50 parts tin
4 parts copper.

(2) 4 parts antimony
2 parts tin.

Recipe 494.—**Glaziers' Solder for "Leaded" Glass.**

5 parts lead
$1\frac{2}{3}$ parts tin.

This solder fuses at 500°F.

Recipe 495.—**Solder for Enamelled Metal.**

25 parts copper
7·07 parts silver
67·93 parts gold.

Recipe 496.—**Very refractory Solder for Metal to be Enamelled.**

18 parts silver
74 parts gold.

Recipe 497.—**Silver Solder for Plated Metal.**

Melt together 10 dwt. brass and 1 oz. pure silver.

Recipe 498.—**Soldering Liquids.**

(1) Cut up some clean zinc and put it in a bottle, and pour on some spirits of salts (hydrochloric acid) and 1 part of glycerine and 8 parts of water, so as to have a clear solution.

This is non-corrosive, but works slower than the ordinary soldering fluid.

Recipe 499.—**Soldering Paste.**

This is made by mixing starch paste with a solution of chloride of tin. This produces a liquid about the consistency of syrup, which is more readily applied to the soldering seams than ordinary soldering liquid. It is used for soft soldering.

Recipe 500.—**"Cold" or Chemical Soldering.**

This is a neat method of soldering small articles ; it is carried out as follows : Cut up a piece of tinfoil the size of the surface to be soldered, dip a feather in a solution of salammoniac and paint the surfaces of the metal, place these in the proper position with a tinfoil between, put it so arranged on a piece of iron hot enough to melt the tinfoil; when cold they will be found firmly fastened together.

Recipe 501.—Soldering Liquid for Copper and Bronze.

This liquid is prepared by mixing finely pulverised "cryolite," and a solution of phosphoric acid in spirits of wine.

Recipe 502.—Jewellers' Soldering Fluid.

Dissolve chloride of zinc in alcohol to make a saturated solution.

Recipe 503.—Magic Solder.

This, as sold in sticks in shops, is composed by melting together, in a crucible at a very moderate heat, 1 part of bismuth, 3 parts of tin, 2 parts of lead, and casting into slender sticks. Another form of magic solder consists in cutting tea lead into strips about 1 inch wide and rolling them up into a tube, and filling the tube with powdered resin.

Recipe 504.—Anti-oxidise for Silver.

To prevent the silver being oxidised while soldering, coat the surface that is not to be soldered with a paste made of whiting and water.

Recipe 505.—Solder for Pewter and Britannia Metal.

(1) Melt 10 parts of tin, 5 parts of lead, 1 to 3 parts of bismuth.

(2) Mix 3 parts of tin, 1½ parts of lead, 1½ parts of bismuth.

(3) *Solder for tin or pewter.*—2 parts of lead, 1 part of bismuth.

Recipe 506.—Soft Soldering Paste for use with Metal, Glass, and Stone.

Dissolve 1 to 2 oz. of sulphate of copper in 1 quart of water, and then dip in the fluid narrow strips of clean zinc, which will cause the copper to be precipitated as brownish metallic copper in the fluid. Collect the precipitate in a filter, and wash it several times with hot water; then put the washed mass into a Wedgwoodware mortar, and for every 3 oz. of it add 6 to 7 oz. of metallic mercury, add also a little sulphuric acid to assist the combination of the two metals when commingled; this forms a paste or amalgam which sets hard in a few minutes; while the paste is soft it should be made into small pellets. When wanted for use heat one or more of the pellets until the mercury oozes out from the surface in small beads, shake or wipe them off, and rub the pellet into a soft paste in a small mortar and filter; use a sheet of glass or tile with a glass muller until it is as smooth and soft as painters' white lead. This, when put on a surface previously amalgamated by the soda and mercury, adheres firmly and sets perfectly hard in about three hours. The joint can be polished if necessary, either by a hammer and cold chisel or by a heat about sufficient to melt plumbers' solder.

Recipe 507.—**Flux for Cold Soldering.**

Mix one part of metallic sodium with 50 to 60 parts of mercury, and shake up in a bottle until they combine; keep the amalgam in a stoppered bottle free from the air. It has the property of amalgamating (equivalent to tinning by heat) any metallic surface, cast-iron included. This is the sodium amalgam referred to in the above formula.

Recipe 508.—**Soldering Glass and China with Metal.**

This process is very useful in fitting up electrical and scientific apparatus. Supposing it is a glass tube that is to be soldered: platinum and glass have nearly the same expansive point, and on this account platinum can be fused in glass without the latter cracking when cold. In the present case we wish to coat the glass with platinum; this is accomplished as follows: Mix very neutral chloride of platinum with essential oil of camomiles, and having heated the glass, spread this mixture on the hot glass; the oil slowly evaporates, and when the white and odoriferous vapour ceases to be given off, the temperature is raised to a red heat; the platinum is then reduced, and covers the glass tube with a bright layer of metal; the metallised tube is then fixed to the negative poles of a battery of suitable energy, the surrounding fluid being sulphate of copper solution, and the current is started, when a layer of copper will be deposited on the platinum that covers the glass. This copper deposit should be very adhesive. The glass, when thus coated with copper, can be treated like a tube of genuine metal, and can be soldered.

Instead of being platinised, the glass may be silvered, by heating the glass, covered with nitrate of silver, to a heat bordering on red; the silver will then become reduced and an adherent deposit of silver formed on the glass.

CHAPTER VI.

SOLDERS OF ALL KINDS FOR ALL PURPOSES.

Table of Solders.

Name of Metal.	Composition in parts by weight.	Metal to be Soldered.	Flux to be used.
Soft, coarse	1 part tin 1 ,, lead	Tin	Resin or chloride of zinc
,, fine	2 ,, tin 1 ,, lead	Brass, copper, or zinc	Zinc chloride
,, fusible	2 ,, tin 1 ,, lead 1 ,, bismuth	Lead	Resin
Spelter, soft	1 ,, copper 1 ,, zinc	Brass	Borax
,, hard	2 ,, copper 1 ,, zinc	Copper and iron	Borax
Silver solder, fine ...	66·6 parts silver 23·4 ,, copper 10·0 ,, zinc		
,, ,, common..	66·6 ,, silver 23·4 ,, copper 3·4 ,, zinc	Brass, copper, iron and steel	Borax
,, ,, ,, ...	66·6 ,, silver 30·0 ,, copper 3·4 ,, zinc		
Silver	1 part silver 1 ,, brass	Brass and iron	Borax
,, more fusible ...	1 ,, silver 1 ,, brass 1 ,, zinc	—	Borax
Gold for 18 ct. ...	66·6 parts 18 ct. gold 16·7 ,, silver 16·7 ,, copper	—	Borax
,, more fusible ...	Same as above with a trace of zinc	—	
Platinum	Fine gold	—	Borax
Pewterers' solder ...	3 parts tin 4 ,, lead 2 ,, bismuth	—	Resin or zinc chloride
Plumbers' solder, coarse	1 ,, tin 2 ,, lead	—	Resin, fluxing point 800°F.
,, "scalded" solder ...	1 ,, tin 2 ,, lead	—	Resin, 441°F.

TABLE OF SOLDERS—*contiuued.*

Name of Metal.	Composition in parts by weight.	Metal to be Soldered.	Flux to be used.
Plumber's fine... ...	1 part tin 1 „ bismuth 1 „ lead	—	Resin, 370°F.
Tinners' fine solder ...	2 parts tin 1 „ lead	—	Resin or zinc chloride 340°F.
„ ordinary ...	1½ „ tin 1 „ lead	—	Resin or zinc chloride 334°F.
Bismuth solders ...	4 „ lead 4 „ tin 1 „ bismuth	—	Resin or chloride of zinc 320°F.
„ „ ...	3 „ lead 3 „ tin 1 „ bismuth	—	Resin or chloride of zinc 310°F.
„ „ ...	2 „ lead 2 „ tin 1 „ bismuth	—	Resin or chloride of zinc 292°F.
„ „ ...	2 „ lead 1 „ tin 2 „ bismuth	—	Resin or chloride of zinc 236°F.
„ „ ...	3 „ lead 5 „ tin 2 „ bismuth	—	Resin or chloride of zinc 202°F.

BRASS SOLDERS.

Name.	Composition in parts per 100.	Colour.
Very strong	58 parts copper 42 „ zinc	Reddish yellow
Strong	53 „ copper 47 „ zinc	„ „
Medium	50 „ copper 50 „ zinc	„ „
„	54½ „ copper 43½ „ zinc	„ „
Easily fusible...	34 „ copper 66 „ zinc	White
„ „	44 „ copper 50 „ zinc	Grey
„ „	4 „ tin 2 „ lead	„
White solder	57 „ copper 28 „ zinc 15 „ tin	White

TABLE OF SILVER SOLDERS.

No.	Name.	Fine Silver.			Shot Copper.			Brass.			Zinc.			Tin.	Arsenic.		Composition.		
		oz.	dwt.	gr.	oz.	dwt.	gr.	oz.	dwt.	gr.	oz.	dwt.	gr.	dwt.	oz.	dwt.	oz.	dwt.	gr.
1	Hardest silver solder .	1	—	—	—	5													
2	Hard	1	—	—	—	—	—	—	6	16									
3	Easy	1	—	—	—	—	—	—	10										
4	Best hard	1	—	—	4	9	—	—	—	—	—	—	15						
5	Medium	1	—	—	—	5	8	—	—	—	—	1	8						
6	Easy	1	—	—	—	6	12	—	—	—	—	2	4						
7	Common	1	—	—	—	9	15	—	—	—	—	2	9						
8	Enamelling	1	—	—	—	5													
9	,, ...	1	—	—	—	10													
10	Filigree	—	16	—	—	—	12	—	—	—	—	—	—	—	—	—	—	3	112
11	Quick running ...	1	—	—	—	—	—	—	—	—	—	—	—	—	—	20	—	10	
12	Chain	1	—	—	—	10	—	—	—	—	—	2							
13	Easy Chain	1	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	10	
14	Common	1	—	—	—	12	—	—	—	—	—	3							
15	Common easy ...	1	—	—	—	—	—	—	—	—	—	3							
16	Very common ...	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	

TABLE II. OF SILVER SOLDERS.

No.	Fine Silver.		Shot Copper.		Pure Spelter.	Tin.	Arsenic.		Composition.	
	oz.	dwt.	dwt.	gr.	dwt.	dwt.	dwt.	gr.	dwt.	gr.
1	1	—	5							
2	1	—	10							
3	—	16	—	12	—	—	—	—	3	12
4	1	—	—	—	—	2	—	—	10	
5	1	—	12	—	3					
6	1	—	3	—	—	—	2			
7	1	—	—	—	—	—	1	—	6	
8	1	—	—	—	—	5	5	—	5	
9	1	—	—	—	—	10	5	—		
10	1	—	—	—	—	—	—	26	15	

TABLE OF GOLD SOLDERS.

No.	Name.	Fine gold parts.	Fine Silver.	Copper.	Shot Copper.	Spelter.	Fusing point.	Colour.
1	Hard solder...	—	16	3½	—	½	1·866° F.	White
2	Medium ...	—	15	4	—	1	1·843° F.	,,
3	Easy... ...	—	14	4½	—	1½	1·818° F.	,,
4	Common hard	—	12½	6	—	1½	1·826° F.	,,
5	Common easy	—	11½	6½	—	2	1·802° F.	,,
6	Best gold solder ...	12½	4½	—	3	—	—	Coloured
7	Medium gold solder ...	10	6	—	4	—	—	,,
8	Common gold solder ...	8½	6½	—	5	—	—	,,

CHAPTER VII.

BRIEF NOTES ON THE CHIEF MATERIALS USED IN PRODUCING THE VARIOUS AGGLUTINANTS, FACTS AND DATA ALREADY GIVEN.

The following facts concerning the materials used as ingredients in producing agglutinants, are not intended to be exhaustive: space precludes full details of them. What is given, however, is fully sufficient to enable anyone to understand the capabilities of the several articles as regards their agglutinative and combining power. For fuller particulars the reader is referred to such technical works as "Thorpe's Dictionary of Chemistry," "Watt's Dictionary of Chemistry," or "Chambers' Encyclopædia."

An inspection of some of the foregoing formulæ will reveal the fact that many dissimilar materials can be combined to form a homogeneous mass, if the correct method of incorporation is followed; but unless a proper procedure be followed no such combination will occur. It is a common fallacy with many that the successful production of an agglutinant is entirely dependent on the mathematical exactitude of the proportion of the several ingredients.

In some few cases this idea is correct, but in the majority of cases success does not depend so much on the precise proportions of the ingredients as on the proper procedure in incorporating them. Such procedure is fully given with each formula, so that there is no need for the reader to make the mistake which one of the writer's clients did, who simply mixed all the ingredients higgledy-piggledy and then wondered why he failed to produce the compound he wished to.

Algin.

This substance is the name given to a brownish jelly-like mass obtainable from certain species of seaweed.

This jelly has a feeble adhesiveness, and is of an alkaline nature, because it is produced by boiling the seaweed in alkaline lyes.

Except as a sizing material for use in the textile industry, algin has not come into general recognition as an agglutinant; but the writer, who has had considerable experience with it, has formulated compounds that can be used for a great variety of purposes: such as the production of a compound for priming linoleum; the production of an elastic composition that can be used for producing cores for tennis and golf balls, etc.

Algin can be utilised in the production of elastic, waterproof and fireproof insulating compounds for electrical use, and as a substitute for gutta-percha and rubber in forming non-conducting coatings for electrical wire installations, and many other purposes. One of the pioneers in the production of algin for commercial purposes was the British Algin Company, of Holywell, North Wales.

Seaweed Jelly or Vegetable Gelatine.

The seaweed, collected by the native name of tenjusa, is carefully washed and afterwards boiled, so as to form a glue-like decoction, which is strained off and put into square boxes. When cool, it forms a stiff jelly, which can easily be divided into squares a foot in height. The manner in which the surplus water is removed is very peculiar: the jelly squares are exposed in the open air during a cold night and allowed to freeze; during the day the sun melts the frozen water, which runs off, leaving behind what one might term the skeleton. It is a white horny substance which is extremely light and easily dissolves in hot water. When cooled it again forms a stiff jelly.

This article can be used for a variety of purposes, for culinary use, the making of bon-bons and jellies, for clarifying liquids as a substitute for animal gelatines, for making moulds used by the plaster of Paris workers, etc. A French firm has invented and patented a method for the recovery of cellulose from seaweed, and also from the refuse of fucose—a gelatine substance suitable for impregnating tissues, leather, and wood—from seaweed.

In this process the seaweed is preserved from decomposing (as it is liable to do when piled on heaps) by spreading out the seaweed and sprinkling it with a 2 per cent. solution of some mineral acid. Algin, which is a different body obtained from seaweed, cannot be used because the algin is obtained by boiling the same seaweed with alkalies, such as soda salts, or else a 2 per cent. solution of zinc mineral acid, or a mixture of 1 part of heavy oil tar and 20 to 30 parts of water. The actual process of extraction consists in macerating the seaweed with acids in water to extract the saline matters, and leave behind the fibre and the gelatine. For example, to obtain an insoluble fibrous jelly, the amount of acid required is 5 to 10 parts per 100 of seaweed and 190 to 195 parts of water, according to the kind of acid used, and the degree of concentration of the latter (50% sulphuric acid, for instance, with an immersion of 15 to 20 minutes). To obtain a fine jelly, slightly soluble in water, 20 to 40 parts of acid and 160 to 180 parts of water will be needed with an immersion of 15 to 20 minutes, the reaction of the acid being allowed to continue for a month before washing. The mass is then washed by the use of a current of steam, either simple or under 3 or 4 atmospheric pressures, and is then placed in a filter press, when two products are obtained : a mass of cellular substance suitable for paper making, and a syrupy alkaline liquid containing the fucose; when treated with mineral acids, the liquor yields a coagulation of fucose insoluble in water and acids, but soluble in alkalines. The coagulated mass combines with alumina and with the oxides and salts of iron, zinc, magnesia, tin, etc., forming various gelatinous compounds suitable for impregnating fabrics, and the mother-liquor is concentrated and treated with chlorine hypochlorate, chloride of iron, and also salts of copper, for the extraction of iodine.

Albumen.

The albumenous substances used as agglutinative ingredients are blood albumen, the white of egg and casein, and the curd obtained from milk. These three bodies are used largely in the leather trade for dressings or finishing glosses; for dyed leather, egg albumen is largely used with lime, also to form quick setting cements for china and glass which are fireproof, and also insoluble. Casein is used in many ways; in fact, its capabilities are not yet fully developed. When dissolved in an alkaline solution or in diluted ammonia, a mucilaginous fluid is obtained which dries with a dull gloss, but when dry is insoluble in all menstrua; such a fluid forms a useful waterproofing vehicle for coating wallpapers, furniture leather, and other materials. When made into a thick mucilage or a pasty mass and made with lime, casein forms hard-setting cements that are useful for a variety of purposes.

Blood Albumen.

This is used in many preparations for dressing textiles, glosses, finishes, etc. To prepare such albumen, the blood is used fresh from the slaughter-house, because the quicker the coagulated blood is placed in sieves the brighter and purer the serum drawn off. The coagulated blood is cut up into cakes in inch cubes, and these are put upon the sieves, and allowed to drain off for 40 to 48 hours; the first drawings will be red, on account of red corpuscles being mixed with it, but in about 1 hour the serum draws off perfectly clear. This clear fluid is drawn off from the red sediment, and run into wooden vats having a capacity of 40 to 60 gallons.

The preparation of natural albumen is carried out as follows:—To every 100 parts of serum add 1 part of oil of turpentine, and agitate the mixture for 1 hour in a suitable vessel fitted with an agitator. The oil of turpentine forms ozone, which exerts a bleaching action on the albumen and withdraws also a mucilage from the serum and acts as a preservative. The agitation is carried on for about an hour; then the mixture is allowed to stand quietly for 24 to 36 hours, when the clear serum is drawn off from the sediment; the serum is then dried on iron trays which have been japanned or coated with paint and lacquer. These trays are about 12 inches long, 6 inches wide, and $\frac{3}{4}$ inch deep; the temperature of the drying room must be about 122° F., and is generally raised for 2 hours to 125° to 130° F.; it is then lowered to 100° to 105° F., and kept at that temperature for 24 hours, when the drying is finished.

Patent Albumen.

This is prepared as follows : Mix together 12 fluid oz. of sulphuric acid, 2 oz. of concentrated acetic acid, and 30 oz. of water, and mix this with 500 oz. of serum; then add 14 oz. of oil of turpentine to the mixture and agitate the whole for 1 hour ; then let the mixture rest for 24 to 36 hours, and draw off the clear serum, neutralise with ammonia and dry it. The yield of dry albumen obtained is about 10 per cent. of the coagulated blood.

A "second" quality of albumen may be obtained by treating red coloured serum, and the sediment even, may be made to yield a "third" quality of albumen by agitating it with water, while the residue of the blood may be dried at a temperature of 145° to 169° F. in sheet iron pans.

Egg Albumen.

This should be clarified by skimming, and if the purpose for which it is to be used permits, a small percentage of glycerine may be mixed with the white of egg. All traces of yolk (which contains an oil, and also sulphur) should be removed from the white.

Acetic Acid and Acetone.

Acetic acid is the commercial name for vinegar. It has the composition $C_2H_3O_2$. It is a fluid which is prepared by the oxidation of alcohol by several processes ; it is also produced by the distillation of wood, when the crude acid thus obtained is known as *pyroligneous acid*. It is used in making cementative compounds, and as a liquefier of gelatinous bodies, whereby they are prevented from gelatinising and form liquid compounds. (See "Liquid Glues.")

Acetone is a colourless liquid that is obtained by the distilling calcium acetate or by oxidising acetic acid vapour. It has the composition C_4H_6O, and is useful as a solvent for resinous bodies and celluloid to form varnishes or agglutinative cementing compounds where resin forms one of the components.

Alcohol, Ether and Methylated Spirit.

The word "alcohol" commonly refers to ethyl alcohol (*i.e.* spirits of wine), which has the chemical composition C_2H_6O. This fluid and its allies of the same group may be looked upon as consisting of the radical C_3H_5, added to one molecule of water (H_2O). It would be outside the scope of the book to go into details concerning various alcohols, so the reader is referred for full particulars to special chemical treatises, such as "Watts' Dictionary of Chemistry," or some other standard work of reference.

To enable alcohol to be used for industrial purposes, but at the same time not fit to drink (brandy, whiskey, etc., are spirits the base of which is alcohol), the spirit is mixed with some non-drinkable spirit (or methylated, as it is termed), such as acetone or wood alcohol. In recent years, however, it has become the practice to produce a methylated alcohol with mineral fluids, such as benzol, petroleum spirits, etc. Although such fluids do not naturally interfere with the use of alcohol in the painting trades, yet the spirit that has been methylated with a mineral oil is not to be recommended for use in effecting the solution of resinous bodies. As alcohol very readily imbibes water, even from the air, it becomes weaker in strength if left exposed to moist air, and if of very weak strength becomes useless as a solvent of resins. Absolute alcohol is alcohol which has been rectified so that there is practically no water in its composition. Proof spirit contains 50·8 parts by weight of alcohol to 40·2 of water, and possesses a specific gravity of 15·5. When methylated, it is usual to add not more than 10 parts of the adulterant to 90 parts of alcohol.

Ether is a spirituous fluid that has the composition of $C_4H_{10}O$, and is used as a solvent for resins when alcohol is too weak to dissolve them, and differs from common alcohol in belonging to the dicarbon alcoholic group.

Chloroform ($CHCL_2$) is a product formed by the action of chlorine on marsh gas. It is used as a solvent for resinous matter, gutta percha and rubber. When inhaled, it acts on a person's nervous system in such a way that he is rendered insensible to pain, or even rendered unconscious if inhaled in large quantities.

All these spirits are volatile and inflammable, and, with the exception of common alcohol, injurious if inhaled too freely. When employing them as solvents of resinous bodies, it is usual to warm the spirit, which is best effected by standing the vessel containing it in another vessel holding hot water, so that the temperature shall not be too high. A high temperature would vaporise the spirit and be liable to cause an explosion by ignition.

Arabic or Gum Acacia.

A solution of gum arabic mucilage contains sulphur, and an acid, which renders the mucilage liable to decompose (become mouldy) and cloudy. These defects can be remedied by mixing 1 part of lime with 4 parts of distilled water, and dissolving the gum in the fluid. When the gum has dissolved, a few drops of sulphuric acid are added, the lime will then be separated as insoluble sulphate of calcium, which will settle as a sediment, leaving a clear solution of the gum that will not decompose ; the clear liquid should be decanted from the sediment and separated by straining the fluid. In the case of inferior gum acacia, the gum should be first moistened in alcohol before dissolving in the lime water.

Beeswax (bleaching of).

A slow, tedious process of bleaching is to form the wax into thin layers after melting it and pour it out into shallow trays and exposing these shreds to sunlight, which will oxidise the colouring matter and destroy the yellow tint. This process is not only long and tedious, but produces only a surface bleaching, and to carefully bleach the whole of the wax it requires to be remelted and cast into sheets and exposed to the sun several times. Another way of bleaching is to mix the melted wax with certain essential oils, which take up oxygen from the air in the form of ozone. Oil of turpentine is the oil most frequently used. Thus a mixture is made of $1\frac{1}{2}$ to 2 parts of turpentine with 8 parts of the wax, and the mixture so heated that the oil begins to evaporate. Then the wax is run into bands or ribbons, and spread out to bleach in the sunlight. By this means the bleaching operation can be completed in a week, whereas by the former method three to four months of exposure to the sun's rays are required. The mixture of wax and oil must not be heated too strongly, otherwise the mass is rendered dark brown and emits an unpleasant odour. Only until the temperature volatilises should the heat be continued. When properly heated, the mixture of wax and turpentine becomes dark, and a black substance separates out from it which must be filtered off through a closely woven linen cloth before exposing the wax to the bleaching process. Metal vessels should not be used for the purifying of the wax and oil, only enamelled ones or better still porcelain vessels.

Bisulphide of Carbon, CS_2.

This is a most evil-smelling fluid, of an oily appearance. It is volatile, inflammable, and poisonous when inhaled, because it is very solvent of animal matter: 1 part by volume or weight will dissolve 5,000 times its bulk or weight of animal matter; consequently, if it gets absorbed into the blood of the operator, the blood will be decomposed, and illness or even death occur. On this account all operations with this fluid should be carried on in the open air, or under a strong current of air (such as a chimney flue) that carries the vapour away from the operator. Another reason for manipulating this fluid in the open air is, that it is highly explosive; 1 volume of the liquid expands to 10 volumes of gas, and as its vapour (*i.e.* gas) ignites at a very low temperature, below zero in fact, all manipulations with this fluid should be carried on out of reach of a naked flame or indeed heat of any sort.

The chief use of carbon-bisulphide in cement making is for effecting the solution of gutta-percha and indiarubber; but as there are other solvents practically as good, it is best to dispense with CS_2.

Besides dissolving the above solids, carbon bisulphide dissolves sulphur and phosphorus. A bit of solid phosphorus dissolved in carbon bisulphide forms a dangerous fluid, because if such fluid be poured on any organic body, such as a piece of paper, the finely divided phosphorus that was dissolved in the fluid penetrates the fibre of the paper and is rapidly oxidised by the oxygen of the air, so rapidly in fact, that combustion occurs, setting the paper on fire. A solution of caoutchouc in this fluid will form a thin layer when the solution is poured over a plate of glass and dried off, because the carbon bisulphide rapidly evaporates, leaving behind only a thin layer of rubber. Carbon bisulphide is insoluble in water, and will not mix with it.

Caoutchouc.

This is the native name for indiarubber; it is a compound of hydrogen and carbon, and is obtained as an inspissation by making an incision in the bark of the rubber tree, and collecting the thick viscid fluid that exudes in the cup of clay applied to the trunk below the incision. In the pure state, this inspissation of gum is of an ivory white with a greyish instead of a yellowish tinge.

Indiarubber chemically combines with sulphur, and when such compounds are submitted to a certain temperature it becomes "vulcanised," forming an elastic insoluble substance that is non-miscible in water, but more or less soluble in several hydrocarbon solvents, such as carbon bisulphide. Mineral matters are usually incorporated in the rubber and sulphur compounds so as to produce compounds suited for various purposes. By heating the sulphur and rubber to a high temperature, it loses its elasticity to a large extent, and forms a black, horny mass, known as "ebonite" or "vulcanite," which is largely used for insulating purposes in making electrical machines, etc. Gutta percha is also the hardened gum of a tree similar in nature to rubber, but different in its physical properties; it is insoluble in alcohol, but soluble in ether, petroleum spirit, oil of turpentine, etc.

Carbolic Acid, Oil of Cloves, Camphor and Essential Oils.

These bodies are used in cements, mucilages, farina pastes, and in gelatine compounds to prevent putrefaction or decomposition occurring. In the case of camphor, that substance is also used in making alcoholic solutions of resins so as to facilitate their solution in the menstrum.

Casein (*i.e.*, the Curd of Milk or Cheese).

This is the "curd" which is formed when milk is coagulated (curdled), by means of rennet, acids, or the formation of lactic acid by warmth.

When separated from the whey and washed, it can be dissolved in alkaline fluids to form solutions which are of a more or less agglutinative nature; such solutions are capable of acting as binding vehicles for a variety of substances, whereby a large number of useful compounds are obtainable. If, instead of dissolving the "soft" (*i.e.* fresh washed and dried) curd, it is pressed and dried in suitable temperatures, the casein dries up to a fine powder very much like grains of sand with a pale to a straw yellow colour, this dry casein can be kept indefinitely, provided it be kept in a dry place, and is soluble at any time in suitable menstrua, to form solutions of an agglutinative or varnish-like nature. For example, when dry casein is dissolved in strong liquid ammonia, a thick varnish-like fluid results, which can be used on paper and other materials as a varnish, which dries with a gloss, and which is practically waterproof when dry.

In other cases, carbonate of soda, sodium hydrate, silicate of soda or of potash and borax dissolve casein, dry or moist, to form solutions which are available as binding materials for the production of waterproof and fireproof paints, for compositions to imitate horn and ivory, and many other substances. When fresh milk is curdled by mixing rennet with it, casein is obtained which is used for making cheese, but for industrial purposes the fresh milk is curdled by the addition of acids which cause a separation of the casein from the whey in a coagulated mass. The yield of casein in any case is about 2 to 2½ per cent., the average being about 3 per cent. The milk sugar, lactic, and other valuable constituents of milk are retained in the whey-milk, from which they can be separated by suitable means. The curd, as it is termed, is insoluble in water or dilute acids, but concentrated acids and solutions of alkalies dissolve it, whereas formalin (formaldehyde) converts it into a tough insoluble mass that can be employed in a number of useful processes in the industrial arts. By the action of prolonged warmth upon fresh milk its constituents become separated with the formation of lactic acid, and the presence of this acid in the milk will cause a separation of the curd.

Casein is not dissolved in fresh milk, but is present in a suspended form. When the milk is curdled the lime in the milk is separated from the casein, and the latter separates from the fluid in a solid form ("soft curd"). Fresh milk is very rich in fats (butter, etc.), which interferes with the presence of the precipitaton of casein, therefore it is usual to employ skimmed milk for the production of casein. On this account, the production of casein should become a valuable adjunct to the dairy, because of its many serviceable applications in the arts, and on account of its comparative high price—60*s*. per cwt. The purest form of casein is that obtained when acids are used as the precipitating agent. The temperature of the milk should not be higher than 140° F., nor lower than 68° F. When precipitating by rennet, only a very small percentage of rennet is required; in fact, only small quantities of any other acid are required to precipitate the curd from skimmed milk. The rapidity of production, and the contractile power of the casein produced, is dependent on the strength and amount of acid used.

To fit the casein for use for industrial purposes, it must be washed free from all traces of acid, pressed to expel all moisture, and either dried to a condition that permits of its crumbling to a powder or else be dissolved in suitable menstrua. Sulphuric acid may be used, or nitric acid, as the precipitating agent; the former causes precipitation at once, but with the latter a little time is required for the acid to operate before the curd separates and is deposited at the bottom of the vessel. The amount of nitric acid required is ½ to ¾ per cent. of acid of 1·300 specific gravity mixed with 4 times its own weight of water.

When the casein is required extra pure, it can be precipitated from the skimmed milk by a mineral acid, such as sulphuric; then separated from the whey, washed and dried, curd is thus obtained. It should then be dissolved in an alkaline fluid, from which it is again precipitated by means of lactic acid.

Then the re-precipitated casein is again washed free from all acid, pressed and dried, or used as "soft" curd for forming solutions. Instead of mineral acids, the "vegetable" acid, acetic, may be used for precipitating the curd. The whey should be tested from time to time to ascertain whether all the curd has been precipitated. The test is made by adding a little acid to a small quantity of whey that has been separated from the bulk of deposited curd. If more casein is still precipitated from the whey, then the bulk of it should be further treated with acid so as to precipitate all the curd; the precipitated curd is drained from the whey, then washed, first with cold and then with warm or hot water, after which it is pressed and dried, or used in its soft state.

The chemical composition of casein is as follows:—

Carbon (C)	52·9	per cent.
Hydrogen (H)	7·0	,,
Nitrogen (N)	15·6	,,
Oxygen (O)	22·7	,,
Sulphur (S)	0·7	,,
Phosphorus (P)	0·8	,,

As the applications of casein to industrial purposes are only just being put to practical use, there is a big future before casein, but to enlarge on its merits here would be to unduly increase the bulk of this book. As the book on "Casein" already referred to contains data collected from various English and foreign sources that have been published during the last fifteen years or so, it forms a useful book for those who want to prepare or exploit casein as a commercial substance.

Celluloid.

This is a product of nitro-cellulose and camphor, and, as a consequence, is very inflammable; even a warm room will cause it to undergo spontaneous decomposition, with the emittance of dense white fumes. There are several varieties of nitro-cellulose, distinguished by the prefixes mon- di- tri- or tetra-, and the production of cellulose is usually obtained from a mixture of the last three forms. The composition of the mixture varies, and these varieties may be the cause of great difference in the thickness of the solution of different batches, a fact that should not be lost sight of in making celluloid varnishes. One of the best solvents for celluloid is amyl acetate, which should be perfectly pure to effect a perfect solution.

Celluloid can be prepared from many vegetable substances which are rich in cellulose, such as cotton, linen, hemp, white rag, unsized paper, and they are dried at the temperature of boiling water (212° F.), ground up, and stored in a place free from moisture. The vegetable substance is then converted into pyroxylin by steeping it in acids. The following is an outline of the process:—The material is put into a glass vessel, or one not capable of being acted on by acid; three such vessels are required. The cellulose is put into one of the vessels and soaked in acid for 10 to 15 minutes; it is then pressed out and put into a second vessel containing fresh acid, which consists of 3 parts of sulphuric acid of specific gravity 1·834 and 2 parts of concentrated commercial nitric acid. The material is steeped in the mixed acid for several hours until the cellulose is converted into pyroxyline, when the mass is spread and freed from adhering acid by washing it in the third vessel in water. It is then pressed out, put into tanks that rest on an inclined plane, and a stream of running water allowed to flow over it. When sufficiently washed, the pyroxyline is converted into celluloid thus:—40 to 50 parts of camphor per 100 parts of pyroxyline are mixed together, and put into some strong fabric capable of great resistance; these bundles are enclosed in bags made of horsehair and placed between the plates of a warm press and subjected to a pressure for an hour or more. The contents of the bags are then removed and the compressed cakes are put into a heated cylinder press and next into an apparatus containing a vacuum, while the jacket surrounding the cylinder contains such substances as chloride of calcium, concentrated sulphuric acid, etc., for the absorption of water; resins and other substances containing resinous matter may be incorporated with the product to obtain uniformly coloured or marbled masses. Cellulose thus produced is plastic when heated, and may be cast. It is inflammable, but may be made incombustible by washing the pyroxyline in a solution of soda silicate, incorporating it with phosphate of ammonia, or soda, borate of lead, or such fluxes as are used in porcelain and glass painting.

A simple process for preparing celluloid consists in dissolving 50 parts of gun cotton in a mixture of 100 parts of ether and 25 parts of camphor, and evaporating the solvent from the resulting jelly-like mass until it is plastic. It is then exposed in plates to the air until it is hard and capable of taking a polish.

Celluloid Billiard Balls.

These are prepared by rolling several plates together and rasping the new-formed plates into a coarse powder. This is dried at 222° F., pressed into suitable metallic moulds, and heated for $1\frac{1}{2}$, or at the most $1\frac{3}{4}$, hours at 248° F.

As regards other forms of celluloid, or "vegetable" celluloid as it is called, potatoes form a useful material for producing it. A process carried out as follows gives good results: Pared potatoes are steeped for 36 hours in a mixture of 8 parts of sulphuric acid and 100 parts of water; the mass is then washed and dried between sheets of blotting paper, and pressed by means of a strong press.

Masses resembling ivory can be produced, which can be utilised for the production of billiard balls, etc., by steeping the potatoes in a solution of sodium hydrate of 3 per cent. strength, instead of sulphuric acid; the mass becomes more elastic, but of a dirty white colour. If steeped in a stronger alkaline solution, such as a soda lye of 19 per cent. strength, a stringy, hornlike mass is obtained, which can be worked and used for many of the purposes that real horn is used for, such as the production of combs, for ornaments for ladies' hair, etc.; Turnips may be used instead of potatoes. These compounds can be coloured with aniline dyes. The product obtained from turnips is "coraline," or coral celluloid.

The moulding of celluloid articles is carried out as follows:—The cellulose material is converted into pyroxyline by steeping in a mixture of sulphuric and nitric acids, and is then removed from the acid, washed in water, and allowed to dry for 12 to 24 hours. Then this mass, while still warm, is put into a solvent, such as methyl-alcohol, ethyl-alcohol, sulphuric ether, to which gums, balsams, resins, colouring matters, etc., have been added, the solvent being mixed in the proportion of $\frac{1}{4}$ gallon to $2\frac{1}{2}$ lb. of pyroxyline, but the quantity varies according to circumstances. The proportions of the other ingredients also vary according to the colour, tenacity and degree of hardness of the mass. The mass is then heated in a suitable vessel at 150 to 220° F., whereby it becomes plastic. It is ground, thoroughly mixed, and dried at a temperature not exceeding 150° F., when it is put, while still plastic, into the desired mould.

The working of cellulose is carried out in a similar manner to the treatment of all hornlike substances; the same instruments may be used for turning, boring, and planing it. By heating it to 165° F. it becomes sufficiently plastic to assume any desired form.

It is necessary to heat the mould, which should be of brass, before pressing the celluloid article; which should be cooled off in the mould by means of cold water. The length of time for the celluloid to remain in the mould depends on the temperature; if it be below 165° F., only a few minutes in the mould are sufficient.

For polishing celluloid, very fine pumice stone and powdered emery, mixed together in equal quantities and kneaded into a dough with hot soap (free from resin), is used. This compound is dried, and then spread upon the polishing instrument. When the articles are to be punched or pressed from the material, the cellulose should be heated in water at a temperature of 100° F., so as to prevent it tearing and splitting off. If, in working, the celluloid becomes brittle, it is softened by dipping it for a few minutes in spirits of camphor. The finished article should not be kept in airtight boxes, as this will prevent the evaporation of the camphor, and so cause the celluloid to undergo incipient decomposition.

For cutting celluloid with iron tools, worked quickly to and fro, as in sawing, considerable heat is generated, which will so soften the celluloid as to render it unworkable; in such a case, water should be allowed to trickle on the cutting or sawing tool.

The cement for fastening celluloid on other substances is prepared by dissolving 1 oz. of shellac in 3 to 4 oz. of methylated spirit (not methylated with mineral oils), and adding 1 oz. of camphor, or else dry scrapings or raspings of celluloid, and dissolving it in alcohol of 90 per cent. strength.

Dextrine, Starch, and Vegetable Gums.

Dextrine is very similar to starch in composition, in its chemical formula also, and also to sugar, its formula being $C_6H_{10}O_5$; it is called "dextrine," because a solution of it rotates a ray of polarised light to the right, and it is also called "British gum," because made use of for coating postage stamps, the dextrine is produced by the action of a small percentage of nitric or hydrochloric acid on starch, and heating the compound, whereby a mass is obtained very much like gum arabic mucilage.

Dextrine can also be produced, together with dextrose ("grape sugar"), by the action of malt extract upon sugar. On boiling with dilute acids, dextrine is converted into dextrose; although soluble in water, it is insoluble in alcohol. Other starches besides "farina" may be used for the production of dextrine.

To test the purity of dextrine, put a few grains of the dextrine in a test tube and pour on it almost 50 times its weight of pure cold water, shake up the mixture, and then let it rest for 10 minutes. If pure, the dextrine will dissolve completely and form a clear solution; add a little water to the residue, heat to boiling and let it cool, and add a few drops of iodine water; if a blue colour appears, it indicates the presence of starch; pure dextrine does not give a blue colour.

Starch.

Starch has the same composition ($C_6H_{10}O_5$)—it is identical, in fact, with dextrine. Some starches have a different composition, but always a multiple of these numbers. Starches are obtained from vegetable substances, and form granules of a distinctly organised structure, but vary in size (see "Farine"). Starch granules are insoluble in water (cold), in alcohol, and ether, but when heated with water to temperatures of 70° to 72° F. the granules split and form a thick mass called starch paste.

Gluten.

Gluten differs from starch in being vegetable, and is combined with starch in wheat flour. It has a composition of which the ultimate constituents are: Carbon 53·5; hydrogen 7·0; nitrogen 15·5; oxygen 22·0; sulphur 1·6; phosphorus 1·4.

Vegetable Fibrine.

This has similar constituents in the following proportion: Carbon 52·7; hydrogen 6·9; nitrogen 15·4; oxygen 23·5; sulphur 1·2; phosphorus 9·3.

Casein.

Casein has the same constituents in the following proportions: Carbon 53·0; hydrogen 7·2; nitrogen 15·6; oxygen 22·5; sulphur 6·9; but no phosphorus.

Gum Arabic.

Gum Arabic is a natural exudation from several species of acacia, and consists principally of the potassic and calcic salts of Arabic acid, and has the composition $C_{12}H_{20}O_{10}$.

Dextrine.

Dextrine is a substance prepared from starch by moistening it with acid and drying it at a certain heat. The following details for the preparation of dextrine will show how to proceed: Mix 4 oz. of nitric acid of 36° to 40° Bé. with $3\frac{3}{4}$ gallons of water, and mix this fluid with 125 lb. of dry potato starch, and then put it in a gentle oven, to dry the mixture into cakes that can be readily broken. Then crush up the dry shining compound and spread it on the floor of a drying closet in a layer $\frac{1}{2}$ to 1 inch thick, and keep the temperature at 230° to 248° F. for $1\frac{1}{2}$ hours; if the temperature be raised, the white colour of the dextrine mass produced will be changed to a buff or brownish yellow.

Items *re* Flour Pastes.

Common wheat flour produces many forms of agglutinants, the simplest of which is a paste, which consists in its elementary form, of flour made into smooth batter with cold water, on which boiling water is poured so as to separate the gluten, and cause the latter to thicken, which is then in a tenacious, sticky form, and exhibits power as it dries, and thereby causes any substance that has been spread with the paste to adhere to any other surface on which it is laid. Until the flour is cooked by hot water, the flour paste or batter has no adhesive properties. The paste made with wheat flour is thick and opaque, of whitish buff colour; but other cereals give pasty masses under precisely similar conditions, that are semi-transparent and greyish in colour, such, for example, as the thick paste obtained by cooking potato starch (farina), cornflour starch (maize), arrowroot, etc. The tenacious qualities of the pastes obtained from the flour of cereals is due to the gluten constituent that is separated; but by suitable means both the gluten and albumen can be separated, and as both these bodies possess adhesive powers the pasty mass is of double tenacity when both gluten and albumen are separated.

Alkalies have the power of causing such separation, especially liquid ammonia. By suitable operations the farina or wheat flour can be converted into a stiff, jelly-like mass that will never decompose but will dry up to a horn-like mass, which when dry can be powdered, and then made into a paste: this is the principle of the cold water paste, which, when a little of the powder is added to ordinary flour paste increases its adhesiveness. There is one disadvantage, however, in such pastes: they are of an alkaline nature, and therefore not adapted for all the uses for which a paste is required. For example, the alkali would discharge the colour of fancy coloured papers, such as on linings, and on coverings of cardboard boxes, also the colour of lithographed paper labels, but this alkalinity can be neutralised by the addition of acids to the paste: formulæ for such pastes will be found elsewhere in this volume.

Owing to the organic nature of the flour of wheat and other cereals, decomposition is liable to be set up by the flour fermenting. When made moist, to counteract such fermenting it is usual to add a little carbolic acid, or some of the essential oils, such as oil of cloves, cinnamon. The acid is not always suitable, as it has an unpleasant odour, but it is the most antiseptic body obtainable.

For special purposes it is often necessary to make a compound paste wherein flour is the chief ingredient, but to which glue, gelatine, dextrine, glucose, and other bodies are added so as to impart some special characteristic, or to adapt the paste for some particular purpose. It is not an easy matter to separate each kind of paste into classes according to ingredients, so no attempt has been made to do so in the formulæ given, but as each formula specifies its chief use, it will be easy to find the formula most suited for one's purpose. The usual way of making flour paste is to sprinkle some flour into cold water, and stir so as to prevent it falling into lumps, and make a smooth batter which is as thick as syrup, and then pour boiling water on this flour batter slowly, and stir all the time until the mass thickens. It is not advisable to boil the mixture, because the heat would decompose the flour and cause the pasty mass to become more or less liquid.

In making compound flour pastes the process of incorporation of the ingredients will vary. Sometimes they require to be added to the flour already made into a paste, in other cases the flour is required to be added to the other ingredients in the form of a fluid batter, and the mixture heated until the flour is cooked (*i.e.* thickens).

It is in not carrying out the precise instructions for incorporating the several ingredients that failure to make a suitable agglutinant compound occurs. If failure results at the first attempt, repeat the operation, closely following the instructions, and watch carefully for the cause of the first failure, it will seldom fail to be discovered when making the second batch of paste.

The addition of fermentative bodies to glue pastes, such as glucose, or of decomposible animal bodies like glue and gelatine, often tends to the production of a compound that will not remain fresh for any length of time: the incipient decomposition which such compounds experience may be arrested by the presence of antiseptics, but the writer has found that there are two chief factors to be guarded against to preserve such compounds from decay, they are moisture and confined air. If the pasty mass be exposed to the air in a damp place, rapid decomposition occurs; while if the paste mass be confined in a vessel in which there is a modicum of air between the paste and the lid, mildew, mould, and other fermentative changes take place, whereas if the pasty mass be kept in a tin having a patent lever lid, and the tin be filled up close to the lid so as not to leave any space, the pasty compound will keep undecomposed for a considerable time.

Items *re* Farina

Pastes made with farina do not usually possess the stiffness or consistency of paste made with wheat flour or rye flour, and as a consequence are not so suitable for special purposes as flour pastes, such, for example, as for wallpapers, strawboards, and affixing the letterpress portion of books to their cases. To adapt farina pastes for special purposes, glue, silicate of soda, and other ingredients require to be added to the farina; the presence of animal matter, such as glue, with farina, increases the liability to decomposition, and the presence of silicate of soda is, in many cases, detrimental, because when such pastes are kept in a confined space they liquefy.

Next to the farina component, the chief one, from the paste maker's point of view, is the gluten, a component of wheat flour.

Composition of Wheat Flour.

Wheat grains are composed of exterior integument or shell covering the nourishing matter (the farina constituent), comprising 14 to 16 per cent. of the weight of the grain, when it is good, but in poor grain the proportion is larger. It generally happens that no more than one-tenth, and frequently one-eighth, is removed by grinding. The floury part of the grain is composed of vegetable gelatine, gluten, oil, and albumen, febrine starch, sugar, gum, water, and organic matter. These constituents are divided into the nitrogenous and non-nitrogenous class. The former consists of the gluten, albumen and oil, and the latter includes the starch, sugar, gum, and inorganic salts.

The following few facts concerning the composition of wheat-flour will be interesting :—

If the wheat flour be kneaded with a little water, or better still, if a small stream of water be directed on to the flour, which should be spread on a thin cloth, the flour becomes entirely disintegrated, because the soluble portions are dissolved in the water and carried away as it passes through the cloth; at the same time the small starch granules are mechanically taken up, and there remain the tough substances unaffected by water. The water as it first percolates through the cloth becomes milky in appearance, and the matter strewn on the filter or cloth, shortened, and more porous, up to a certain point. As the filtrate passes off clear, the mass remaining, agglutinates into a compact body which is known as crude gluten, but really consists of vegetable gluten and fibrin; crude gluten does not swell when treated with water, but combines with a definite quantity, acquiring a certain degree of tenacity, which, however, is not increased by any further addition of water. It is not liable to decomposition. According to one authority, the alcoholic solvent of the gluten deposits, on cooling, a substance similar to casein, and on concentrating the residuary liquid a mucilaginous mass is obtained, consisting of water and the adhesive substances, which he calls gluten. Both of these may be separated by ether, which dissolves the oil, the proportions of which are found to be analogous to those of the other fatty oils; a considerable portion of this oil is carried away in the percolation with the water, and is found deposited with the starch. It may be removed by treating the starch with ether, filtering, and evaporating the solution.

When wheat is subjected to a spontaneous fermentation or putrefactive action, starch is obtained from it, or a simple washing, aided by treatment with crude soda, also extracts its starch. According to the first method, the wheat is allowed to swell in water, and is then crushed in bags, the starch being then exuded and carried away by a stream of water. The water containing starch in suspension is run into tanks, where it remains for a fortnight or three weeks, during which time fermentation sets in at the expense of the gluten, which has accompanied the starch when it was first washed out of the grain. If the fermentation be controlled so that the putrefaction stage is not reached, the starch is little affected, and can be separated and purified from gluten by systematic washing. Instead of removing the gluten by the above fermentative process, caustic soda of specific gravity 1·073 can be used as a solvent for the gluten, the quantity used being such as to keep the liquid always slightly alkaline; that portion of the gluten which is not dissolved by the caustic soda is removed by a fine meshed sieve, while the insoluble portion is washed away.

Rye Flour

When rye flour is washed with water, of the pasty mass of rye flour formed no residue remains, such as is left in the case of wheat flour. The flour is carried off mechanically in the solution, because the gluten of the rye flour cannot be removed from the starch as in the case with that of wheat. The gluten of rye contains very little fibrine, but chiefly a nitrogenous substance which is called vegetable gelatine.

Composition of Rye Flour.

Various analyses have given the following results as being the composition of rye flour:—

	Per cent.	Per cent.	Per cent.
Gluten	9·48	12·8	10·5
Albumen	3·28	58·8	64 0
Starch ...	61·07	10·4	3·0
Sugar	3·28	7·2	11·0
Gum	11·9	—	5·0
Woody fibre ...	6·38	—	—
Acid	5·62	7·8	3·5
	100·20	100·00	78·0

Composition of Cereal Flours.

The comparative difference between wheat and rye flours, and rice starch, corn flour, or potato starch, is that the first two contain gluten as a constituent, whereas the last three are starches only. Potato starch contains only 15 per cent. of water, nearly six times that contained in the above substances, while the amount of nitrogenous substance, or gluten, is very much smaller. The gluten is vegetable fibre, which, when heated with water to a certain temperature, turns an opaque grey or whitish grey, whereas farina becomes a semi-transparent mass when similarly treated. The presence of gluten modifies the products; for example, a farinaceous body containing much gluten will give a stiff stodgy mass, whereas potato starch can be produced of a consistency but little thicker than "white" (albumen) of egg. The percentage composition of wheat flour and the starches are shown in the following table :—

Composition of Wheat Flour.

Starch	70·0	per cent.
Woody fibre	2·5	,,
Nitrogenous matters	12·4	,,
Fat	1·4	,,
Ash	1·8	,,
Water	11·6	,,

Composition of Cornflour Starch.

Starch	68·4	per cent.
Woody fibre	2·5	,,
Nitrogenous matters	9·9	,,
Fat	4·6	,,
Ash	1·5	,,
Water	13·1	,,

Composition of Rice Starch.

Starch	76·5	per cent.
Woody fibre	0·6	,,
Nitrogenous matters	7·8	,,
Fat	0·9	,,
Ash	1·0	,,
Water	13·7	,,

Composition of Farina (Potato Starch).

Starch	26·7	per cent.
Woody fibre	1·4	,,
Nitrogenous matters	2·0	,,
Fat	0·2	,,
Ash	1·0	,,
Water	64·7	,,

A few Facts concerning Farina.

Starch is a vegetable carbo-hydrate that occurs abundantly in all plants ; its general composition is $C_6H_{10}O_5$, or some multiple of these numbers.

The only means of distinguishing one starch from another is by microscopical examination, the difference in size of the granules affording the distinguishing test.

The average diameter of the starch granules is as follows :—

Beetroot	0·004 mm.
Millet	0·010 ,,
Rice	0·022 ,,
Maize, or Indian corn	0·030 ,,
Wheat	0·050 ,,
Sago	0·070 ,,
Arrowroot	0·140 ,,
Potato	1·185 ,,

Starch granules are not dissolved by cold water, alcohol or ether, but when starch is heated with water to between 70 and 72° C. (153° to 161° F.), they swell and split open, forming a thick mass called " starch paste " ; by boiling the paste with a larger quantity of water, the starch particles become so finely divided that they pass through a filter, and if boiled for a long time the solution becomes clear, and the starch is rendered soluble. On the addition of alcohol to such a solution, a white powder of soluble starch is precipitated.

When starch is heated to 160° C. (340° F.), it is converted into dextrine, or "British gum," but a similar conversion product is effected by the aid of a little water on starch. The best chemical test for distinguishing the presence of starch in a substance is iodine, because starch, in both its soluble and insoluble modifications, forms a deep blue compound with pure iodine; at a temperature slightly above 100° C. (212° F.), the colour disappears, but it reappears on cooling. Only starch produces the blue colour. Any isomers of starch, such as dextrine, etc., do *not* produce it.

When starch is mixed with cold, strong sulphuric acid, it is dissolved, also nitric acid dissolves it, but on adding water to the solution a white substance called "xyloidine" is precipitated; this is a "substitution" product, being starch in which one atom of hydrogen is replaced by nitrogen dioxide, (NO_2), *e.g.* $C_{12}H_{19}(NO_2)O_{10}$.

By careful manipulation with acid, it is therefore possible to obtain mucilaginous fluids that form useful adhesives. Especially so is this the case when starches are acted on by alkalies, which greatly increases the adhesiveness in farinaceous pastes, because alkali separates both gluten and albumen components, whereas hot water only separates the gluten; the action of acids on farinaceous bodies more or less destroys the adhesive quality of the agglutinative constituents. The opalescence or "milky" appearance exhibited by starch paste is due to the shreds of fine membranes which envelop each starch granule; the gelatinous compound that is produced by boiling starch with a large quantity of water is called *amidin;* such gelatinous starches when exposed to the air in a thin layer become converted into a yellowish, horny substance like gum, which, when put into water, again softens and swells. This is a fact that appears to have been generally disregarded by makers of flour pastes. The solution of starch above referred to is acted on by many of the metallic oxides. For example, barytes, lime, protoxide of lead, and also a large addition of alcohol precipitates the starch. A solution or infusion of galls throws down a yellowish precipitate containing tannic acid, which re-dissolves when the solution is heated.

Glycerine, Sugar, Glucose and Treacle.

These substances differ much in appearance, but chemically, they are closely allied; thus, glycerine is chemically known as a tri-atomic alcohol, having the formula—$C_3H_5(OH)_3$. It is a thick, sweetish, water-white liquid, that leaves a peculiar taste in the mouth after moistening the tongue with it: it is the basis to which various fatty acids are attached in animal and vegetable fats and oils; when these fatty acids are separated by proper means, the glyceryl base (C_3H_5), is eliminated, and, by combination with the radical (OH) becomes oxidised into glycerine.

Sugar and glucose are closely allied bodies; cane sugar (sucrose) having the composition $C_{12}H_{22}O_{11}$, whereas glucose (*i.e.* dextrose, or "grape-sugar,") has the composition $C_6H_{12}O_6$. Treacle is the uncrystallisable residue left after concentrating and crystallising cane sugar; all of these bodies have a sweet taste, and their action on mineral matter such as glue and gelatine, is to minimise the brittleness of the compounds formed by dissolving those substances to form agglutinants; the presence of a small percentage of any of these bodies in a glue compound renders such compound very flexible and elastic, and increases its contractive power; they have no adhesive qualities themselves, but when used in connection with various other bodies, increase the tenacity of the compound to a very large extent. Glycerine can be dissolved in alcohol or water, or ether, and in oils, and therefore forms an excipient for effecting the combination of very many "incompatible" bodies.

Gum "Dragon," or Gum Tragacanth.

This peculiar-looking substance makes a mucilage that is largely used by curriers, because it dries to a hard, waterproof surface. The "leaf" gum dragon takes a long time to dissolve, but powdered gum dragon can now be had from the drysalters' which dissolves at a much quicker rate. Only cold water should be used, and the gum allowed sufficient time to thoroughly dissolve. The gum requires a large quantity of water. Any white lumps represent undissolved gum; these lumps should be picked out, or else removed by squeezing the mucilage between cotton cloths. As a rule, 1 oz. of leaf gum dragon will swell up to a thick mucilaginous mass in 1 gallon of water in the course of 2 or 3 weeks. By just souring the water with 1 oz. of sulphuric acid per gallon of water, or by the addition of 1 oz. of oxalic acid, the gum dissolves in a few days, instead of taking weeks to do so. But for some purposes, the addition of such acids is undesirable, especially if the mucilage is to be mixed with neat's foot oil, or any other oils, for "oiling off" or "gumming" operations, such as are carried out by curriers.

Items *re* Glue and Gelatine.

The usual method of making glue solution is to soak the hard glue in cold water (never in hot water), and then dissolve it by the heat of a water bath (a common gluepot is a typical water bath or water-lined vessel). The Grove Chemical Company, Apply Bridge, Wigan, are the English agents for an American form of glue heater which is far superior to the ordinary form of gluepot. The glue when made is used hot, and when cold it becomes stiff and unusable; by repeated meltings glue thus made loses its tenacity, or contractile power. By mixing glue with various other substances, however, good adhesive compounds can be made to suit a variety of purposes (see "Flour and Glue Pastes"); thus, by adding finely sifted wood ashes to a hot solution of glue, an adhesive is produced which will firmly affix glass and wood together; by steeping glue in acetic acid or nitric acid, it can be rendered permanently fluid; the acid prevents the glue gelatinising, but without impairing its adhesive qualities. By the addition of lime, size, glucose, glycerine, resin, venice turpentine, alcohol, etc., to glue, a variety of agglutinants can be made that are adapted to meet the wants of a large number of trade uses.

Glue is obtained from

tendons, hides, sinews, hoofs, horns, etc., but "fish glue" is obtained from the skins and bones of fishes; what is known as "isinglass" is the "sound" or "bladder," usually of the sturgeon, which is cleaned and dried.

Glue is made by boiling Bones

until soft and gelatinous; this produces a very inferior quality glue. "Vegetable" glue is obtained from seaweed, and a product called "algin" was made by the British Algin Co., which serves a useful purpose in many industries, especially as a sizing agent for textiles. (See "Algin").

Elsewhere in this volume is a very representative selection of formulæ, showing the various combinations in which glue can enter.

To test the Adhesive Power of Glue.

There are several ways of ascertaining the adhesive quality of glue, of which the following is one of the simplest:—Put 1 lb. of the glue into a gluepot together with 1 quart of cold water, and after soaking for 1 or 2 hours, melt the glue by heating the pot, keep it heated until the weight of the original mixture is reduced to $1\frac{3}{4}$ lb., when the glue is ready for making the test, which is carried out as follows: Take a piece of hard or soft wood, 1 in. thick and 16 in. long; cut this in halves, so that each half is 8 in. long; now apply the glue to the ends that have been separated by the saw cut, and joint the wood, then lay it aside in a warm place for a few days; after which take the piece of wood, and at one end, 1 in. from the extreme end, insert an "eye bolt," fix the piece of wood flat and firmly on a table, so that the joint is just "flush" with the edge of the table and the eye-bolt projecting downwards; then attach weights to the eye-bolt, and notice the number of them the joint will bear without breaking. First-class glue should not break under a strain of 150 lb.; the test should be begun with 50 lb. and the weight increased by 10 lb. every minute until the breakage occurs.

Some Peculiarities of Glue.

Good glue, when soaked in water, should swell considerably. It should not absorb the water to any great extent, nor should it give off much soluble matter to cold water, and above all, it should not give off a disagreeable odour, or mouldy smell, even when digested for 24 or 48 hours in cold water, nor should it become softened enough to flow, but when heated at a temperature of 120° F. it should dissolve, and be easily dissolved at 125° F.

Items *re* Gelatine.

This is an animal jelly, obtained by the prolonged action of boiling water on the organic tissue of the bones, tendons, and integuments, the cellular tissues, the skin, and the serous membranes.

Glue and size are common varieties of gelatine: they are prepared from hoofs, hides, skins, etc.

Gelatine foil and sheet gelatine are largely used in confectionery as coloured wrappings for sweets and "bon-bons." It may be prepared by dissolving finest gelatine or isinglass in water, so that the solution when cold may be consistent enough to allow of making the gelatine into a sheet. Heat a sheet of thick glass by dipping it in hot water or steam, wiping off all moisture, and then strongly grease it one side; this glass should be fitted in a metal frame the edge of which is just as high above the glass as the sheet of gelatine is to be thick. Then pour the melted solution of gelatine on this sheet of glass until it is flush or level with the top edge of the frame, then lay another sheet of glass, also hot, on the gelatine, so that the sheet of glass rests on the metal frame, and by its pressure the thin cake of gelatine is rendered uniform. When the glass plates are cooled the gelatine will be solid, and can be easily removed owing to the grease on the plate. The sheet gelatine is then cut up into sheets and discs. If required coloured, the solution of gelatine should be coloured by the addition of a little aniline dye; a few grains is sufficient to colour a pint or so of the gelatine.

Bichromated Gelatine.

When bichromate of potash is mixed with gelatine or glue, they become insoluble in water after having been exposed to the air or sunlight.

Such a compound is prepared by making a medium to a saturated solution of bichromate of potash in cold water, and in a separate vessel a strong solution of gelatine, then pour the two liquids together, and allow to cool.

The manufacture of bichromated gelatine varies according to the use to which the compound is to be put. Keep the mixture in closed earthenware jars until wanted for use, as exposure to light will prevent it becoming soluble again.

The Action of Formaline (Formaldehyde) on Glue.

Formaline has the property of converting animal bodies, such as glue and gelatine, into a kind of leather, which is impervious to water. The addition of more than 12 per cent. of formaline will entirely prevent the glue from gelatinising. 0·5 per cent. of formaline added to a 50° solution of glue acts as a preservative, so much so that it does not become mouldy in hot or damp localities. It also causes the glue to gelatinise quickly. This amount of formaline has apparently no influence on the binding or adhesive quality of the glue, but larger quantities injure it considerably.

"Non-sulphur" glues remain neutral when treated with formaline. They are unchanged by the hottest weather, and so do not darken; they melt slowly in water, but absorb a larger proportion than those that have not been treated with formaline. The formaline should be added to the glue liquor in the vacuum pan.

A Mucilage from Glue.

This is made by mixing equal quantities of water and strong commercial vinegar and pouring this on half its weight of glue, and letting the glue soak for an hour or two; then dissolve the glue by heating it in the usual way, and while hot put in alcohol in the proportion of 1 part for every 4 parts of vinegar and water used, stir well, and then add a small quantity of a saturated solution of alum in water. The vinegar will prevent the glue gelatinising when cold; nitric acid may be used instead of vinegar.

Marine Glues, etc.

Glue combines well with all flours to form stiff agglutinants of a pasty nature, and by suitable means resin and other resinous matters can also be combined with the glue, while by the addition of acids the solid glue is reduced to a fluid form, which does not congeal, or congeals in such a way that it softens again by the heat of a water bath. Alkalies, however, decompose glue and gelatine and cause them to lose their adhesiveness, but alcohol increases the adherent and coherent qualities of glue. Saccharin and other materials such as glucose, treacle, and glycerine, also increase the adhesiveness of glue and render it elastic and plastic, so much so that a glue compound can be made into a fair imitation of rubber or gutta percha. Marine glue is the name given to a glue compound to which a solution of rubber or gutta percha is added, owing to the insolubility of gutta percha and rubber in water, it is waterproof: hence the name "marine," because serviceable as cement for use in cementing water tanks, vats, and other vessels in which water oils and resins are constituents. Glue compounds in which saccharin matters are combined are generally insoluble in spirits and hydrocarbon fluids, such as naphtha, petroleum, carbon bisulphide, benzol, etc.

Glue and flour compounds, however, are not insoluble in water.

Perhaps of all the agglutinants the greatest variety is obtained with glue as a chief ingredient, because it can be made to combine with such a wide range of substances to produce compounds that are suited for special purposes: wood, leather, china, glass, paper, textiles, stone, and even metals can be cemented by means of a suitable agglutinative.

In the formulæ given in this book reference is made to the purpose for which each compound is best suited; but it should not be supposed that such compound is useful for that one purpose only, because it is not convenient to state with each formula the exact number of materials of and purposes for which the agglutinant can be used. Glue includes all animal matter of an agglutinative nature, such as size, gelatine, fish glue, isinglass, etc.

Gutta Percha and Rubber Goods.

Many compounds of a plastic, adhesive, and waterproof nature can be made by commingling rubber or gutta percha with various other substances.

In making rubber cements, only pure (*i.e.* Para) rubber, or "caoutchouc" as it is called, should be used.

Rubber that has been vulcanised is useless for preparing cements.

In making rubber cements, the general process is to cut up the rubber in threads, and put it in a strong iron boiler, one that is airtight and provided with a good safety valve. Then pour on the rubber 4 to 5 times its weight of carbon bisulphide, (or any other of the "solvents" for rubber), close all the openings of the vessel, and place it in a suitable water bath, or else have a small steam coil inserted in the interior of the vessel, and heat the contents of the boiler for an hour, at a temperature of 212° F., then allow the vessel to cool, and rake out the fire from the furnace before opening the vessel; this precaution is necessary because the carbon bisulphide vaporises at the ordinary temperature, and is very inflammable and explosive when it reaches a naked flame (especially so when mixed with air). On this account, it is usual to prepare rubber cements in a shed isolated from the main building, or else in the open air.

In preparing a rubber cement on a small scale, it is usual to put the rubber or gutta percha in a glass bottle or tin can together with the solvent fluid, such as chloroform, benzine, naphtha, &c., then cork the bottle, and stand it in a vessel containing hot water, and allow the solid matter to dissolve by slow digestion, giving the bottle an occasional shake up to facilitate the solution of the solids.

For a very pure cement, the solvent should be perfectly pure chloroform containing a large excess of alcohol. The solvent action is very slow, consequently only a small amount of rubber becomes dissolved.

To avoid an explosion of the mixture of air and vapour, it is best to fill the bottle with the solvent, putting the rubber in first, and then adding the liquid.

As the rubber softens, it swells up considerably, and the bottle should be shaken vigorously, or the contents stirred with a glass rod.

A thin solution of gutta percha in chloroform, when poured on a glass plate, and then drained off, yields a thin film which is useful for photographers as a focussing screen for cameras.

A mixture of methylated ether and petroleum spirit forms one of the best solvents for rubber, better than ether-alcohol.

A ver thick solution of rubber can be made by dissolving

1 oz. of good rubber in 2 oz. of benzoline and 1 oz. of sulphuric ether. The solution will be complete in a few hours, when it may be diluted to any strength with benzoline alone.

Vulcanised rubber is often prepared by steeping the rubber in a mixture of 30 parts of bisulphide of carbon and 1 part of chloride of sulphur, then placing the mixture in a warm room heated to 76° F. When all the bisulphide has been volatilised, the process is so far complete that it is only necessary to boil the material in a solution of about 18 oz. of caustic potash to 2 gallons of water, the vulcanised rubber being then washed to remove excess of alkali.

Items *re* Plaster and Calcareous Compositions.

To harden plaster of Paris compositions, such as casts, moulded figures, and similar compositions, numerous patents have been obtained and many methods employed. To obtain the maximum of hardness, the plaster should be gauged as fine and quick as possible. When plaster is hardened by soaking or coating with a solution, the mass should be perfectly dry, and also warm, so that the solution may penetrate more easily. When possible, the cast should be immersed in a weak solution; the work of hardening and polishing should be done in a clean and dry warm room, free from draughts, cold or damp air or dust.

Cornflour added to plaster to the extent of about 5 per cent. renders it hard and tough. Such a composition is useful for coating plaques, medallions, and similar ornaments. Ground rice may also be used for a similar purpose. By adding pulverised marshmallow root to plaster, it is made hard and tough; also, by gauging the plaster with water in which marshmallows have been boiled. If the plaster is gauged with 4 per cent. of finely pulverised marshmallow, the setting is retarded for about 1 hour; when dry, it may be sawn or turned. With 8 per cent. of marshmallow, the setting is further retarded, but the toughness and hardness is increased. It may be used as a substitute for "carton-pierre," also for the manufacture of enrichments on mouldings that have to stand rough usage; also for frames. The above composition can be polished.

A hot solution of alum is also useful for hardening plaster casts; it may be either brushed over the plaster or the composition itself be steeped in the above solution.

One peculiar feature about the composition prepared with marshmallow is that the product, when soaked in a hot solution of alum, becomes as hard as stone and as tough as wood, and capable of being polished equal to marble. A sharp blow will not shatter it, but only indent it. It presents a good surface for paint or gilt.

The following process for hardening plaster compositions will be found useful: Dissolve stearine in soda lye to form an emulsion, and soak the plaster work in the fluid mass, or the plaster may be soaked in a hot solution of melted stearine, and, when dry, polished by rubbing with soft rags, or cotton wool, or a soft brush.

Instead of stearine, a melted mass of paraffin wax may be employed. Another method is to soak the plaster in linseed oil for 10 hours, then allow to dry in the air, and again soak for 6 hours in the oil. Another process is to soak the plaster in a hot solution of gluesize and then dip it in a strong solution of potash alone, or a solution of sulphate of zinc. The steeping in alum should not last longer than 2 hours, otherwise the plaster will become brittle; a strong solution of borax, also, hardens plaster, and gives it the appearance of marble when polished; even paraffin oil may be used in which to steep the plaster. All the above compounds render the plaster waterproof. The following process is one for rendering the plaster hard and tough while preparing it, whether it is to be used for cast or laid work:—

Gauge the cement with 10 to 15 per cent. of "minion" (that s, the siftings of ironstone after calcination).

A semi-transparency can be imparted to plaster by gauging fine ground rice with fine plaster in the proportion of 1 of plaster to 3 of rice.

Items concerning Plaster of Paris.

"Gypsum" is the technical, and sulphate of calcium (C_aSO_4) the chemical, name of the substance. The material is a native mineral earth, and receives its name, "Gypsum," from two Greek words meaning "the earth" and "to concoct" (*i.e.* "concocted in the earth"). The Italians call the material "gesso," while in Scotland it is called "stucco," and in America calcined plaster, while in England it is simply designated plaster.

The employment of gypsum is of ancient origin. Thus Strabo states that the walls of Tyre were set in gypsum, and Pliny mentions it as having been used by the ancient artists, while a stone called *gypsos* by Theophrates, chiefly obtained from Syria, was used by the ancients for making plaster. In Greece, two kinds were known: the pulverulent and the compact. The latter was obtained in lumps, which were burnt in furnaces and then reduced to plaster, which was used in building and for making into casts.

The native sources of supply from which gypsum is obtained are Italy, Sicily, France, the United States, and Canada. It is also found in some English counties, for instance, Derbyshire, Cheshire, Cumberland, and Westmoreland. But the finest deposits are those found in Canada.

"Alabaster"

is the name given to the purest kind of plaster; it is soft, but fragile, and has a semi-translucent appearance, is usually of a greyish colour, but frequently mottled with reddish brown or blackish grey veinings. Alabaster is a compact mass of crystalline grains, and is chiefly used in its native state for making small statuary, vases, and other similar ornamental articles. The commercial plaster of Paris is found in the tertiary strata of Montmartre, near Paris (hence its name). This variety usually contains 10 per cent. of carbonate of calcium (chalk), not always in union with the sulphate, but interspersed with grains of other minerals. The combination of this contaminating substance gives plaster of Paris some of its useful properties in the colour trade.

"Terra Alba"

is a commercial name for plaster of Paris. Amongst colour (pigments) manufacturers it is also used for calcining (instead of lime, *i.e.* calcium oxide) with iron oxides in the production of Venetian red and other red pigments, of which oxide of iron is the basis. The object of using this material as a diluent to the oxide is to give weight and bulk at the expense of the red colouring matter, but inasmuch as plaster of Paris possesses no qualities to fit it for use as a paint, its inclusion as an ingredient of red oxide is not only a fraud, but is positively injurious to the permanency of the paint. Terra alba is also used for sophisticating chrome yellow and other pigments. Plaster of Paris did not come into general use in England until the middle of last century. It had been previously imported in blocks from France, and calcined and ground here in small mills. But commercial plaster is now largely imported from France ready calcined and ground. It is one of the most fire-resisting materials obtainable for building structures. The production of plaster of Paris is effected as follows: Blasting and picks are used for the extraction of the native gypsum, and the lumps thus obtained are simply cleaned and chipped, so as to free them from earthy matters, which, if calcined along with the gypsum, would spoil its colour. The freshest and whitest gypsum is used for the fine plaster, and the darker and coarser for the coarse plaster work.

In this country the conversion of the gypsum into plaster is effected by two processes, viz., by boiling and baking.

In the boiling process the gypsum is reduced in size by means of a pulveriser, and then carried by means of elevators into a "hopper," from which it is conducted down again by a spout to a pair of millstones, the speed being regulated by means of a small spindle attached to the crossbar of the stones, which, in revolving, are made to agitate the spout and cause the gypsum to fall in a regular stream between the stones. After grinding, the gypsum is again elevated into hoppers, which feed it into a large open pan or boiler to a depth of about 3 inches. This pan has large flues underneath it, heated by a furnace at one end; the gypsum is kept in agitation in the boiler by means of a pair of rakes attached to a spindle which revolves by machinery. After being in the water for about one and a-half hours the powder becomes agitated by the heat, and small volcano-like eruptions take place, the powdered gypsum becoming more dense and sand-like, and rests very heavily on the scrapers or rakes. This is termed by the maker "just caught," and an experienced plaster boilerman knows by the way the powders "hang," when it is ready. As soon as the plaster is ready a slide, which forms one of the side plates of the boiler is drawn, and the plaster is thrown off by the circular motion of the scraper. It is then left to cool, and afterwards bagged up for commerce. There is about 20 per cent. waste gypsum in the boiler furnace, but the plaster is fine in texture, works very freely, and does not warp when set, and is more reliable than boiled plaster, because more malleable if properly treated, and the material alike throughout. If the powdered gypsum is left too long in the boiler it is burned, and will not set for a considerable time at all. It is very chalky, and if it is not baked enough it is also weak, so that the greatest care and experience is required in the boiling of the plaster.

Baked Plaster.

There are several methods adopted for baking the plaster in this process, the usual one being by means of a flat kiln, or oven, so constructed that the fuel is never in contact with the stove in which the water is evaporated. This process is simply one of dehydration, therefore great skill is required for carrying it out, for although the temperature may be kept within proper limits, the plaster possesses the power of reabsorbing water with avidity. This power is diminished if the gypsum is overheated. When subjected to a red heat, the gypsum increases in density, and if the temperature be continued it gradually assumes the character of natural calcium sulphate, which has totally different properties to those of plaster. It is safer not to drive off the whole of the water than risk exposing the gypsum to too high a temperature. As the reduction of a small portion of moisture does not prevent the plaster from reabsorbing the water that has been drawn off, the time required for burning depends greatly upon the quality and hardness of the stone in the kiln. It is considered to be sufficiently baked when the plaster becomes of an oily consistency and adheres to the workman's finger.

The setting qualities of plaster vary according to the way in which it is used. If prepared in lumps, its preparation is different to that adopted when prepared in powder. The former, when mixed with its own weight of water, sets in five minutes, while the latter, under similar conditions, takes five months. The reason probably is that the plaster in powder is more uniformly burned than when it is in lumps, which tends to prove that when the latter is exposed longer than usual to the action of heat it sets slower than when prepared at a higher temperature.

Gypsum loses more and more of its affinity for water, retaining, however, its property of absorbing water of crystallisation. Plaster heated to redness and mixed in the ordinary manner will not set, but if instead of applying a large quantity of water the smallest possible amount only is used, it sets almost immediately. If, however, the burning is again resumed the substance soon loses its moisture, and if then exposed to the air it very rapidly retakes the water of crystallisation and absorption continues more slowly. Great hardness is obtained when the material sets slowly. The writer is indebted to Miller's "Decorative Plaster" for the above particulars; and for further particulars concerning plaster and other calcium substances the reader is advised to consult this most excellent work, which is soundly practical and exhaustive. It is published by Messrs. Batsford, of High Holborn, W.C.

Testing Plaster of Paris.

The quality of plaster may be tested by simply squeezing it with the hand. If it coheres slightly and keeps its position after the hand has been gently opened it is good, but if it falls to pieces immediately, it has been injured by damp. Water does not chemically combine with more than one-quarter of its weight. Yet it is nevertheless capable of forming a thick layer into a solid mass, the particles of plaster being converted into a network of crystals mechanically enclosing the remainder of the water. Sulphate of lime (plaster) is soluble in water to the extent of 1 part in about 4 or 5, the solution becoming but little influenced by temperature.

It is on account of this solubility that water cements, which have to a large extent plaster for their base, are capable in their raw state of being exposed to the weather. The setting of plaster is due to hydration, *i.e.*, to its having not too much water to take up. To resume a state of consolidation plaster is used with quicklime to stop the slaking and convert the lime into cement. These are then called "silicate cements."

In 100 parts of gypsum there are 46 parts acid, 32 parts lime and 22 parts water. Good plaster should not set very soon, and it should remain for a considerable time in a creamy state; when it sets it should be very hard. Plaster should set slowly, partly because this gives more time for manipulation, but principally because plaster which sets quickly and swells never becomes so hard as it should. Colour alone cannot determine the quality of plaster, as the quality of the gypsum regulates the colour of the plaster. The whitest and hardest generally yields the best plaster, but as the exception proves the rule, it may be mentioned that Cumberland plasters are of a delicate pink and of a very pale grain and exceedingly slimy when gauged.

Coarse plasters are darker in colour than fine; coarse plaster of a sandy nature, and which rapidly sinks to the bottom when put in water, contains too much silica or imperfectly burnt gypsum, is derived from a bastard gypsum, and is generally of a weak nature.

Compression and Adhesive Strength.

The compression or resistance of properly baked plaster is about 120 lb. to the square inch when gauged with water, and 160 lb. when gauged with limewater. Limewater hardens and increases the affinity of plaster. The adhesion of plaster to itself is greater than to stone or brick, the adhesion to iron is about 24 to 43 lb. to the square inch.

Relative Porosity of Plaster.

The porosity of plaster and cement is as follows:—Common lime cement (1 to 2) 100, plaster of Paris 75, Roman cement 25, and Portland cement 10.

A plaster impervious to water is made by mixing 2 parts of fine plaster and 1 part of fluorspar powder, and when the composition is dry giving it a coating of silicate of soda.

A Waterproof Coating for Plastered Walls

is prepared by mixing 6 parts of boiled linseed oil with one-sixth of its weight of litharge, and adding 1 part of wax. Lay this on the dry plaster with a brush. A solution of alum, sulphate of zinc, chloride of sodium (common salt), sulphate of potash, or a solution of dextrine may be used for gauging the plaster. To retard the setting of plaster, it may be gauged with either size water, ammonia or stale beer.

A Cement for setting Tesseræ or Mosaic in Walls, Floors, etc.,

is composed as follows:—Mix together 13 parts of dissolved glue, 14 parts of pulverised litharge, 8 parts of white lead, 1 part of plaster, and 10 parts of very fine sawdust, spread this over the surface uniformly, and press the mosaic into it and remove the superfluous composition which squeezes out, by scraping off with a trowel.

Plaster to imitate Marble

is prepared as follows:—Mix 2 parts of white marble dust (or 1 part of white marble and 1 part of alabaster in powder) with 1 part of plaster, and mix into a paste with ½ part of soluble glue, and put the composition into moulds that have been oiled with olive oil. If the compound is too stiff a little size water may be mixed with the gauge water. When the mass is moulded it may be polished with Tripoli powder, French chalk, or any other of the usual methods of polishing marble. To make plaster medallions to look like marble, boil sweet milk and skim it two or three times, pour it on the face of the medallion, and blow it evenly on all the parts (a pair of bellows is useful to do this), being careful that it does not get on the back. Then lay the medallion aside for a few days, covered with clean paper to keep it free from dust, then put it in a shallow tray face upwards and pour on oil of sweet almonds until it reaches half of the edge of the medallion, being careful that no oil falls on the face of the cast. As the plaster absorbs the oil, pour more oil into the tray until the plaster is saturated, when the plaster will be found beautifully transparent and the surface will bear washing.

Plaster made to imitate Old Ivory.

Take superfine plaster and tint the water used in gauging it with yellow ochre, in the proportion of ½ oz. of ochre for each pound of plaster gauged. When the plaster articles are thoroughly dry dip them in melted spermaceti wax, and suspend them so that the surplus wax may run off, and when the last is nearly dry, but still sticky, sprinkle it over with fine yellow ochre, and wipe the prominent parts with fine rags or cotton wool ; the ochre is best dusted on through a fine muslin bag, and the skill with which the high lights (prominent parts) are wiped free of the ochre determines the verisimilitude to real ivory for wall plaques, medallions, etc., of heads, busts, etc. ; this method of treating plaster improves its appearance very much. In the case of large casts the melted spermaceti may be laid on the plaster with a brush, working quickly and carefully so that the wax does not cake. It is best to have the plaster slightly warm when applying the hot wax, a mixture of equal parts of spermaceti and stearine waxes may be used, instead of the former alone ; polish by rubbing with cotton wool.

Linseed Oil. Oil of Turpentine.

Linseed oil is the oil obtained by expression from the seeds of the flax plant; when heated with salts of lead or manganese it becomes more or less decomposed into the fatty acids, which become oxidised by the oxides of the metals added to the oil to form metallic salts, which dry at a quicker rate than raw linseed oil; for example, when linseed oil is heated for some time at a temperature slightly under the boiling point of the oil, with red (oxide of) lead, a compound is formed that dries very hard, and is of an agglutinative or cementing nature. The ways in which linseed oil acts in the production of cements are too numerous and complex to be enumerated here, but formulæ in which such oil is used will be found under "Calcareous Cements," "Compositions," "Gutta Percha Cements," etc.

Oil of Turpentine belongs chiefly to the complex group of carbohydrates; it is used as a solvent for rubber, gutta percha, resin, and balsams in making agglutinative compounds.

Petroleum and Paraffin

are fluids consisting of mixtures of various hydrides, formed from marsh gas. Some of these are solid, and when they contain a large number of atoms of carbon are known as paraffins, of which paraffin wax is an example of the solid form. By "fractional" distillation these hydrides can be separated, to form distinct fluids known as "petroleum spirit," "petroleum oil," etc. They are more used in the paint industry and varnish trades than in the production of cements, but under "Compositions" will be found compounds of which they are essential ingredients.

Gelatinising Starch with Cold Water.

Ordinary starch can only be made to swell into a mass by means of boiling hot water. By proper treatment, however, starch can be made to gelatinise by mixing it with cold water only. To effect this result the starch is treated as follows:—The starch is stirred with pure or diluted alcohol, and then treated with an aqueous solution of caustic alkali, or the starch can be stirred up with water and treated with an alkaline solution, which must contain at least 50 per cent. alcohol. For example, by stirring about 50 to 90 per cent. alcohol at 60° F. a milky liquid is obtained; to every 100 kilos of starch in the mixture, 40 kilos of caustic soda lye of 30° Bé. is added, this thickens the mass. After some time the alkali is neutralised with acetic acid, and the starch pressed or ground. On stirring the product with 10 times its weight of water, it swells in a short time to a strong paste; the starch is unchanged, excepting that it is now possessed of the property of swelling with cold water, which renders it very useful in various technical processes, as a substitute for adhesives and finishing agents generally used, such as gum arabic, dextrine, etc.

To make Gelatine into Glue.

Soak 5 lb. of glue for 48 hours in 6 quarts of strong malt vinegar in which 2 to 3 scruples of carbonate of potash has been dissolved; then pour off the vinegar and place the glue in a sieve suspended in a vat of cold water, and allow it to remain for 12 hours to dissolve out acetates adhering to the glue; the glue will then be very clear, and of a yellowish tint, and when melted and poured on glass will yield white sheets of gelatine. They are slightly brittle, but by adding a small percentage of glycerine to the cold glue, the sheet of gelatine becomes flexible.

Items Concerning Shellac.

The word "lac" is from a Greek word meaning milk, and is the general name given to the resinous matter that surrounds the coccus lacca insect, as it fastens itself to several species of trees growing (for) in India, & also to some extent in Ceylon & the Antilles.

Like many other resinous matters that exude from trees, it is seldom free from dirt and *débris*, and to fit it for commercial use the lac has to be freed from such impurities, and the various purifying processes the lac undergoes, are known by their names thus: stick lac, seed lac, button lac, etc. The first is the name given to the crude lac after it has been freed from colouring matter, while button lac is formed from shellac by melting the lac, and allowing it to fall in drops on a cold surface so as to form pieces about $1\frac{1}{2}$ in. in diameter. These discs are thicker than shellac, and therefore darker in colour ; they are ruby red, and sometimes called ruby lac.

The Composition of Lac is as follows :—

	Stick Lac.	Seed Lac.	Shellac.
Resin	68·0	88·5	90·7
Colouring matter	10·0	2·5	0·5
Wax	6·0	4·5	4·0
Gluten	5·5	2·0	2·8
Foreign bodies	6·5	—	—
Loss	4·0	2·5	1·8

The commercial uses of shellac are numerous, but its chief value is in making varnishes, lacquers, and polishes for wood and metal.

Lac is insoluble in water, but freely dissolves in an alkaline solution made by dissolving soda carbonate, caustic soda, borax, ammonia, etc., in water, and dissolving the lac in the alkaline lye at the boiling temperature. Alcohol also dissolves shellac, but not completely, because there is a waxy constituent, which will not dissolve completely in alkali or methylated spirit (excepting at certain temperature); ether, chloroform and oil of turpentine also partially dissolve shellac, but it is perfectly insoluble in petroleum and most hydrocarbon liquids. The colouring matter of shellac may be removed by dissolving the lac in an alkaline solution and then precipitating the dissolved lac by passing chlorine gas into the fluid; the precipitate, after washing and kneading with the hands, will exhibit only a pale straw colour, but such bleached shellac loses its property of dissolving in alcohol unless freshly employed. For other particulars concerning shellac see the Author's book, "Sealing Waxes and other Adhesives."

Rosin* and Turpentine.

Venice turpentine or Venetian turpentine is a crude resin of a semi-viscid nature. Its employment as an adhesive is to

* Rosin is the name given to the residual products obtained by distilling pine resins. Resin is the name given to fossil or native resins.

lessen the brittleness of resinous agglutinatives, and to render farinous cementing compounds water-resisting.

Colophony and rosins refer to the residuum that is left after distilling crude turpentine; in some cases colophony refers to the lightest or amber-coloured resin, and rosin to the darker and most impure residue, sometimes called black rosin when it is opaque. These varieties of rosins are dependent upon the quality of the original crude resin from which the rosin is a bye-product, the best light coloured being obtained from pine resin, while those resins collected later in the season give the common rosin, and the scrapings of the resins from the bark of the tree give black rosins. The extent to which the distilling of the resins has been carried also influences the colouring of the rosins. Colophony melts at a low temperature, and at 212° F. it is quite fluid, forming a clear liquid. It is insoluble in water but soluble in alkaline solutions, from which it can be precipitated by means of acid; and alcohol, benzol, coal tar, naphtha, acetone, turpentine, ether, and many other fluids readily dissolve it. When rosin (colophony) is itself distilled in some water or spirit, a heavy oil (rosin oil) and a residue of pitch (artificial asphaltum) results; all the rosins are inflammable, fusible, and give off an inflammable vapour at a low temperature. In its solid state resin is brittle, has a glassy fracture, and softens at 177° F.

Shellac.

The adulteration of shellac is carried on somewhat extensively when the market price of the article fluctuates to a high figure; the least costly and best adulterant is rosin, which is readily soluble in 95 per cent. alcohol. The adulterations are generally effected by dissolving the rosin and shellac together in the alcohol, or else by melting the two solids together, and then pouring the mixture on to a cold plate to cool and assume a proper form, such as thin plates to represent the genuine shellac, or discs to represent button lac. The compound thus formed of rosin, shellac, and wood alcohol mixes readily with "gloss" oils or rosin varnish, which is the name given to a solution of rosin and benzine. It is needless to say that such a solution when sold as pure shellac varnish is a fraud, as the presence of the rosin in the varnish prevents it drying hard.

Bleached Shellac.

Shellac is denuded of colour, or "bleached," by the action of hydrochloric acid, but unless kept under proper conditions it will not properly dissolve in alcohol. Pure bleached shellac, in good condition, should dissolve in alcohol of 95 or even 92 per cent. strength, that is, a mixture of 95 or 92 parts of absolute alcohol and 5 or 8 parts of water, both parts by weight. If a larger proportion of water be present, the shellac will not dissolve in alcohol of the above strength; moreover, there should be no appreciable deposit or sediment.

Bleached shellac should be bought in the twisted form, not in powder, and to keep these twists in good condition they should be stored as follows: Half fill a keg with cold water, above the surface of which is a wooden crate or cage, in which the twists should be laid so as to be in contact with the water; the top of the keg should be covered with a cloth, and the keg kept in a cool place. If bleached shellac be kept in a dry place it crumbles and becomes useless and insoluble, while, when kept under water, it tends to blacken and mould. When wanted for use, the shellac should be put into a strong bag and beaten to pieces with a hammer or iron pestle, and the pulverised shellac be sifted from time to time; the finest powder is then put into a wide-mouthed bottle or jar, and the required quantity of 95 per cent. grain alcohol added, the bottle then closed with a stopper, and the contents often stirred up. To hasten the solution of the shellac, the bottle may be stood first in warm water and then in hot water, when a clearer solution results. The addition of Venice turpentine to the solution adds toughness to the varnish and causes it to flow more freely, but does not increase its drying properties.

To produce white shellac varnish of medium body, the following proportions should be used:—

2 lb. bleached shellac
$\frac{1}{2}$ lb. clear Venice turpentine
6 lb. 95 per cent. alcohol.

The varnish should be kept in a glass bottle, as iron vessels cause it to darken. Methylated spirits will not dissolve bleached shellac, especially if the spirit be methylated with mineral oils, which will not dissolve shellac at all.

To bleach coloured shellac, put in a copper boiler

10 parts of orange shellac
4 parts of crystallised carbonate of soda
120 parts of water.

Heat the mixture until the shellac dissolves, then filter the liquid through cloth into a wooden tub; 10 parts of chloride of lime are mixed with a solution of 20 parts of soda in 200 parts of water, and filtered into the shellac solution. When the mixture has cooled off, a small quantity of hydrochloric acid is added until some of the shellac separates, then it is permitted to rest for a few days, and the remainder of the shellac precipitated with hydrochloric acid. The precipitant is worked up to a plastic mass, pulled into sticks, and twisted by hand. The longer the amount of pulling, the whiter the colour becomes.

Wax.

Wax is the name given to mineral and vegetable substances, such as beeswax and Chinese and Indian white waxes (these are of animal origin); carnauba, palm wax and myricia wax are of vegetable origin. Earth wax is a mineral wax obtained during the distillation of paraffin oil. The difference between a wax and a fat is distinguished by its saponification with alkalies. A wax will not eliminate glycerine; fat will produce that viscid, sweet-tasting fluid.

Waterglass, or Soluble Glass,

is the name given to silicate of soda and potash. When first introduced this material was confidently looked upon as a most infallible material for rendering any surface waterproof, but the expectations have not been maintained, as it is found that under many circumstances the waterglass effloresces, and thereby produces a whitish water on the surface; at the same time the waterglass composition becomes decomposed and peels off.

Waterglass, however, is useful in many ways, and in some cases it is a useful ingredient in making cements, pastes, and other agglutinative compounds; but judicious care has to be observed as to what other materials are mixed with the waterglass; for example, silicate of soda or of potash is perfectly useless in pastes made with potato starch; the compound becomes whitish, and either dries up to a horny, insoluble, non-shrinking mass if exposed to the air in thick layers, if exposed in thin layers it gives a white coating that peels off, whilst, when such paste is kept in a confined space, it liquefies and becomes destitute of adhesiveness.

Commercial waterglass is a thickly fluid mass of a clear, glassy transparency. It is obtained by fusing together quartz sand with soda or potash, whereby a silicate of soda or of potash is produced. It is, in reality, "glass," but of a soluble variety. The solution possesses an alkaline taste, and on exposure to the air is gradually converted into a gelatinous, transparent mass, which finally becomes hard.

This phenomenon is caused by the expulsion of the silicic acid from the waterglass by the carbonic acid of the air, thus forming a gelatinous mass of hydrated silicic acid.

The substance must, therefore, always be kept in hermetically sealed vessels; glass stoppers must not be used, as they hold so tightly to the neck of the vessel that they often cannot be removed without the greatest difficulty.

There are 4 varieties of waterglass known in commerce, viz., patent waterglass, compound waterglass, soda waterglass, and fixing waterglass.

Methods of preparing Potash Waterglass.

Mix 1 part of pure quartz sand with 10 oz. of potassic carbonate and 1 oz. of charcoal powder.

Fuse this mixture in a crucible, then allow the contents to become cold, when the fused mass is removed, pulverised and exposed to the air, being frequently turned over; then the powder is washed several times with cold water, and finally boiled with 5 times its weight of water, until all is completely dissolved; the solution is then filtered and evaporated to a specific gravity of $\frac{1}{25}$. By this means a sticky, syrupy liquid is obtained which, when exposed to the air, dries to a transparent glass.

Or 15 parts of quartz sand, 5 parts of potash, and 4 parts of soda may be operated on as above directed.

Method of preparing Soda Waterglass.

Mix together 15 parts of finely ground sand, 8 parts of sodium carbonate (anhydrous), and 1 part of wood charcoal. Calcine and treat the fused mass as directed for potash waterglass. A mixture that fuses more easily than the above is prepared by mixing 45 parts of quartz sand, 25 parts of sodium carbonate (anhydrous) and 3 parts of wood charcoal.

Another process consists of fusing together 1 part of finely powdered quartz and 2 parts of crystallised carbonate of soda.

While in yet another process the following are the proportions:—100 parts of quartz in fine powder, 60 parts of sulphate of soda ("Glauber's salt"), and 15 to 20 parts of pulverised wood charcoal; these are fused together; the product when dissolved in water is more opalescent than potash waterglass.

Preparation of Compound Waterglass.

Mix together: 3 parts of concentrated potash waterglass and 2 parts of concentrated soda solution, both in the "syrupy" state.

Another process is to fuse together 100 parts of quartz, 28 parts of purified potash, 22 parts of neutral anhydrous soda silicate, and 6 parts of wood charcoal; the subsequent operation being the same as that for potash waterglass.

Preparation of fixing Waterglass.

Fuse together 3 parts pure anhydrous soda carbonate and 2 parts pulverised quartz, and make a concentrated solution of the fused mass. Then mix 11 parts of this solution with 4 to 5 parts of concentrated pure waterglass completely saturated with silica.

Some very durable cements are made with waterglass and earthy bodies, such as lime oxide, etc., whereby a double silicate is formed, which becomes hard. A "hydraulic" cement is made by mixing finely pulverised cement with a solution of waterglass. This cement should be used quickly, as it hardens rapidly under water.

Soluble glass, also known as waterglass, is an impure alkali silicate. It can be prepared by fusing together 1 part of silica and 2 parts of carbonate of soda, or of potash.

Another process is to fuse together 70 parts of dry carbonate of soda, and 192 parts of silica.

The product is soluble in boiling water, yielding a transparent elastic mass for mixing with mineral colours, which is useful for coatings for walls, etc.

"Glutina" Cement

(An elastic, spirit, oil, and fireproof cement).

This cement is a peculiar compound made from glue and sugar. It has some curious properties not possessed by any other cement: for example, glutina can be used like ordinary glue, but it can also be mixed with earthy and mineral matters, and used as a paint for wood or iron. In such a case the coating is not affected in any way by the action of oils, spirits or hydrocarbon fluids, therefore this cement forms a good non-impenetrable paint for casks, barrels or tanks for holding such fluids as petroleum, benzine, carbon-bisulphide, benzoline, naphtha, methylated spirit, turpentine, or any kind of oil. Moreover, the cement is one which will affix the most diverse substances to one another, such, for example, as glass to wood or metal, stone, leather, china, and especially lead and tin "foils" to paper or other bodies.

A special feature of the cement is that it is, when dried by "dry" heat, practically insoluble, and forms one of the best cements for leather belts for machinery and leather goods in general.

Glutina cement was invented by the Author of this book to meet the special requirements of a firm of tea merchants who wanted to affix tinfoil paper to metallic lead sheets or foil, by coating the paper or foil with a cement, and passing the paper and metallic foil between heated rollers to affix and dry same. This the cement does perfectly; for although softened by the heat of a water or sand bath, it is rendered insoluble by "dry" heat.

To prepare Glutina Cement.

Soak 1 lb. of white glue or gelatine in 4 lb. of cold water for 10 hours, then melt in a gluepot, together with any unabsorbed water, until it boils, then stir in 1½ oz. fluid of "shellac drier" (*vide infra*), and immediately afterwards stir in 4 oz. of brown Demerara sugar that has been melted by dry heat in a saucepan (without any water), until it gives off fumes which can be ignited; these fumes should be set alight for a few seconds, and then the molten mass of burning sugar poured into the boiling glue solution, and the whole kept at the boil for 10 minutes, when the cement should be poured out into moulds to set and cool; when cooled, it should be removed from the moulds and exposed to the air for a few days. It will then be in the form of a dark brown jelly. When the cement is wanted for use it is melted in a gluepot like ordinary glue (no water being added to the cement), and used like ordinary glue while hot. To affix paper to leadfoil, the paper may be coated with the hot glue and then laid on the metallic foil, and the cement dried by pressure of a hot iron, or by passing the paper and foil between heated rollers.

To use Glutina as a Paint.

The colouring matter should be put into the boiling hot glue mixture, after the burning sugar has been added, and the paint thus made is laid on any surface with a brush like common paint; when cold, it is hard and firm, and insoluble in any of the fluids already mentioned.

Glutina can also be used as a cement for china and glass, by melting it in a saucer and applying it to the fractured edges to be joined, which are best warmed before applying the cement, so as not to chill it.

The tenacity and drying power of the cement is improved if the glue be first made into a size before adding the sugar. Thus, after melting the softened glue in a gluepot at the boil, turn it out into moulds to set and cool, and when cool turn out the glue size thus made and expose it to the air for a few days before melting it and adding the "dryer" and burning sugar.

The shellac drier is made thus: Boil 1 pint of water, then add $\frac{3}{4}$ fluid oz. of strong liquid ammonia (·880), and at once stir in 1 oz. of orange shellac, and stir and heat the mixture until the whole of the shellac has dissolved; skim off all scum and pour out the purplish fluid into a bottle for use as required. Not more than $1\frac{1}{2}$ fluid oz. of this liquid shellac drier per 1 lb. of glue taken should be used, otherwise the adhesiveness will be lessened.

To cement Leather Belting with Glutina.

Roughen the surfaces to be joined with a rasp or coarse file, then coat one of the surfaces with the cement, clap on the other surface, and put the joint under pressure (hot pressure if possible), and keep it so until the cement is dry. The writer has found that for "chrome-tanned" leather for machinery belting, no other cement is equal to glutina. Samples of all kinds of leather have been kept for 5 and 6 years in damp places without the cement loosening—in fact, it is easier to tear the leather itself than to tear apart the cemented joint.

When properly made, Glutina cement is a stiff brown jelly, very sticky to the touch, and dries up on exposure to the air to an elastic, tough, hard mass resembling indiarubber, but it can be re-melted by heating in a gluepot without any water being added to it; after repeated heatings, however, it refuses to re-melt. Its retains its elasticity for a long time, and on this account could be used for affixing the cloth covers of books to their paper contents, instead of the stiff harsh glue paste now so generally employed by bookbinders.

As glutina will neither burn nor catch fire, it should be useful as an insulating compound for electric wires, as if they fused this insulating material would not catch fire like gutta percha, but would quench the heat of the fusing wire, especially if lampblack be mixed with the hot glutina.

By repeated heatings glutina loses its power of becoming softened or dissolved by heat; if put into a fire of burning coals, glutina will not burn, and on this account may be used as a fireproof paint for theatrical scenery, wooden panels, etc.

ADDENDUM.

Additional Recipes not otherwise Classified.

Dammar Cement.

Dissolve gum dammar in benzol until no more will dissolve; then to every 3 oz. of the solution add 1 oz. of gold size, and mix well by shaking. This dries very quickly and is waterproof.

Cement to unite Glass to other Substances.

Pick out the purest white gum arabic and mix it with only just sufficient cold water to dissolve it, allowing the gum to slowly dissolve for 5 to 10 hours, so that a mucilage as thick as treacle is obtained; pour out some of this mucilage on a glass plate, and mix sufficient calomel (the sub-chloride of mercury) with the mucilage, by means of a spatula or palette knife, to make a sticky mass. As the mixture sets very rapidly, only sufficient for immediate wants should be made at any one time. The cement is hard in a few hours, but it is best to leave the cemented article a day or two before use. Only genuine gum acacia of a superior quality should be used; inferior qualities and the "Bassora" gum are perfectly useless.

This cement is extraordinarily adherent to any surface.

Resin and Glue Cement.

Mix 10 oz. of anhydrous ether with 5 oz. of absolute alcohol, and dissolve in the mixture 5 oz. of hard Canada balsam and 5 oz. of orange shellac. When the solids are dissolved, strain through fine muslin, or else allow all sediment to deposit and pour off the clear fluid, and evaporate over a clear fire until the fluid is of a syrupy consistency. This cement is waterproof.

A Waterproof Cement for Jet, etc.

Melt together 2 oz. of orange shellac, and 1 oz. of Venice turpentine, and pour the melted mass into brass moulds so as to form sticks. For use, the end of the stick is melted over a flame, just like sealing-wax. This cement is useful for articles made of jet, but shellac alone is often used; the cement should be coloured with a little lampblack; the Venice turpentine prevents the cement being brittle, as shellac alone is.

A Waterproof Cement for coating Varnished Labels.

Dissolve 1 oz. of balsam of fir in 3 oz. of oil of turpentine, and brush this over the varnished surface; colour-printed or lithographed labels may be steeped in it and dried, when they become semi-transparent and waterproof.

Agglutinant for attaching Labels to Tinware.

Dissolve gum dammar in oil of turpentine to make a saturated solution, and then mix 1 oz. of this with 4 oz. of a thick solution of gum dragon mucilage (this is made by soaking gum tragacanth in cold water until it swells up to a jelly-like mass, straining it, and using the clear solution).

Cement for affixing Lenses together to make Compound Lenses.

Use Canada balsam alone. Cleanse the separate lenses from all grease with ether, benzine, or turpentine, and then put a drop of pure balsam in the middle of the concave surface and press down the convex lens gently on it until the balsam oozes out at the edges, then apply a gentle heat until the balsam has hardened.

Gum Cement for Marble Statues, etc.

Make a thick mucilage of gum arabic, and mix 8 oz. of it with $1\frac{1}{2}$ oz. of "dental" plaster, and then mix in $\frac{1}{2}$ oz. of finely-powdered quicklime; mix well, and heat the surface of the marble before applying the cement.

Cement for mounting Opaque Microscopic Objects.

Put into a small bottle 2 drachms of isinglass and 1 drachm of gum arabic, and cover the mixture with proof spirit of wine. Cork the bottle loosely, and stand it in a water bath or in a vessel of hot water, heat the water until the solids have dissolved; then strain for use.

Colourless Cement for Mica.

Soften best quality clear gelatine in a little cold water until the gelatine is soft throughout, but it should not lose its form; then lay the sheet of gelatine between the folds of a cloth, and press out all excess of water; next put the softened gelatine into a gluepot and heat it until it melts, and add just sufficient proof spirit, but not too much, to make it fluid; to each pint of this solution add gradually, stirring all the time, $\frac{1}{4}$ oz. of gum arabic and $1\frac{1}{2}$ oz. of mastic resin (which has been previously dissolved in 4 oz. of rectified spirit). Keep in bottles the stoppers of which have been dipped in melted paraffin wax. When wanted for use, it is liquefied by standing in a cup of hot water or by gently heating it. When properly prepared, this cement is waterproof.

Cement for Minerals, Fossils, etc.

Put 4 oz. of sugar in sufficient cold water to dissolve it, and then add 1 oz. of starch; separatively dissolve 1 oz. of gum arabic to make a thick mucilage, then mix the two fluids, and heat and stir until the starch is cooked.

Cement for Naturalists' Use, Artificial Flowers, Confectioners, etc.

Take a medium thick solution of gum arabic mucilage, thicken with starch powder or farina, and then heat the mixture until the starch is cooked.

Cement for Fixing Labels on Nickel.

Dissolve 4 oz. of gelatine in 50 oz. of cold water, then add 2 oz. of glycerine and 1 oz. of glucose, heat the mixture and stir until homogeneous.

Cement for mending Shells and similar Articles.

Crush up 2 oz. of sugar candy and dissolve it in 5 oz. of gum arabic mucilage, and then add sufficient dry whitelead to colour the mass.

Agglutinant for Porcelain (non-waterproof).

Mix dry plaster of Paris with gum arabic solution to make a thick mass, and use at once.

Mucilage for affixing Paper Labels to Smooth Surfaces.

Dissolve 1 lb. of genuine gum acacia in 5 gallons of boiling water, and then add 8 fluid oz. of glycerine. The presence of the latter fluid has the defect of causing the mucilage to attract moisture and thus render the paper liable to dampness and peel off, but it lessens the brittleness of the gum.

Cement for Parchment and Stiff Papers.

Dissolve 1 lb. of dextrine in $1\frac{1}{2}$ pints of cold water, and in a separate vessel dissolve 1 lb. of gum arabic, in powder, in $1\frac{1}{2}$ pints of boiling hot water, then mix the two solutions, and stir in 8 fluid oz. of glycerine and $\frac{1}{2}$ scruple of oil of cloves, or of cinnamon.

Mucilage for Tissue Paper and similar soft Tissues, such as "Lining" Paper of Cardboard Boxes.

Dissolve 1 lb. of gum arabic in powder and 4 oz. of loaf-sugar in 3 gallons of boiling hot water; separately mix $\frac{3}{4}$ lb. of rice starch (laundry starch) in 5 gills of cold water to make a smooth batter, then cook the starch by heating it to form a paste by pouring on 6 pints of boiling water; then pour in the gum and sugar mixture, and stir until cold.

Mucilaginous Paste for Paper, Strawboard, etc.

Mix rice starch with just sufficient cold water to make a smooth batter, and then make into a paste by pouring boiling water on it in the usual way, and to every 16 oz. of such paste stir in 7 oz. of glucose syrup, ½ oz. of hard ("curd") white soap, 5 oz. of dextrine in powder, and 1 drachm of borax, and heat and stir the whole at a gentle heat until the ingredients are well incorporated, then thin down to a similar consistence with fresh skimmed milk. Use the paste warm and as thick as possible.

Gum "Dragon" (*i.e.*, Tragacanth) Mucilage.

Rub up 1 oz. of powdered gum dragon in 4 oz. of pure glycerine in a Wedgware mortar, and when the gum has dissolved, pour it into 3 pints of boiling water, and give the mixture a week's rest; if it swells too much, dilute as required with more cold water.

Dextrine Mucilage for Labels.

Digest 2 lb. of dextrine in 2 quarts of cold water, and then add 16 oz. of acetic acid and 16 fluid oz. of alcohol.

Gum Dragon Mucilage for Paper Labels for Glass, Wood, etc.

Dissolve 30 grammes of gum dragon and 120 grammes of gum arabic in 500 cubic centimetres of water, then filter, and add 2½ grammes of thymol mixed in 120 cubic centimetres of glycerine; then add sufficient water to make up the bulk to 1 litre (35 fluid oz.).

Compound Gum Arabic Mucilage.

Gum arabic will not affix paper labels to a smooth surface, because the gum dries to a glossy film on the paper, which fails to adhere to a smooth surface, thus allowing the label to peel off. By the addition of other bodies, however, a mucilage can be obtained that is devoid of this defect: thus, dissolve 8 oz. of gum arabic in 8 oz. of water, then add 1 oz. of soaked gelatine (that has been soaked in water for 1 hour), heat the mixture, and add to it 9 oz. of "rock-candy" and 3 oz. of gum arabic; dilute with water if required thinner.

Acidified Alcoholic Mucilage.

Dissolve dextrine in alcohol to a suitable consistency, and then add a little acetic acid to increase the mobility of the fluid. Instead of the acid, the dextrine can be dissolved in water, and then alcohol added to render it quick drying.

Elastic Mucilage that does not Crack.

Dissolve $4\frac{1}{2}$ oz. of soft soap in $4\frac{1}{2}$ oz. of glycerine. Separately dissolve $1\frac{1}{2}$ oz. of salicylic acid in 30 fluid oz. of alcohol, and mix this with the soft soap solution. Mix well by shaking, and then mix this with a solution of gum arabic, which can be made by dissolving $8\frac{1}{2}$ lb. of gum arabic in $13\frac{1}{2}$ pints of water; mix well, and keep in bottles. This mucilage is elastic when dry, not harsh, and does not crack like ordinary gum arabic solution.

Gum Arabic that will adhere to any Surface.

For many purposes gum arabic mucilage is unsuitable as an agglutinant; but the following compound is practically a universal mucilage, as it will cement together all sorts of materials:—Dissolve $\frac{1}{2}$ drachm of pure sulphate of alumina (not common alum) in 16 scruples ($\frac{2}{3}$ oz.) of water, and mix the solution with 8 oz. of strong gum arabic mucilage. The mixture will not be affected by damp or moisture, and is very adhesive for labelling glass and smooth surfaces.

A non-brittle Gum Arabic Mucilage.

This is made by adding 1 or 2 per cent. of glycerine to ordinary gum arabic mucilage; but too much must not be used, because it is hygroscopic and will attract moisture.

Ordinary dextrine mucilage is made by dissolving the dextrine in hot water to form a syrupy liquid, and to prevent decomposition or mildew being engendered, adding a few drops of oil of cloves (an excess of dextrine should be used: that is, the mucilage should not be too watery), and the mixture stirred, then allowed to cool, and the resulting fluid strained through fine cloth, and, to impart a glossiness to the mucilage, a little powdered sugar may be dissolved in the hot water before adding the dextrine.

Mucilage from Starch.

Mix 4 oz. of nitric acid with 1 pint of cold water and pour this into 5 lb. of potato starch, placed in a glazed vessel; stir well with a wooden stick, and allow it to stand for 24 hours in a warm place, then boil it until it becomes thinly fluid and very transparent. If necessary, it may be diluted with water and filtered through a cloth or finer fabric. This mucilage, in fact, is akin to dextrine, which is a substance obtained by torryfying starch. Next dissolve 3 lb. of gum arabic and 1 lb. of sugar in $\frac{1}{2}$ gallon of water, add 7 drachms of nitric acid and heat it to the boiling point, and then mix the fluid with the starch mucilage.

There are many other compounds in which gums are utilised as ingredients in forming agglutinants, such, for example, as one in which wheat flour is the chief ingredient. Such compounds have been described under the section dealing with flour pastes.

Fish Glue from comminuting Ivory and Bones.

Boil isinglass in water until it is very thick, then add sufficient zinc oxide to make a paste as thick as treacle.

Isinglass glue is prepared by dissolving isinglass in warm water, straining it through coarse linen, then adding a little alcohol and evaporating the mixture to such a consistence that, when cold, it will be dry and hard; the resulting compound is very tenacious.

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[*See also "Wood Waste Utilisation"* p. 44.]

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