DRESSINGS AND FINISHINGS FOR TEXTILE FABRICS AND THEIR APPLICATION

F. POLLEYN

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DESCRIPTION OF ALL THE MATERIALS USED IN DRESSING TEXTILES
THEIR SPECIAL PROPERTIES, THE PREPARATION OF DRESSINGS
AND THEIR EMPLOYMENT IN FINISHING LINEN, COTTON,
WOOLLEN, AND SILK FABRICS. FIREPROOF AND
WATERPROOF DRESSINGS, TOGETHER WITH
THE PRINCIPAL MACHINERY EMPLOYED

BY

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PREFACE TO THE FIRST EDITION

Though well aware of the difficulties attending the production of a work relating to a branch of industry which has already reached a high stage of development, the author entered on his task with pleasure, being convinced of the existing necessity for such a work in connection with the preparation and application of dressings, or at any rate of a work in the form of the present one, which deals chiefly with the chemico-physical side of the matter.

From the outset there could not be any question of producing a work similar to that of Dr. Grothe, which treats principally of the mechanical side, and is unsurpassed in that respect; nor did the author intend to imitate in any way the equally excellent work of Romen, his programme being restricted to dressing materials, in the narrow sense of the term, their properties, suitability, and preparation, points which had hitherto been treated in a scanty fashion; as also to give a series of dressing recipes, and briefly describe the application of the finished dressings.

In compiling the work, the whole literature of the subject has been gone through carefully, suitable material being utilised, and particular attention bestowed on the patents that have been taken out in recent years.

The finisher will find all the information he can desire set forth in the concise form necessitated by the limitations of space, so that the author ventures to hope that the book will meet with an exclusively friendly reception. At the same time, he will be pleased to receive corrections where necessary, and to bear them duly in mind.

PREFACE TO THE SECOND EDITION

Spurred by the favourable criticism with which the first edition of his work was received in the trade, the author, in preparing the second edition, has omitted everything that seemed out of date or superfluous, shortening passages that appeared needlessly diffuse, and added new matter, so that he feels justified in assuming that everything possible has been done, in revising the book, to make it practically a new work.

PREFACE TO THE THIRD EDITION

The fact that a revised edition has been found necessary within a comparatively short time constitutes the best proof that the work itself has fulfilled practical requirements. In the revision, attention has been paid to recent improvements. It is true that there is no striking novelty to record, the finisher being accustomed to work with long known raw materials, which are rarely supplemented by new ones; and the effects to be produced are based more on the mechanical treatment. Nevertheless the book, in its amplified form, will afford valuable assistance to every finisher, and repay consultation; and the author hopes to gain additional friends by bringing his work up to date.

F. POLLEYN.

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DRESSINGS FOR TEXTILE FABRICS

CHAPTER I

THE DRESSING PROCESS AND MATERIALS FOR SAME

TAKEN as a whole, the process of dressing or finishing any goods implies effecting an improved appearance, especially in the case of fabrics, paper, leather, etc., in order to fit them for their destined purpose or for sale, by imparting certain properties which they do not possess as a rule, or not to the extent required.

The finishing of fabrics comprises all the operations—apart from bleaching and dyeing—which improve and complete the material.

Hence the finishing process may be regarded as one of beautifying, completing, improving the appearance and concealing defects; and in such case its object is the removal of adherent foreign bodies, such as particles of wood and straw, etc., washing, smoothing, and glazing, whether by mechanical treatment alone, or in combination with such materials as are suitable for developing smoothness and gloss. The various operations to which the rough and unsightly fabrics coming from the loom are subjected, are:—

1. Cleansing the fabrics by washing, carbonising, nopping and gassing; 2. Milling; 3. Raising; 4. Ratteening; 5. Shearing; 6. Grinding; 7. Brushing, and 8. Beetling (though, of course, these are not all required in every case); 9. Dressing (stiffening and glazing); 10. Levelling and smoothing; 11. Drying; 12. Glaze calendering; 13. Beaming; and 14. Folding, lapping, measuring, and rolling up.

Out of all these operations we have here only to deal with those relating to the dressing process, and, indeed, only in so far as they concern the dressing materials and the properties and application of same.

In the restricted sense, the term "dressing materials" implies all the substances, of organic origin, which are used for stiffening, glazing, loading, etc., yarns and fabrics, whereas, in a broader sense, it might be extended to the appliances used for beautifying and improving the quality of these products.

Dressings may be classified in various ways, such as: in accordance with their origin (organic or inorganic), or the kind of fabric to which they are to be applied. In this latter case we have:—

Dressings for cottons;
" " linens;
" " woollens;
" " mixed fabrics;
" " silks.

Nevertheless, since many dressings are used for improving fabrics of more than one class, it is more convenient to classify them according to the purpose for which they are used. Such a classification, adopted by Grothe, is the following:—

1. Dressings, properly so-called, for stiffening and glazing (flour and starch); and (1*a*) dressings with adhesive properties for the same purpose (size, gum, resins, mucilage, etc.).
2. Dressings for producing a soft and supple finish (glycerine, fats of all kinds, oil, wax, stearine, etc.).
3. Dressings for loading and increasing weight (mineral substances).
4. Dressings possessing antiseptic properties.
5. Dressings for waterproofing and preserving the fabric.
6. Dressings for shading the colour of the fabric (blueing).
7. Dressings for rendering fabrics uninflammable and incombustible.

A closer examination of this classification shows that all the dressings in Classes 1 to 4, and also 1*a* and 5, are important; and the substances comprised therein do, as a matter of fact, play the chief parts in all the operations of the dressing process.

For stiffening and glazing, use is made of: wheaten flour, rice meal, maize meal, sago, tapioca, arrowroot, potato starch, wheat starch, rice starch, maize starch, rye starch, arrowroot starch, acorn starch, Jerusalem artichoke starch, horse-chestnut starch, protamol and dissociated starch (dextrin); also vegetable mucilage, size, gelatine, gum, resins, etc.

The loading and weighting materials include: barium sulphate, heavy spar, lenzinite, mineral white, gypsum (calcium sulphate), magnesium sulphate Glauber salt (sodium sulphate), lead sulphate, aluminium sulphate (alum), magnesium silicate, steatite, soapstone, aluminium silicate (China clay), potassium silicate, sodium silicate (water-glass), calcium chloride, zinc chloride, barium chloride, magnesium chloride, barium carbonate, magnesium carbonate, and magnesium sulphate.

Flexibility is obtained by the use of: beeswax, vegetable wax, animal fats, oils, stearine, glycerine, etc.

The application and suitability of these loading ingredients will be dealt with fully in due course.

Flour, starch, and mineral substances are the dressings most frequently used, partly for imparting stiffness and "grip," and on the other hand for concealing defects in the goods, making loose fabrics appear more solid, and, in short, to make inferior goods more saleable.

This masking the true character of a fabric is often carried to such an extent that the fabric really serves merely to hold the dressing together. Open fabrics are loaded and faced with such a quantity of starch, flour, and mineral substances that they look solid and good, producing the impression of strong goods; but, when the dressing is removed, by rubbing or washing, the real fabric is left, and its character is then learned for the first time.

Loading and weighting are effected with mineral substances, especially such as are insoluble in water; and these substances require the addition of a suitable quantity of flour, starch, size, or other binding medium, since, without these, they would not adhere to the fibre, but would separate in the form of dust. Moreover, used alone, they make the threads stiff and hard, to prevent which defect the dressings are incorporated with substances that impart flexibility, such as glycerine, fats of all kinds, oils, soaps, etc., the goods being thereby rendered supple and elastic.

The gluten contained in flour is of high value as a bind for loading materials, since it enables the flour to form, with a larger or smaller quantity of water, a tough, elastic, binding paste, that will take up large quantities of the mineral loading ingredients. It is owing to its larger percentage of gluten that wheaten flour is superior to rye and barley flour as a binding medium. On the other hand, the lack of gluten in starch unfits the latter for binding any large quantities of mineral substances, so that it cannot retain the 600 to 800 per cent. of these latter present in loading preparations, but allows them to dust off, the dressing being therefore worthless. In spoiled flour the binding power of the gluten is more or less completely dissipated, and such flour therefore is unsuitable.

Shading ingredients are added to the dressing preparations in order to transform the ordinary yellow or greyish-white tint of the flour, starch, China clay, etc., into a bluish-white tone that is pleasant to the eye. Ultramarine, indigo, indigo-carmine, Paris blue, and coal-tar dye stuffs are used for this purpose.

The addition of antiseptic ingredients is an important matter in connection with dressing preparations. Flour, starch, size, tallow, fat, and all organic substances have a known tendency to become mouldy, more especially when stored in a damp place. Even in dry rooms, however, they attract moisture from the air, the result being that the dressings are spoiled in the first place, and the fabrics are ultimately damaged. To prevent this injurious influence of moist air and retard the formation of mould as long as possible, it is the custom to add antiseptics to the dressing preparations at the time of manufacture. The antiseptics include: carbolic acid, creosote, salicylic acid, acetic acid, thymol, tannin, camphor, oxalic acid, picric acid, carbon disulphide, cyanogen compounds, arsenic, arsenic acid, ferrous sulphate, salts of copper, alumina and zinc, chlorine compounds of barium, zinc, aluminium, magnesium, calcium, sodium, potassium and mercury, sodium nitrate, boric acid, chromic acid, potassium chromate and manganese salts. Their poisonous nature should, however, be borne in mind, especially when used on dyeings (*e.g.* picric acid).

No manufacturer would knowingly make use of compounds that are likely to endanger the life of his fellow-men; and the inclusion of certain antiseptics with poisonous properties in the above general list does not imply their use in the dressing of fabrics.

Wax, paraffin wax, and stearine are important ingredients of dressings, because, by suitable treatment (calendering, pressing, and satin-finishing) they impart to the fabric a high gloss that is unattainable by any other means.

The dressings used for the purpose of waterproofing are referred to here, only in so far as they are adapted for impregnating fabrics without changing their external appearance and special properties in any way. Hence it is necessary to exclude: solutions of rubber and resins, linseed oil, tar, pitch, rosin, and naphtha, which alter the fabric more or less, cover it with a solid protective coating of other materials, or change its appearance in some other way, their application belonging to another technical branch.

The following waterproofing ingredients are used: ferrous sulphate (green vitriol), acids, copper salts, zinc salts, alumina salts, tanning materials, soaps, paraffin wax, wax, etc. These are dealt with in the chapter on waterproof dressings.

Dressings for rendering fabrics uninflammable have not yet met with the extensive application they deserve. It is true that they do not furnish absolute security against the action of flame or heat, but they protect fabrics from readily catching fire. An unimpregnated material will ignite at once when brought near a flame, whereas an impregnated material will not do so until it has been in contact with the flame for some time, and in consequence of the heat has given off inflammable gases. In many cases, however, help has already been rendered before the liberation of gas has had time to occur, and, therefore, the moral value of suitably impregnating fabrics with fireproof dressings cannot be too highly estimated.

The fireproofing substances suitable for application to fabrics include: all salts endowed with the property of melting at a low temperature and providing the fabric with a vitreous coating, such as: alum, borax, sodium tungstate, ammonia, ammonium phosphate, calcium chloride, potassium carbonate, water-glass (alkali silicate), etc.

There are also a number of special dressings, such as those for imparting a metallic, bronze, silvery, or silky lustre, the production of an imitation embroidered effect, the production of lustrous beads, dewdrops, iridescent effects with fish-scale solution, brilliants, etc. These, more than any others, are dependent on the dictates of fashion, and fluctuate accordingly.

Dressings are very extensively used, and their application is in some cases the business of a separate industry, manufacturers sending their goods to the finisher to be treated. Cotton, linen, and mixed (union) goods are those most extensively subjected to dressing. All the ingredients mentioned above are used in more or less varying proportions, the predominant position in all cases, however, being occupied by flour, starch, and one or more loading ingredients. On the other hand, the additions of size, gelatine, tallow, wax, soap, paraffin wax, antiseptics, blueings, etc., are always small, the amount varying with the purpose in view.

Woollen goods are dressed with starch, gum, Carragheen moss, size, gelatine, dextrin, blood albumin, water-glass, soda solution and sal-ammoniac, whilst lead acetate, lead sulphate, alum, witherite, China clay and glucose are used for loading. Westphal dresses woollens with wheaten starch to which are added a little rape-oil and fleawort mucilage; worsted yarn is dressed with gum or size.

Velvets are sometimes dressed with gelatine, gum arabic, oxalic acid, and also with beer, generally on the underside of the fabric.

For silk dressing, use is made of: tragacanth, gum arabic, ox gall, sugar, isinglass, shellac, amber, gelatine, fleawort mucilage, beer, collodion, stannous chloride, etc. Ordinary woven silk fabrics, however, especially those made from unloaded yarn, are merely warm pressed and not treated with dressings, and it is only when the fabric is loose and hungry that attempts are made to replace the absent properties by dressing.

The number and nomenclature of dressing preparations have increased considerably in the course of years. Every fashionable fabric put on the market exhibits a special finish. It differs from others in feel and appearance; and if one were to apply a new name to every novelty, and to every slight modification in dressings, their number would be very large indeed, and it would be impossible to keep track of them all.

How far, indeed, the views of different authors vary on this point, may be gathered from the following comparisons:—

Käpelin distinguished between dull, plain, moiré, glacé, elastic and waterproof finish; whereas Romain, in his work on bleaching, dyeing and finishing, classifies dressings according to the surface appearance (on one or both sides) and the feel of the fabric.

In the former category he draws a distinction between: 1. Semi-dull and dull; 2. Semi-gloss and full gloss, also high lustre; 3. Semi- and full silky finish; 4. Velvet finish; 5. Barre de fer, rough (and semi-rough) finish; 6. Loadings (interior); 7. Facing finishes; 8. Broken finishes; 9. Moiré finish; 10. Press finishes; 11. Fancy lustred and satin finishes; 12. Cloth finish; 13. Mineral and metallic finishes; 14. Elastic finishes, hard finishes, Apprêts à la Tartare; 15. White-goods finishes for linens, cottons, and unions; 16. Sundry more or less varying finishes, devoid of any special character; 17. Waterproof finishes.

With regard to the feel of the finished goods, Romain makes the following classification:—

1. Hard finishes of divergent character; 2. Soft finishes, various; 3. Light, loose, and open finishes; 4. Heavy, loaded, and almost greasy finishes; 5. Damp and linen-like finishes (cold finishes); 6. Scroopy, rustling, woolly, velvet finishes; 7. Elastic, flexible, ductile, non-brittle finishes; 8. Stiff, up-standing brittle finishes.

Dr. Grothe is of opinion that there is now scarcely any possibility of classifying dressings with accuracy according to the outward appearance, feel, etc., of the fabrics, more especially since fashion is daily bringing out new goods, and with them alterations of varying importance in the finish, so that the latter cannot be grouped in any of the general classes.

In the present work, the classification according to the kind of fabric for which the dressings are used has been adopted, viz:—

1. Dressings for linen;
2. „ „ cotton;
3. „ „ mixed fabrics (unions)
4. „ „ woollens;
5. „ „ silk;
6. Waterproof dressings;
7. Fireproof dressings;
8. Special dressings (silky lustre, metallic lustre, imitation embroidery, production of metallic, diamond, and dew-drop glitter effects, etc.).

Moiré and embossed finishes are produced on all kinds of fabrics, by passing the goods through engraved rollers, or subjecting two superimposed layers of the fabric to heavy pressure between rollers, so that the threads are pressed together irregularly and produce the desired effect of reflection.

In the following chapters the various dressings are dealt with according to their purpose and properties, their method of preparation and application to the fabric being then described.

A final chapter is devoted to the investigation and testing of the dressings on the finished fabrics; but it would be beyond the scope of the work to mention and describe all the machines used for this purpose; nor could the subject be dealt with so thoroughly and exhaustively as in Dr. Grothe's book, *Die Appretur der Gewebe* (Finishing Textile Fabrics), which will amply repay perusal.

A critical report will be found on the ready-made dressings, which have been introduced of late years to save the finisher the trouble of making up his own.

CHAPTER II

STIFFENINGS AND GLAZES

Starch.

Nearly all plants, except those belonging to the lowest orders of vegetable life, contain starch as one of their constituents, though few of them can be used with advantage in the preparation of starch on a manufacturing scale. Starch occurs in fairly considerable amount in certain parts of plants, more particularly the root-stocks and root-nodules (tubers), the pith, and also numerous fruits (seeds). In these members the starch is present in the form of microscopic grains of peculiar structure, enclosed in cells, many of which contain so much starch that, when dried, the entire portion of the plant has the appearance of a very friable, mealy substance. The detection of starch in plants is effected by touching a section with iodine tincture, which gives a blue to bluish-violet coloration with that substance.

Starch makes its appearance most abundantly at the close of the vegetative period of the plant. It is stored up as a food-stuff for the coming year: in the seeds for the development of the embryo, and in other parts for the continuation of the general growth. Elder wood, for instance, is so full of pith that the latter occupies nine-tenths of the diameter of the twigs, and consists chiefly of starch. The conditions are similar in the young and old stems of the sago palm, in the grains indigenous to Europe, all pod plants, rice, buckwheat, acorns, edible and horse-chestnuts, potatoes, etc., nearly all of which are used, more or less, for the preparation of starch.

For the preparation of dressings and other technical purposes, however, wheat, maize, rice, potatoes, pulse, buckwheat, artichokes, manioc, and the sago palm are practically the only sources of starch.

The properties of starch vary according to its origin, especially as regards the shape and size of the grains; and though it may be assumed with a fair amount of certainty that the various commercial grades of starch possess about the same chemical properties, there are, nevertheless, some varieties of starch that differ from the rest in this respect. Such a starch, for instance, is inulin, from the nodules of *Inula hellenium*; another being lichenin, from *Lichen islandicum.*

The microscope affords a means of reliably identifying the origin of any particular kind of starch, the differences in the size and shape of the grains being sufficient in many cases to reveal the plant from which they were obtained.

All starches contain a fairly large amount of water, in some cases as much as 14 per cent. When starch is artificially dried by the aid of heat, it soon reabsorbs moisture when exposed to the air.

Starch is composed of carbon, hydrogen, and oxygen (formula $C_6H_{10}O_5$). It belongs to the group of carbohydrates, and its properties are closely allied to those of vegetable fibre (cellulose), gum, and sugar, into which latter substances it can be transformed by chemical processes.

Starch is insoluble in water, and also in alcohol, acids, or alkalis. It is, however, not indifferent to the action of concentrated acids and alkalis; and when treated with concentrated sulphuric acid it undergoes transformation into a gelatinous mass, which is no longer starch. When potato starch is subjected to this treatment, a peculiar and highly characteristic odour is developed.

When starch is distributed in water and heated to a certain temperature, a peculiar change occurs, the previously thin and milky liquid becoming thick and opalescent (translucent), the starch being gelatinised and thus acquiring the character which constitutes its special value as a dressing. The temperature at which this gelatinisation occurs varies, according to the kind of starch, between 145° and 190° F., being 145° to 156° F. for potato starch, and 179° to 190° F. for wheaten starch.

Thin starch paste closely resembles a solution. When the paste is made from perfectly pure starch it will keep unaltered for a long time in air that is free from dust. On the other hand, the paste from ordinary starch, which always contain small quantities of impurities, quickly turns sour in the air, lactic acid being formed, and afterwards changed into acetic and butyric acids.

Starch paste is not a chemical compound of the dissolved substance (starch) with the water, and its formation may be classed along with the solutions obtained with dextrin, albuminous substances, gum, pectin bodies, etc. The comparison, however, is not complete, the substances in question always entering into a state of intimate combination with the water. For instance, their solutions are absorbed into porous substances without alteration, and they can be separated by precipitants (dextrin being thrown down by alcohol), though they will redissolve in cold water at once. If starch paste, however, be placed on a brick, only the water will be absorbed, the starch being left behind in the state of a film. When starch paste is frozen, the starch is deposited in an insoluble form, and does not redissolve in cold water, the paste not being re-formed until the normal gelatinisation temperature is reached. Moreover, starch cannot be brought into such a highly soluble modification by mere infusion or short boiling as is the case when the boiling is prolonged.

Among the important changes sustained by starch are those produced by the simple action of heat, diastase, acids, and alkalis.

If starch be heated to 392° F., it is transformed into a pale yellow mass that is soluble in water and is known as dextrin. A previous moistening with dilute nitric acid causes this transformation to occur at a temperature only slightly higher than the boiling-point of water. The action of diastase (a peculiar substance present in germinated barley) converts starch into dextrin, accompanied by the formation of grape-sugar (starch-sugar). In all these processes, the inner and denser portions of the starch grain are dissolved first, leaving the outer layers suspended in the solution, though these also dissolve completely under the prolonged influence of acid or diastase.

When starch is boiled for a short time with alkalis or acids, a partial transformation into dextrin occurs, and in this condition the starch—potato starch especially—loses its properties. If starch be suffused with dilute caustic soda, it swells up very rapidly, and gelatinisation occurs without any application of heat, the time required being in inverse ratio to the moisture content of the starch. With a suitable proportion of alkali the starch paste is colourless, and can be brought into any desired consistency by boiling it for several hours in a pan fitted with stirrers. The resulting mass is neutralised with sulphuric acid, in order to destroy the alkaline reaction, this treatment being effected either before or after the mixing process. The maker can turn out at will a neutral, alkaline, or faintly acid product, which can be mixed with various other dressing ingredients and salts according to requirements. Starch paste modified in this way is known as vegetable glue, and is met with in commerce, in either a solid or liquid condition, under various names: poliocolle, sizing preparation, apparatin, crystal dressing, vegetable size, alligin, etc.

If starch be heated by itself to a high temperature, it is, as already stated, first converted into dextrin; but when the temperature is raised above the point necessary for the production of dextrin, a whole series of products are formed: sugar, assamar (bitter), dark caramel, and various other little known bodies, classed as empyreumatic aromatic principles by Rehwald.

In the preparation of commercial starch, the starch grains have to be separated from the vegetable substances in which they occur, and for this purpose these substances (parts of plants) are crushed so as to break open the cells in which the starch is imprisoned. The powdered products resulting from this operation are treated with water, in which they become disseminated, finally settling down as a fine, delicate sediment. Simple as this process appears, it is nevertheless attended with a number of difficulties owing to the fact that other substances, beside the starch, are disseminated mechanically in the water, and must be separated from the starch grains by chemical treatment, in order to obtain the latter in a sufficiently pure state.

The following brief account will afford some idea of the methods by which starch is prepared:—

Potato Starch.

The potatoes are first freed from adherent soil in washing drums of various sizes and forms, and are then subjected to the four principal operations: pulping, washing out the starch, cleansing the latter and drying it, in some cases followed by moulding the purified starch. The pulping is effected in pulping machines, many of which are of very antiquated pattern.

The resulting pulp consists mainly of disrupted cells and their contents, the cell walls and fine granules of starch being disseminated in the liquid contents of the cells. In addition, the torn skins of the potatoes and unbroken cells are present in larger or smaller amount.

The separation of the starch from the other substances is effected mechanically, the pulp being treated in sifting machines, levigation agitators, roller brush machines, and spiral brush screens, for the purpose of driving the starch grains, by the aid of water, through the screens, and at the same time eliminating the pulp. The milky effluent from these machines consists of water, in which all the sap constituents of the potato are dissolved, together with starch, cork substance from the potato skins, unbroken cells (cellulose, starch grains, and sap), and dissolved colouring matter. When left to itself the liquid soon clarifies and deposits a dirty white sediment covered by a brownish liquid. The sediment is starch, plus the other ingredients mentioned, the liquid consisting of the water employed and the potato juices. This supernatant water is drawn off as soon as possible, because the substances it contains in solution rapidly putrefy and give off a very unpleasant smell.

The crude starch is purified by levigation, and the superfluous water is removed. The starch granules stirred up in the levigation process, settle down again in strata of progressively increasing fineness, the topmost layers consisting of starch and unbroken cells, surmounted by the cork substance. These uppermost layers are removed, and are left in a damp condition, to facilitate decomposition by putrefaction, whilst the bottom portions are again levigated. The levigation tanks are arranged so as to receive a continuous supply of water, containing the finely divided starch from the settling tanks.

When the starch has settled down, the water is run off, and fresh water is admitted to repeat the levigating process. The wet purified starch forms a pasty mass, containing a large amount of water, but of such consistence that it cannot be shovelled out of the tanks. This water is removed by pressing the starch in cloths, leaving it to drain off by a suction or centrifugalising apparatus.

The dried cakes of starch should not break when handled, but be capable of transference to the drying-room. This room consists of a chamber, adapted to be heated by suitable means (hot air, water or steam pipes), to a temperature of about 75° to 85° F., and fitted with racks for holding the drying-frames. In this room the cakes dry on the outside, the water from the interior passing outward through the pores and being evaporated on the surface. The progress of drying can be ascertained by breaking a partially dried cake in two. The wet central portion has the appearance of cheese, whilst the drier outer portions look like chalk. The time required for drying depends on the temperature of the drying-room, the degree of moisture of the starch, and the size of the cakes.

Potato starch, as it is put on the market after drying, is in an air-dry condition, *i.e.* it looks dry without being really so, the moisture content being still rather high, and averaging 18 per cent. The starch forms a white powder that is readily distinguishable from other kinds of starch by its semi-translucent appearance. Potato starch should not ball when pressed in the hand, that tendency indicating imperfect washing or drying, but it should give out a peculiar crackling sound and remain floury.

When stirred up in water it should subside quickly, leaving the supernatant liquid perfectly clear; and this latter should not give off any unpleasant smell or turn sour when left over the starch for several weeks, the appearance of these phenomena indicating insufficient purification of the starch.

Wheaten Starch.

The preparation of this product differs in many points from that briefly described above, and is based on the removal or destruction of the gluten present in the flour. According as it is desired to recover the gluten, which forms a valuable food-stuff, separately, or merely to get rid of it, the method of preparing the starch proceeds on different lines, both in the case of wheat and other cereal starches. In the former case the method is one of levigation, and in the other of fermentation. This latter system, however, has been abandoned by those desiring to work economically, being antiquated, uneconomical, attended with considerable waste, and injurious to health. True, it is rather difficult, in practice, to recover the starch and gluten at the same time; but the difficulties are not insurmountable, and can be obviated or avoided. Nevertheless, in spite of all the care bestowed, a certain amount of loss, both of gluten and starch, has to be faced.

The fermentation process is divided into six stages:—

1. Soaking: the grain being steeped in water until the corns have become sufficiently distended.

2. Crushing the soaked grain in a grist mill, so as to burst the husks and partially squeeze out the damp contents.

3. Fermentation. This is an important stage, in which the gluten is destroyed by fermentation. The tanks are filled, one-third full, with water, the crushed wheat is run in, and sufficient water is added to make a thick pulp that can just be stirred. Unless fermentation sets in spontaneously, a ferment is added, and the temperature may also be raised by adding warm water. In the course of fermentation the gluten is partially dissolved by the acetic and lactic acids formed, and partly undergoes putrefaction.

4. Levigating the fermented mass. This is a troublesome operation, not only because the starch has to be separated from the adherent acid liquor, but also by reason of the presence of residual particles of gluten, there being still about 25 per cent. of the original flour in the mass. The process of separation commences by drawing off the liquid from the pulp as completely as possible. Levigation is then effected in large washing drums, in which the pulp is placed on a fine-mesh screen and is washed away by a constant stream of water, or a special double drum may be used.

5. The purification of the starch is an operation for the purpose of separating the starch itself, as completely as possible, from the remaining foreign bodies (particles of gluten and husks), by repeated levigation.

6. Drying is effected in the same manner as for potato starch, but should be performed as quickly as possible in order to avoid considerable loss.

The top layers of the starch sediment, contaminated with gluten and other waste products, is put through another process of fermentation, followed by levigation and drying, and is brought on the market as second-grade starch.

The preparation of wheaten starch without fermentation is based on the peculiarity of wheat flour (and those of other cereals) of parting with its starch when the crushed grain, placed in a linen bag, is kneaded in water so long as a milky liquid runs away. This milky liquid contains the starch of the grain, whilst the gluten remains behind in the bag as a tough, elastic, brownish mass, along with the husks, cellular tissue, etc. The preparation on a manufacturing scale is divided into four stages, the two first of which—soaking and crushing—are the same as already described, except that warmer steeping water is used, and the grain is more finely crushed.

The lixiviation of the starch is a somewhat troublesome operation, that was formerly performed in bags alone, but is now carried on in washing drums and in special apparatus. The crushing and washing can also be done in one operation, the grain being put through a system of rollers, between which it is squeezed and partially washed, and then falls on to a sieve, where it is further treated with water. This method facilitates the levigation of the starch and frees it from the bulk of the gluten.

Maize Starch.

This starch was formerly imported from America exclusively, where the conditions of soil and climate, coupled with the ease with which the maize plant can be cultivated, gives it an advantage over the true cereals. At present, however, large quantities of best maize starch are also produced in Europe.

In order to recover the starch, the maize corns are crushed to a coarse meal, which is levigated in precisely the same manner as wheaten starch, without fermentation.

An experienced eye can easily distinguish between maize starch and wheaten starch, the former having a faintly yellowish tinge, whilst the former is pure white. It may also be mentioned that wheaten starch no longer appears white when compared with potato starch, but has a greyish or brownish cast, owing to the presence of small quantities of gluten, from which the potato is free.

Rice Starch.

Starch is recovered from the waste resulting from the husking and polishing of rice, and also from sea-damaged rice, the preparation being carried out on a large scale in England, Belgium, Austria, France, Germany, and Italy. The difficulties at first encountered have now been overcome by a process of maceration with alkalis. The levigation of the crude product is carried out by running the grist into a tank containing water that is kept in continuous agitation, since otherwise the grist forms a thick mass, which requires very protracted treatment before it parts with the whole of its starch.

Buckwheat Starch.

Although this is not an important article of commerce, it is produced in a few English works from the seeds of *Polygonum fagopyrum* (buckwheat); and in view of the large yield of starch obtained, it is not improbable that this article may grow in importance.

Wiesner states that English buckwheat starch is a fine powder, almost pure white in colour, with merely a faint tinge of yellow. The grains of this starch are mainly simple and polyhedral, somewhat recalling those of rice starch, though of different size. Buckwheat starch also contains compound granules, consisting of 2 to 9 grains, arranged in line, in a highly characteristic manner.

The component grains of these granules behave like the simple grains, though they are frequently rounded in shape, and not polyhedral.

ARROWROOT.

Wiesner states that this starch, also known as Tik, Tikur, or Tikor flour, is obtained from two East Indian plants: *Curcuma angustifolia*, Roxbg., and *C. Leucorrhiza*, Roxbg., which are cultivated in Further India (chiefly Malabar), on account of the richness of their root-stocks in starch. The starch grains of both plants are large, but flat, and of elliptical outline, resembling discs.

Flückiger mentions that arrowroot starch does not begin to swell up in water at a lower temperature than 161° F.

In the bazaars at Bombay, this starch, stained a dark red, is also sold under the name of "Gûlal," and is probably used for dressing and dyeing fabrics in one operation.

TAPIOCA.

This is a whitish mass of coarse starch grains, usually caked together and, in part, gelatinised, and is obtained from the tubers of the manioc plant, *Manihot utilissima*, Pohl. The plant is indigenous to South America, where other species of Manihot, also yielding starch, are found.

In the country of origin, several different products are obtained from the manioc plant. The tubers are peeled and freed from their contained poisonous substances by careful washing, decantation, and drying. When this product is dried and ground, it forms the manioc of commerce, which is used in the preparation of food, especially in Brazil. By more thoroughly crushing the dry manioc tubers and levigating the resulting meal with water, a kind of starch, cassava—also known as Brazilian arrowroot—is obtained, this being chiefly used in the preparation of tapioca.

In principle, the manufacture of tapioca consists in granulating the moist starch by the aid of sieves, and heating the resulting granules on metal plates, this treatment partially gelatinising the starch and causing the tapioca granules to cake together.

The pure white tapioca of uncaked meal, sold in France, is prepared in that country from cassava.

SAGO.

Sago is composed of starch grains of different sizes and colours, partly unaltered and partly gelatinised, obtained from the stem of several species of palm.

The sagos of importance to European commerce are those from *Sagus Rumphii*, Wild, and *Sagus laevis*, Rumph., as also from *Sagus farinifera*, Lam., all of which are indigenous to India, and are cultivated in the Sunda Islands and in other tropical districts.

The starch is contained in the pith of the palm stems, which are cut before flowering, because the pith of ten- to twenty-year-old palms is full of starch at that period, whereas after flowering-time the proportion diminishes to nil. The felled stems are either sold or split up on the spot, the pith being taken out, broken into fragments, and washed on sieves. This sago flour is a somewhat important article of commerce, which is manufactured into sago in some of the large cities of India.

The preparation of the sago consists in granulating the moist starch by the aid of sieves, the irregular grains passing through the mesh being rounded off by shaking them up in bags, fitted with cross sticks. The Indians subject the granules to a process of partial gelatinisation in pans that have been rubbed over with vegetable fat.

At the present time, sago is usually put on the European market in the form of white or brownish granules, the brown varieties being coloured with caramelised sugar. Formerly a brick-red sago was obtainable, the colour of which, to judge from the residual ash, was due to some mineral pigment, probably bole.

The starch grains of the various sago palms are of fairly concordant structure, or at any rate of the same general type.

ARTICHOKE STARCH.

Wiesner reports on this product, the starch of *Batatas edulis*, that he examined samples of starches from this plant, which grows in all warm countries, from Martinique, Guadeloupe, Réunion, Cochin China, and India. The samples in question were sent to the Paris Exhibition of 1867, under the name "Fécule de patate." The starch, prepared in the above-mentioned countries from the artichoke tubers, by very primitive methods, is not very fine or pure white in colour, but rather a greyish-yellow powder, that can be purified by washing with clean water and repeated levigation.

The majority of the granules are compound, associated with a very small number of simple grains, the latter varying considerably in dimensions, the large diameter ranging between 0·010 and 0·050 millimetres. The simple grains are either globular, or somewhat distorted to an ovoid or pear-shaped form. The polarisation cross is recognisable in highly magnified specimens, but is never sharply defined.

Differentiating and Examining Starches.

To the consumer of large quantities of starch, it is a matter of some importance that he should be able to distinguish between the various kinds, in order that his interests may not be prejudiced, and it is therefore useful to repeat the remarks of Wiesner on the differentiation of the starch granules of wheat, rye, and barley.

The starch granules of these three cereals are very similar in a morphological sense, and whilst it is easy to distinguish them under the microscope from all other commercial starches, there is some difficulty in differentiating between them. Apart from their relative dimensions they are so much alike that it has frequently been asserted that no special characteristic for each sort can be identified. According to Wiesner, the differentiation can be made in all cases occurring in practice; a fact that is even more important in connection with flour than with starch, since, as a rule, rye starch and barley starch are not made separately, and are probably seldom used in substitution for wheaten starch. It often happens in practice that one has to decide whether a given flour has been made from wheat, rye, or barley, and whether any one of these is mixed with any other of them. This can be done by measuring the dimensions of the starch grains. In all varieties of wheat the albumen tissue of the seeds contains three species of starch grains. Two of these, the large, lenticular species and the small, globular, polyhedral variety, have long been known; but the third, which consists of agglomerated grains, has almost entirely been overlooked up to the present. Very careful examination of commercial wheats, or what is easier, the fresh tissue of the grain, reveals the appearance of granules composed of 2 to 25 fragments.

(a) *The Large, Lenticular Starch Granules of Wheat.*—These granules are almost invariably of accurately lenticular form, both sides of the outline having the same curvature, though small irregularities occur now and then. The elliptical nucleus of fresh granules from live tissue is replaced in commercial starch by a small cavity, which is filled with air, and therefore appears black under the microscope, and by larger fissures, also filled with air. The polarisation cross is well defined, though never exhibiting the same sharpness as in potato starch. The cross is regular, and the point of intersection coincides with the nucleus.

Stratification is sometimes undiscernable, and if visible is rather indefinite. Dilute chromic acid, containing a little sulphuric acid, breaks down the starch granules of wheat, by the successive removal of the granulose, into a number of well-defined strata, traversed by radial streaks. A reticulated marking is often observed on the surface of the large, lenticular granules.

(b) *The Smaller Starch Granules of Wheat.*—Like the foregoing, these are simple bodies. They are often globular in shape, and in some cases show polyhedral lines of demarcation. Occasionally these granules are irregular, and in some instances pointed. They do not exhibit stratification, even on treatment with chromic acid. In the unaltered condition and under high magnification they are seen to consist of a dense (bluish) envelope, and a softer (reddish) nucleus, which latter is hollowed out by chromic acid.

The small starch granules of the four species mentioned cannot be differentiated in point of size.

(c) *The Agglomerated Starch Granules of Wheat.*—These consist of 2 to 25 grains, in a state of true agglomeration, and are easily separated into the component fragments. Twinning is often observed, and in fact both this form and triple granules are of frequent occurrence in commercial starches and flours. The fractional granules are of the same dimensions as the small simple granules, except that those in the twinned granules are sometimes larger. In relation to the large granules, the complex granules of wheaten starch are small in number, though not insignificantly so.

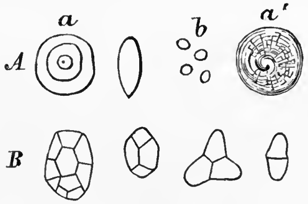


Fig. 1.—Wheaten starch.
A, magn. 300 ; *a*, large, lenticular granule ; *a′*, same after treatment with dilute chronic acid ; *b*, smaller granules. *B*, magn. 800 ; agglomerated granules.

(d) *The Differentiation of Wheaten Starch from Rye and Barley Starch.*—Like wheaten starch, the starches of rye and barley consist of large, lenticular grains, together with small, round, or polyhedral forms; and complex forms are also met with in both cases, of similar character to those in wheaten starch.

The method of differentiation is based on the relative dimensions, both of the large and small granules.

Potato Starch can be distinguished from that of wheat, even by the unassisted eye, the granules of the former being visible, especially in a strong light, whereas under these conditions wheaten starch has the appearance of homogeneous meal, the granules being invisible until examined under a powerful magnifier.

Under the microscope potato starch can be clearly differentiated from all other kinds, the granules being almost without exception simple, and prolonged examination being necessary to discover twinned or triple forms. The starch granules from full-grown potatoes are large, ovoid, and definitely stratified. Unripe potatoes yield starch that contains, in addition to the large granules, a number of small ones of globular or elliptical form and with less decided stratification.

The fully developed starch granules are mainly ovoid, and not infrequently of somewhat irregular shape. The nucleus is almost invariably situated at the narrow end of the granule. The eccentricity is $\frac{1}{4}$ to $\frac{1}{6}$. The strata are arranged eccentrically, some of them in each granule being more sharply defined than others. The polarisation cross shows up very clearly.

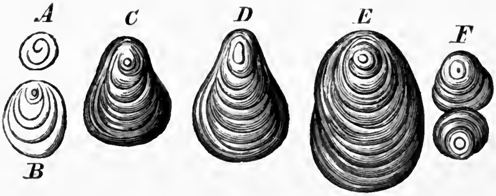


Fig. 2.—Potato starch.
A, young, undeveloped granule; *B–E*, developed granules; *F*, complex granule.

Rice Starch.—Like wheaten starch, this has a uniform, mealy appearance, the granules being invisible to the eye, even with the aid of a strong magnifier. This circumstance, coupled with the observations recorded above in connection with wheaten and rice starch, teaches that the three chief commercial starches, viz. potato, wheaten, and rye starch, can be distinguished by the fact that the granules of the first named are visible to the naked eye, and those of the second under a strong magnifier which will not reveal those of the third.

The microscope enables the granules of rice starch to be differentiated from all other commercial varieties. The starch-bearing tissue of the rice grain, the cells of which are tightly packed with starch and contain only very small quantities of gluten and other plant constituents, presents two kinds of starch granules; complex and simple. The former are ovoid, the largest diameter measuring 0·018 to 0·036 mm. (usually 0·022 mm.), and they consist of 2 to 100 fractional granules, which are mostly polyhedral, appearing under the microscope as 5 to 6 sided (rarely 3 to 4 sided) grains, in which the nucleus is replaced by a rounded or polyhedral, and sometimes stellar cavity. The grains forming the external portion of the complex granule are slightly curved on one of their sides.

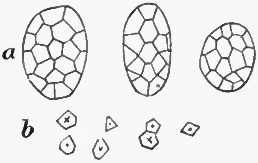


Fig. 3.—Complex granules of rice starch.
a, magn. 400; *b*, fragments of complex granule.

The diameter of these grains varies between 0·003 and 0·007 mm., mostly about 0·005 mm. No stratification is directly visible, but it can be revealed by treatment with dilute chromic acid, the simple granules agreeing with the complex granules in this respect. In commercial rice starch the complex granules are no longer in evidence, being all broken down into the component grains, though rice meal exhibits cells, and even entire portions of tissue, the simple and complex granules being present intact. Under the microscope, rice starch is seen to be composed of a mass of uniform, angular grains, the simple granules being no longer distinguishable from the fragments of the complex granules.

Oat Starch.—The granules of this starch, which is seldom prepared, are more like those of rice than any other. Oatmeal can be distinguished from rice-meal under the microscope at the first glance, inasmuch as complex granules preponderate in the former and simple granules in the latter. Oat starch, however, is composed like rice starch, almost entirely of uniform angular grains, the separated fragments of complex granules, the only difference between the two sorts being their relative size, which in the case of oat starch is 0·003 to 0·011 mm., the mean being about 0·008 mm. It is true that the shape of the complex granules of oat starch is somewhat different from that of the simple ones, but the latter are present in such small amount that they cannot serve as a means of identification.

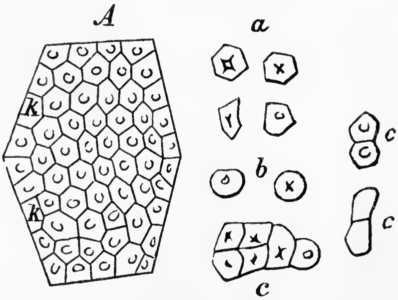


Fig. 4.—Starch-bearing cells from the horny portion of maize.

A, magn. 30; *kk*, nuclei of the starch granules; *a*, starch granules from the horny portion; *b*, those from the friable portion of the corn; *cc*, complex starch granules.

Maize Starch.—Reports on the dimensions of the starch granules in maize are conflicting, owing to the fact that different varieties of maize, exhibiting differences in the form and size of the granules, are used for making starch.

Estimating the Relative Value of Potato, Wheaten, and Maize Starch for Stiffening, Glazing, etc.

Experiments on this point were conducted by Wiesner, the varieties of starch selected being kept for a long time in the same room. The determination of moisture gave the following results:—

Wheaten starch	13·91 per cent.
Potato starch	14·07 ,,
Maize starch	14·71 ,,

The starch paste was prepared in each case by distributing 1 grm. of starch in 15 c.c. of distilled water, and warming it in the water-bath, with continued stirring. Although the treatment was the same in all cases, the potato starch was the first to undergo gelatinisation, being followed by the maize starch, and finally by the wheaten starch, the two latter being still liquid at the time the potato starch changed. Each sample was taken from the water-bath as soon as gelatinisation occurred, and left to cool before being used for the stiffening tests. The resulting pastes contained—

Fig. 5.—Starch grains from tubers of *Maranta nobilis* (magn. 300).

Paste from potato starch . .	94·2 per cent. of water.
,, maize ,, . .	91·43 ,, ,,
,, wheaten ,, . .	87·77 ,, ,,

The stiffening test was performed by treating yarn of a certain count with the starch paste and, when dry, fixing the same in a simple clamping device in such a manner that each thread stood up vertically. The clamps were then gradually and successively raised, being clamped again each time, until the thread bent over till its tip was on the same horizontal level as, or lower than, the part held by the clamp, an exactly horizontal position not being always possible with this somewhat crude method of testing. The separate threads were carefully weighed, in order to ascertain the amount of paste used with each.

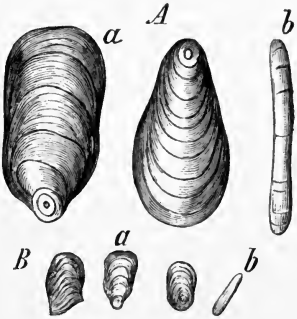


Fig. 6.—Curcuma starches (magn. 300).

A, starch granules from *C. Leucorrhiza*—*a*, face view; *b*, side view. *B*, starch granules from *C. angustifolia*—*a*, face view; *b*, side view.

It may be taken for granted that, for a given percentage of paste, the stiffening power will vary directly with the length of the deflected portion of the thread. The yarn for this test must be, so far as possible, of uniform rigidity; and this condition was fulfilled by that used in Wiesner's experiments. A piece of the yarn, weighing in the air-dry state 1 to 2 grms., was measured off and divided into two equal parts: the one half being used for the moisture determination, the results of which were taken into consideration in testing the second portion. This latter was divided into lengths of 50 cm. (20 inches), carefully treated with the starch paste, and left to dry. The best method of applying the paste was found to be by taking some on the fingers and drawing the thread several times between them. The air-dry threads were then tested for stiffness in the manner already described. A number of measurements were taken with each treated thread, the latter being then well dried, and weighed to ascertain the quantity of starch paste used in each case.

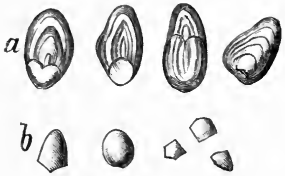


Fig. 7.—*a*, starch granules from the tubers of *Maranta arundinacea*; *b*, those from *M. indica* (West Indian arrowroot).

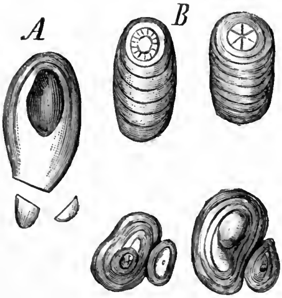


Fig. 8.—*A*, starch granules from *Sagus Rumph.*; *B*, from *S. boratsus*.

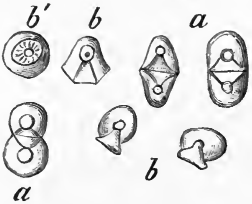


Fig. 9.—Starch granules from the tubers of *Manihot utilissima*. *a*, twinned granules; *b*, side view of broken granule; *b′*, face view of broken granules.

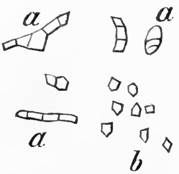


Fig. 10.—Buckwheat starch. *a*, complex starch granules; *b*, simple granules.

The average lengths of the bends in the stiffened threads were—

213·6 mm. in the threads stiffened with 15·6 per cent. of potato starch paste
223·7 mm. ,, ,, 7·6 per cent. of maize ,,
215·8 mm. ,, ,, 7·9 per cent. of wheaten ,,

In the observations in middle positions—

145·3 mm. in the threads stiffened with 4·2 per cent. of potato starch paste
159·2 mm. ,, ,, 2·8 per cent. of maize ,,
132·2 mm. ,, ,, 2·8 per cent. of wheaten ,,

From these results Wiesner concludes: (1) That, under identical conditions of preparation, maize starch paste has a more powerful stiffening action, weight for weight, than wheaten starch, and this in turn than potato starch; (2) that potato and maize starch are more uniform than wheaten starch, probably because two entirely different species of starch granules are present in the latter, whereas the differences are more nicely graduated in the grains of potato and maize starch.

The property of gelatinisation is a very important one in starch; and the temperature at which this phenomenon occurs varies with the kind of starch. In the following Table, A denotes the temperatures at which the starch begins to swell up, B incipient gelatinisation, and C complete gelatinisation.

The Gelatinisation Temperature of Starches.

	A	B	C
Rye starch . . .	45·0	50·0	55·0
Rice ,, . . .	53·75	58·75	61·25
Barley ,, . . .	37·5	57·5	62·5
Maize ,, . . .	50·0	55·0	62·5
Potato ,, . . .	46·25	58·75	62·5
Wheaten ,, . . .	50·0	65·0	67·5
Arrowroot . . .	66·25	66·25	70·0
Buckwheat starch . .	55·0	68·75	71·25
Acorn ,, . .	57·5	77·5	87·5

These figures are not invariable.

Since starch of all kinds is not only subjected to various forms of adulteration—consisting in the addition of inferior grades of starch, or mineral loading ingredients, such as gypsum, heavy spar, etc.—but is also liable to deterioration from defects in manufacture or unsuitable storage, it is highly necessary that the starch for each dressing should be tested.

The Bloch method of testing starch is based on the experience that 10 grms. of dry potato starch, when disseminated in water and allowed to subside, will occupy a space of 17·567 c.c. If 10 grms. of a damp starch be treated in this manner, the starch will occupy a smaller volume. Bloch has devised a special instrument for this test, and named it the feculometer. It consists (Fig. 11) of a tube, divided into two portions, the lower one holding exactly 17·567 c.c., and being graduated into 100 equal degrees. Ten grms. of the potato starch under examination are stirred up to a pulp and poured into the feculometer, the inside of which is rinsed with water, and the tube closed. After vigorously agitating the instrument, the particles of starch adhering to the sides are rinsed down with water into the graduated lower portion, and the whole is left to stand for an hour. If the starch be pure, the line of demarcation of the sediment will be sharply defined; the scale on the lower portion of the tube shows the height of the column of deposited starch in degrees which represent the percentage of dry starch in the sample. With impure or spoiled starch the upper edge of the sediment is indefinite, and the proportion of the impurities is revealed by the feculometer. The instrument, however, is attended with the drawback that it can only be used for potato starch.

Fig. 11.—Feculometer.

The Scheibler method of determining the moisture content of starch is based on the change of density experienced by alcohol of given strength when left in contact with a known quantity of damp starch for a short time, since, apart from traces of fat, starch does not contain anything that is taken up by alcohol.

Absolutely dry starch is even capable of absorbing water from concentrated alcohol. If a definite quantity of starch be mixed with alcohol of known density, the density will diminish in the case of dry starch, but increase if the starch be damp.

Scheibler compiled a table for determining the moisture content of starch, based on the alteration sustained by alcohol of sp. gr. 0·8339 when 2 parts of same by weight are mixed with 1 part of starch containing the proportions of moisture indicated below:—

Temperature 15·55° C.

Moisture in Starch.	Sp. Gr. of the Alcohol.	Moisture in Starch.	Sp. Gr. of the Alcohol.	Moisture in Starch.	Sp. Gr. of the Alcohol.	Moisture in Starch.	Sp. Gr. of the Alcohol.
Per Cent.		Per Cent.		Per Cent.		Per Cent.	
0	0·8226	17	0·8405	34	0·8563	51	0·8695
1	0·8234	18	0·8416	35	0·8571	52	0·8703
2	0·8243	19	0·8426	36	0·8579	53	0·8710
3	0·8253	20	0·8436	37	0·8587	54	0·8716
4	0·8262	21	0·8446	38	0·8595	55	0·8723
5	0·8271	22	0·8455	39	0·8603	56	0·8731
6	0·8281	23	0·8465	40	0·8612	57	0·8738
7	0·8291	24	0·8474	41	0·8620	58	0·8745
8	0·8300	25	0·8484	42	0·8627	59	0·8753
9	0·8311	26	0·8493	43	0·8635	60	0·8760
10	0·8323	27	0·8502	44	0·8643	61	0·8767
11	0·8335	28	0·8511	45	8·8651	62	0·8775
12	0·8346	29	0·8520	46	0·8658	63	8·8783
13	0·8358	30	0·8529	47	0·8665	64	0·8791
14	0·8370	31	0·8538	48	0·8673	65	0·8798
15	0·8382	32	0·8547	49	0·8680		
16	0·8394	33	0·8555	50	0·8688		

Scheibler's researches have also shown that when 1 part of starch is mixed with 2 parts of alcohol of 90 per cent. Tralles strength, or sp. gr. 0·8339, at 15°·57 C., no mutual reaction occurs if the starch contain 11·4 per cent. of moisture. To perform this test, 100 c.c. of alcohol of the above strength are placed in a stoppered glass flask, one-half, 41·7 grms., of the starch being added, and the whole, after being shaken up vigorously, left to stand for several hours, then filtered, and the density ascertained in the usual manner. Saare proposed a simpler and very efficaceous method which, however, requires the use of a balance. It is based on the fact that starch dried at 120° C. will, without being mixed with water, always occupy a constant volume or displace an equal volume of water, *i.e.* has always the same sp. gr., viz. 1·647 to 1·623, the mean of 30 tests being 1·6196, or in round numbers 1·620, at 15°·5 C. One hundred grms. of the starch are weighed out into a tared dish, and stirred to a thin milk with water at 17·5° C. (if necessary, left for a short time, to enable the lumps to crumble down, and then stirred up again), the milk being then rinsed, without waste, into a flask, bearing a 250 c.c. mark on the neck. The flask should be gauged beforehand. It is then filled nearly up to the mark, placed for half an hour in a large vessel containing water at 17°·5 C., and carefully filled with distilled water until the meniscus exactly coincides with the mark. The flask is next dried and weighed, the weight of 250 c.c. of starch and water being ascertained by deducting from the gross weight the known weight of the perfectly dry flask. The larger the percentage of moisture in the starch, the lighter the final weight. The corresponding moisture content is given in the table on page 26.

According to Bondonneau, 4 to 5 grms. of starch should be distributed in 100 c.c. of water, and treated with 4 to 5 grms. of concentrated caustic soda solution. If the starch be pure, the paste will be transparent, that from impure starch being yellowish and turbid. To examine the clouding particles under the microscope, an excess of hydrochloric acid is added, whereupon the starch dissolves, whilst the suspended particles subside, and can then be readily identified as cellulose (cell walls), sand, etc.

Krüger proposes to differentiate between potato starch and wheaten starch by suffusing the sample with a 2 to 4 per cent. solution of caustic potash. Potato starch forms a thick jelly, whereas wheaten starch subsides. Müller, however, also found in the sediment either ungelatinised or only partly gelatinised potato starch.

Determining the Value of Starch for Dressing Purposes.

Romen, in his previously mentioned work, gives the following rules for valuing wheaten and potato starch :—

If either starch, on being mixed with water and allowed to settle, leave the supernatant water either: (*a*) turbid, (*b*) frothy or effervescent, (*c*) maladorous, or (*d*) dirty, the starch is not of best quality.

DETERMINATION OF THE MOISTURE CONTENT OF POTATO STARCH FROM THE SPECIFIC GRAVITY.

Weight Obtained.	Moisture.	Weight Obtained.	Moisture.	Weight Obtained.	Moisture.
Grms.	Per Cent.	Grms.	Per Cent.	Grms.	Per Cent.
289·40	0	281·10	21	273·25	41
289·00	1	280·75	22	272·85	42
288·60	2	280·35	23	272·45	43
288·20	3	279·95	24	272·05	44
287·80	4	279·55	25	271·70	45
287·40	5	279·15	26	271·30	46
287·05	6	278·75	27	270·90	47
286·65	7	278·35	28	270·50	48
286·25	8	278·00	29	270·10	49
285·85	9	277·60	30	269·70	50
285·45	10	277·20	31	269·30	51
285·05	11	276·80	32	268·90	52
284·65	12	276·40	33	268·50	53
284·25	13	276·00	34	268·10	54
283·90	14	275·60	35	267·75	55
283·50	15	275·20	36	267·35	56
283·10	16	274·80	37	266·95	57
282·70	17	274·40	38	266·55	58
282·30	18	274·05	39	266·15	59
281·90	19	273·65	40	265·75	60
281·50	20				

Further information is afforded by the behaviour observed with regard to sediment in the boiling pan; consistence in boiling and on prolonged boiling; deterioration of the dressing; the dressed products; the finished goods.

Cloudy Water.—It is not claimed that the supernatant water from the soaked starch should be free from all trace of cloudiness, since this occurs in almost every starch water. It will be, however, easy to distinguish between the ordinary cloudiness produced by best starch and that furnished by an inferior quality. The more or less pronounced turbidity makes its appearance ten to fifteen minutes after soaking has commenced, whereupon the scum collecting on the water is blown aside, and the water is transferred to a small glass and held up against the light. Indications will be given by the appearance of thick clouds, more or less rapid subsidence, and the colour of the water (yellow or brownish).

Frothy Water.—If the supernatant water be covered with a strong and persistent froth, and bubbles are disengaged from the subsided starch, the latter will be more or less impure, this behaviour being specially exhibited by sour starch. The supernatant soaking water should not give any red coloration to blue litmus paper on being evaporated.

Malodorous Water.—A bad smell, recalling sulphuretted hydrogen, is an indication of defects in the preparation of the starch, or that the latter has been stored in a fusty or close atmosphere.

Dirty Scum.—More or less dirt, and particles of wood, collected on the surface of the water, give an idea of the relative purity of the starch. The sediment left after pouring off the supernatant water should not exhibit more than a thin film of dirt; the thicker the latter, the greater the contamination.

In sifting the deposited starch, the residue left by second-grade wheaten starch should not exceed 1 to 3 per cent., and that from best starch $\frac{1}{4}$ per cent. Prime potato starch should leave no residue at all.

The greater the residue on the sieve, and the harder and tougher the residual mass, the lower the quality of the starch. The presence of sand and mechanical impurities can be detected by removing the dirt from the sediment, together with a little of the starch, after the supernatant water has been removed.

With regard to the deposition of sediment in the boiling pan, it may be remarked that, for ordinary purposes, the starch may either be soaked overnight, or stirred up direct with water in the morning. On running the starch from the weighing apparatus into the soaking pan it should be noted that if the starch—no matter whether wheaten, potato, rye, rice, or maize starch — settles to the bottom quickly after entering the water, this behaviour indicates dampness, and the rapidity of deposition will be in proportion to the amount of moisture in the starch. Air-dry starch, on the other hand, sinks very gradually; and indeed, good starch should need stirring to induce it to subside. The quality of starch is in inverse ratio to the ease with which it can be disseminated in water. Sour starch also sinks rapidly, and in proportion to the extent of the sourness.

Potato starch is never left to soak all night, since it would settle down so firmly as to be impossible of dislodgment. This starch is simply stirred up with water and sifted into the boiling pan at once, the sieve being emptied at intervals, rinsed out and refilled, the contents being stirred intermittently to prevent deposition. Wheaten starch may either be soaked overnight, or stirred up with water for a few minutes before sifting into the pan. If it settle down quickly, the above remarks apply; so that deposition in the pan, whilst affording an indication of quality in the case of wheaten starch, is no criterion for potato starch.

Consistence in Boiling.—Every experienced finisher is able to tell at once from the finished dressing whether the starch was good or bad.

Dressing that has been boiled for only a short time is always thicker than if subjected to prolonged boiling; but the loss of consistence is often out of proportion to the length of boiling, and the final consistence varies in different dressings. This result ensues in the case of mixed, sour, or alkaline starch, the last-named condition being the more usual, since caustic soda is more frequently used than acids in the preparation of the starch.

Deterioration of the dressing may be manifested: (1) by the mass becoming watery; (2) a glazed (spongy) appearance; (3) shortness of texture; (4) loss of homogeneity.

It would be incorrect to ascribe all these defects to imperfections in the starch; and the only way to obtain correct results and accurate information is by securing uniformity: (*a*) in the amount of fat added; (*b*) length of boiling; (*c*) in the character, pressure, heat, and dryness of the steam used; (*d*) the loading ingredients added; (*e*) the volume of the liquid; (*f*) the pressure applied in starching. Observation of the last five points is essential.

In all circumstances:—

1. The dressing becoming "watery" will indicate imperfect character of the starch used. This behaviour is not due to absorption of water, but to the separation of water owing to the low binding quality of the starch. The mass becomes watery, and the dressing can therefore neither fill nor cover the fabric. This defect is usually due to the use of starch that was either sour or damp, or both.

2. A glazed or spongy appearance, setting in as the dressing cools, so that the starch no longer "runs" in the duct, is due to the material, the composition, the boiling, or the added fat. Running in the duct is a guarantee that the dressing will behave well when applied to the fabric. No matter how thick the dressing may be, it should always become more fluid in the machine without any separation of water or lack of coherence so as to appear soapy or spongy.

The adhesive property of starch paste depends, according to Brown and Heron, on the dryness of the starch—in other words, on the percentage of moisture. Damp starch, boiled direct at 100° C. for twenty-four hours, gave a paste the adhesive power of which was taken as 1. The same starch, after being dried under the air-pump and then at 100° C. for twenty-four hours, gave the adhesive value 2·306; and finally, the same starch, dried under the air-pump and then at a temperature not exceeding 30° C., gave the value 3·288. This observation is highly important with regard to the value of starch as an adhesive.

FLOUR.

Flour is the well-known product obtained by husking and grinding cereal grains (wheat, rye, barley, oats, buckwheat), either simply or by the aid of highly complex machinery of the most modern type. According to the class of cereal and the care bestowed on the grinding, flour is a more or less pure white, yellowish, or greyish powder, of varying fineness, which crackles when compressed. When stored in a damp place it readily absorbs moisture and turns fusty; hence it must be kept with great care. Stirred up with water it forms a paste, or a sticky mass, which becomes more consistent when heated, in which condition it is able to bind mineral substances with ease, but on drying forms a solid mass, more or less white in colour.

Flour in all cases consists of portions of the bran, fine starch granules and small fragments of tissue from the albumen of the grain, these latter being filled with starch and gluten. The larger the percentage of free starch and the smaller that of the bran and tissue, the finer the flour.

The chemical examination of flour reveals the presence of the following constituents, though they cannot be separated perfectly by mechanical means: (1) gluten, (2) husks, and (3) starch. The gluten is composed of albumen cells and the residual protoplasm of the starch cells. The husk comprises the dry, air-laden cells of the envelope of the seed, and the cell membranes of the starch-bearing tissue, and is therefore composed of cellulose and the constituents of the vegetable cell wall. The portion regarded as gluten is not that substance alone, but contains husk constituents in addition.

The origin of a flour can be determined by the microscope; and the purpose of the examination is generally achieved by determining the morphological character of the starch granules of the flour, and deducing its origin from the result. In the case of unmixed flours this method always furnishes decisive results; and in such cases it is possible to distinguish not only between oat, rice, maize, and buckwheat meal, the starch granules of which are readily differentiated, but also to identify rye, wheat, and barley flour, although the form of their starch granules agrees very closely. Greater difficulty arises when flours composed of a number of raw materials come under examination. Potato, maize, and buckwheat flour can be accurately identified in a mixture; and with a little care, rye flour can be detected in barley flour (though such a mixture does not occur in practice); but it is extremely difficult to ascertain the presence of barley in wheaten flour. It is only by making a large number of measurements of starch granules and a highly accurate investigation of the morphological conditions of the tissue of the grain of barley and wheat that a solution of the problem in question can be obtained by the expert.

Cereal flours are occasionally adulterated with pulse meal; but this is easily detected. The starch-bearing tissue of pulse has a highly characteristic appearance, and consists of comparatively thickened cells, which, moreover, are separated by remarkable, intercellular air-passages, and are filled with starch granules of peculiar shape and mingled with legumin. The starch granules are of one kind, viz. simple, with decided stratification at the edges and elongated nuclear cavities filled with air. The dimensions of the granules also afford a guide as to the kind of pulse meal present.

Pulse meal can also be detected in wheaten flour by the ash test. According to Fresenius, the ash of wheaten flour is granular, almost sandy, does not change the colour of turmeric paper, though it reacts with red litmus paper; stirred up with water, a white precipitate is given with an aqueous solution of silver nitrate. Pulse meal ash, on the other hand, is deliquescent, gives an alkaline reaction with turmeric paper; and the precipitate obtained with silver nitrate turns blue on prolonged exposure to the air.

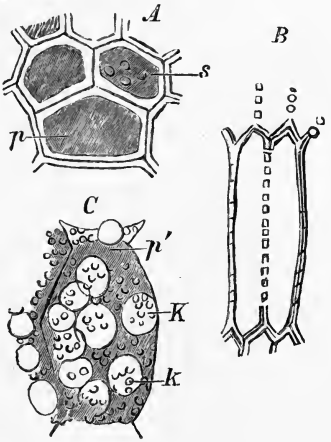


FIG. 12.—Constituents of wheaten flour (magn. 300).

A, gluten cell; *p*, protoplasm; *s*, starch granules; *B*, bran cell; *C*, fragment of starch-bearing tissue; *K*, large starch granule; *k*, small starch granule; *p′*, residual protoplasm.

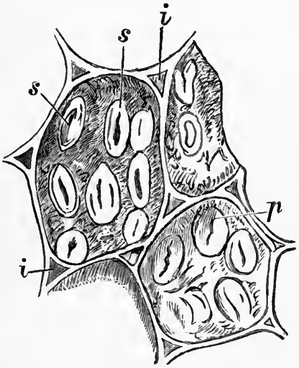


FIG. 13.—Fragment of tissue from the cotyledons of the pea (magn. 300).

ss, starch granules; *p*, protoplasm (legumin); *ii*, intercellular air-passages.

Louyet states that the weight of ash will furnish a guide, since dried old wheaten flour or rye flour yields under 1 per cent. of ash, whilst pulse meal yields below 3 per cent.

Lecanu proposes the following method of testing for added starch in wheaten flour:—

The flour is made into a paste with 40 per cent. of its own weight of water, a thin stream of water being then allowed to run over the paste, which is kept kneaded, until the effluent water it clear. The water is stirred up and passed through a sieve, which retains the particles of bran. The liquid is next transferred to a cylindrical vessel and left to settle, the supernatant liquid being decanted into another vessel. The residual sediment is stirred up several times with fresh water and allowed to settle; and in this way five or six portions of liquid are obtained. The deposits from these liquids are examined with a magnifier, and in the event of potato starch being present, the last of these sediments exhibits a sheen like crushed sugar, all the others being matt powders. In a mixture of wheaten flour and potato starch, the latter settles down at once and forms the bottom layer of the sediments, because the potato-starch grains are larger than those of wheaten starch.

According to Bohl, the presence of mineral additions can be detected by heating the flour with potassium nitrate and sodium (or potassium) carbonate, extracting the melt with water, and treating the solution with hydrochloric acid and barium chloride. Only a faint precipitate should result, since pure rye flour contains only 0·0023 per cent. of sulphuric acid, and wheaten flour only 0·0034 per cent., to form with the barium chloride a compound that is insoluble in water. If the said solution be super-saturated with ammonia, the formation of a turbidity indicates the addition of alum.

Laissaigne tests for the presence of mineral substances by placing 5 to 10 grms. of the flour in a test glass, and shakes it up with chloroform. On settling down, any added mineral substances will be found at the bottom of the glass, whilst the flour will float on the intervening layer of chloroform. The sediment can then be easily examined further. Himly, however, points out that even pure flour will give a slight sediment under this test, consisting of millstone dust abraded from the stones in grinding the flour; and that it is only when the sediment is more considerable that the presence of mineral adjuncts can be deduced. Nessler stirs the flour up well with water, and then adds an equal volume of sulphuric acid, in which latter the flour dissolves, leaving mineral admixtures to sink to the bottom.

Bornträger mixes the flour with an equal quantity of ammoniæ nitrate. The percentage of ash differs according to the cereal grain, but is fairly constant for each, viz.—

Wheaten and rye flour . . .	1	per cent.
Barley meal	1½	,,
Oatmeal	2	,,
Pulse meal	3·3 to 5	,,

Flours containing bran will yield about double the above percentages of ash. The contamination by millstone dust, etc., rarely exceeds 0·002 per cent.; and therefore one may conclude with certainty that a sample giving a higher ash content has been mixed with mineral substances, which are easily identified.

In order to test flour for its most valuable constituent, gluten, Romen recommends kneading it to a stiff paste with water, working the mass thoroughly, and testing the elasticity of the paste by pressing it with the finger. On the basis of this feature, Boland devised the aleurometer (Fig. 14), which has been modified at various times, *e.g.* by Dr. Sellnik and by Kunis, though its essential characteristics have been retained. It consists of a sheet-metal casing, *A*, with oil bath, *B*, in which is suspended a hollow metal cylinder, *D*, about 11 cm. long and 2½ cm. in diameter. The bottom of the cylinder is either closed, so that the gluten must be inserted through the top, or else—as in Sellnik's modification—open at top and bottom, each end being closed by a detachable cap. A brass plunger, with graduated stem and bottom terminal plate, can be moved up and down through the cover. The plunger is graduated in 25° (25° to 50°). For use, a stiff paste is made with 30 grms. of flour and 30 grms. of water; the gluten being separated by washing, in the manner described below, 7 grms. of the moist gluten are weighed out, formed into a cake, which (if necessary) is rolled in a little

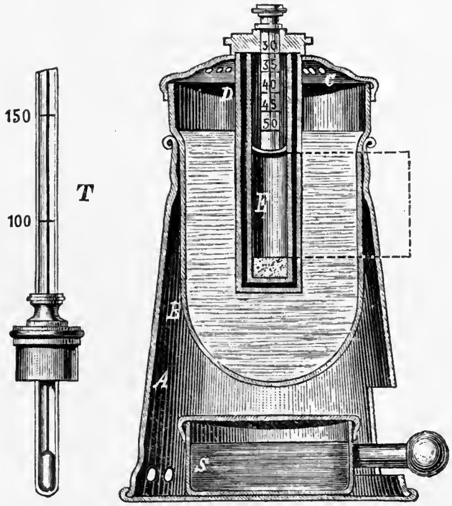


Fig. 14.—Boland's aleurometer.

potato flour and inserted into the greased tube *D*. Meanwhile the oil bath has been heated by the lamp, *s*; and when the temperature reaches 160° C. the thermometer, *T*, is withdrawn from the bath and replaced by the tube *D*. Heating is continued for another ten minutes, to raise the temperature to 250° C., whereupon the lamp is extinguished. At the end of a further ten minutes the baking test may be regarded as completed. The high temperature evaporates the water absorbed by the gluten; but since the steam (and expanded air) cannot escape through the mass of the gluten, the latter becomes distended and pushes up the plunger. As a rule this expansion is between 29° and 50° on the scale. The higher the plunger is lifted, the better the baking properties of the flour. After cooling, the cylinder of gluten—to some extent a skeleton loaf—can be ejected, and its porosity ascertained by a longitudinal section.

The following method is pursued in separating the gluten from the flour: the flour, mixed with the specified amount of water, is placed in a cloth or bag, which is held under a jet of water and kneaded in all directions, the starch then running away with the water and leaving the gluten in the bag as a yellowish, gelatinous, viscid mass. Any escaping flakes of gluten are caught in a hair-sieve underneath and added to the contents of the bag. Washing is continued until all the starch is removed and the water runs away clear. Of course the gluten is never obtained entirely free from starch; but the small quantity remaining is negligible.

Flour should also be tested for its content of bran. According to Wetzell and Haas, 100 parts of good rye flour should contain 13 per cent. of husk; but the latter is never quite free from adherent particles of flour, so that 100 parts of dry rye husks correspond to 269 parts of rye bran, and 100 parts of dry wheat husks to 200 parts of ordinary wheat bran. The percentage of bran in flour is ascertained by suffusing 100 grms. of the flour with water, and warming the mixture in a porcelain dish on the water bath. After a short time the dissolved portions are passed through a hair sieve, and the residue is washed with pure water, until the latter runs away clear; the residue being collected, dried, and finally weighed, the percentage of bran being determined by a simple calculation.

The employment of flour in dressings is founded—

1. On the capacity of the glutinous flour to bind all manner of mineral substances (even such as are insoluble) in water, and retain them in a finely divided state in the soaked flour. Gluten is the most valuable constituent of flour, since it imparts to the latter the property of forming a tough, elastic, and binding paste when mixed with water. Wheaten flour has a greater binding power than rye flour or barley meal; and this power is not lost when the flour is used in a merely stirred condition. Starch, on the contrary, has a very low

power of binding mineral substances; and loadings containing a six- to eight-fold quantity of these latter are useless for their purpose.

Flour is an important dressing material, since both its starch and gluten play an active part, the latter more especially with regard to the mineral ingredients added to dressings. The highly loaded dressings now used would be impossible without flour, and the loading ingredients would rub off in the form of dust if ever so lightly touched. The gluten in flour, however, holds the starch and mineral matters (which are often immoderately large) together, and forms a solid coating on and between the threads of the fabric. In order for this to take place, the gluten must be completely dissolved, and intimately mixed with the other substances.

Spoiled flour, especially such as has become damp, is no longer suitable as an ingredient for dressings, since the adhesive properties of the gluten have been modified or lost entirely. Spoiled flour gives off a peculiar smell, changes colour, and has a pungent, disagreeable smell, fungoid spores being discernible under the microscope.

2. On the covering power of the flour. When pure, white flour is boiled for the preparation of dressing, and is spread out and dried, it forms a pure white, covering layer, whereas starch remains more or less transparent, glassy, or translucent when boiled, and forms a more horny layer.

3. On the fact that it imparts a soft, though full feel to the fabric, whilst starch decoctions make the goods hard, stiff, and rough.

4. On the filling property of the flour. When applied to the fabric, it fills up the pores of same, especially when forced in well by a calender or beater, whereas starch merely covers the intermediate spaces over with a glazed, refractive layer.

In certain fabrics it prevents penetration, especially when these are afterwards glued on to a substratum, *e.g.* in bookbinding and wall hangings. Starch is unable to produce the same effect.

Opinions differ considerably on the method of preparing flour dressings, some finishers recommending that the flour should be put in soak overnight, and boiled next day, whilst others soak the flour for several days, even in the presence of weak acids or alkalis, and allow it to ferment, so that the gluten is partially or wholly dissolved.

PROTAMOL FOR DRESSINGS AND SIZES.

Under the name "Protamol," a new product has been introduced for use as an adhesive, as well as a dressing and sizing material. It is a white, somewhat heavy and granular powder, without taste or smell, and is prepared from clean rice by a method patented by the Ersten Triester Reisschälfabrik A.G., Trieste. Protamol contains both starch and gluten (proteids, vegetable albumin), and therefore differs essentially from ordinary starch from any raw material (even rice); and, the gluten being in a dissociated condition, its high adhesive power comes into play. It is prepared for use in the same manner as starch (soaking in boiling water, and boiling), though, for special purposes, it receives additions of fats, wax, or other adhesives. In practical application it has proved superior to starch, the effect being midway between that of dextrin and starch, and it is also capable of replacing the former in many cases. Protamol dressings penetrate the fabric better than starch, without pressing the fibre like the latter; it imparts a natural feel to the cloth (like dextrin), and is cheaper than dextrin, 75 parts producing the same results as 140 to 160 parts of this latter substance. The dressing does not rub off as dust, it does not effect the brightness of the colours like starch, and it attains a high gloss when calendered and mangled. Used for carrying pigments in printing, a sharp impression is obtained and the colours are bright. Protamol is suitable for dressing all kinds of cotton, union, and linen goods for which dextrin is employed, such as parti-coloured fabrics, calico-printing, blue printing, white goods, single-colour goods, cotton, beaver, and flannel; also for sizing cotton or woollen warps, and (in special liquid form) for dressing woollens and half-woollens. The preparation is highly suitable for sizing both woollen and worsted yarns, possessing all the advantages of animal glue or other sizing materials hitherto used, while being 50 per cent. cheaper than glue. When properly applied it is readily absorbed by the threads and renders them supple, whilst preventing the inconveniences (the formation of dust especially) arising in weaving when other sizings are used. Woollen or worsted yarns sized with Protamol have high tensile strength, that of Cheviot No. 6/1 being 480 to 540 grms., worsted yarn No. 52/2, 180 to 250 grms., and No. 45/2 cop twist 290 to 360 grms. It should also be mentioned that the disagreeable smell of animal size is absent.

Protamol may also be used as a filling for fabrics, imparting to fancy cottons (imitation worsteds) a full feel, similar to that of real worsted, without covering the face of the goods. In the case of light semi-worsteds, this dressing gives the material the desired thick, woolly feel, which is also produced on woollens.

CHAPTER III

ADHESIVE DRESSINGS

Gluten.

Thoroughly purified gluten forms a tough, sticky, ropy mass, which, in the fresh state, is perfectly inodorous and has a faint taste of dough; it is soluble in water, but only partially so in weak alcohol, though completely soluble in concentrated acetic acid and in alkalis. When dried, it is a pale yellow or yellow-grey mass, brittle, horny, and soluble in alkalis, as also to a large extent in concentrated acetic acid.

The liquefaction and gradual solution of gluten can be accelerated by the action of water containing a few parts of acid per thousand. Caustic soda, lime, ammonia, sodium carbonate, etc., are also used as solvents.

Gluten may be liquefied spontaneously by storage, the resulting acid being then neutralised with sodium carbonate, and the separated gluten kneaded repeatedly in water, and finally dissolved in weak caustic soda. Solutions of this kind must, naturally, be used while fresh, owing to the extensive changes that ensue on decomposition.

Luzin is chiefly gluten that has been liquefied by auto-fermentation and then dried at 25° to 30° C.

Protein Glue.

If washed gluten be exposed to a temperature of 15° to 25° C. for some time, it decomposes, with formation of lactic acid, the mass becoming liquid, and dissolving completely in water after some considerable time. Gluten modified in this manner is usually dried in flat pans, and if the drying be effected at a temperature not exceeding 30° C., the resulting cakes possess properties analogous to glue. Like the latter, they will dissolve in 2 parts of water, and can be used in the preparation of sizes, dressings for dyeing and printing, and finally for clarifying liquids, etc.

Vegetable Glue.

Under the appropriate name of vegetable glue, as well as under a number of fancy designations—arabil, tragacanthine, alligin, Japan glue, hydrofucol, Gummi Germanicum, Gummi Saxonium, etc. etc.—the market has long been familiar with certain whitish, translucent to transparent products, more or less gelatinous, or even liquid, that have been recommended as substitutes for gum, size, and starch paste, for all purposes; and have actually come into use in certain industries, *e.g.* for dressings, as a bind for pigments, for sizing paper, and so forth. These products are all distinguished by great cheapness in comparison with the others in question; and as a matter of fact they can be supplied cheaply, being all able to hold large quantities of water without losing their gelatinous character.

All these vegetable glues are mainly composed of dissociated starch. It is well known that starch granules, when treated with caustic alkalis, alkali carbonates, salts like magnesium chloride, or alkali silicates (water-glass), and corresponding quantities of water at suitably high temperatures, have the property of bursting their envelopes, and then swelling up and passing into a certain soluble form. This soluble form of starch is present in all vegetable glues, potato starch being used, for the most part, as being the cheapest, and also probably capable of taking up a larger amount of water than any other kind.

Flour, as well as starch, may be employed for these products; and the resulting vegetable glues possess greater adhesive properties than those from starch, since the gluten easily passes into solution, and acts as a bind when even very dilute alkalis are used.

The chief advantage of vegetable glue is that it will fix earthy substances: China clay, talc, etc., on the fibre, and thus prevent loss of size, through the formation of dust, in weaving.

Vegetable glue of special composition when added to sizing will fix fat and starch on the threads, makes the latter smooth, and renders the dried size more insoluble, by the formation of a glaze that is not very soluble in water and does not give off dust in weaving.

When of composition suitable to the yarn and fabric, vegetable glue gives better results than starch, flour, gum, or size, and even than tragacanth. Experiments have been made in the application of size dressings containing fat, both alone and in conjunction with vegetable glue, and it was found that the latter gave the best results, by dissolving and distributing the fats, whilst the finished fabrics thickened up more readily in the subsequent steaming process.

In dressings for linens and muslins, and heavy dressings, short boiling is preferred, the thinner preparations obtained by longer boiling being more suitable for sizing and for cotton trouserings. The best method of preparation is to boil the starch and fat first, and then add the diluted vegetable glue a little at a time in the cold. Under these conditions the salts in the vegetable glue have a solvent action on the fat and starch. When good vegetable glue is used in this manner, the dressing will be softer and finer, running more freely in the duct and filling the fabric more completely. Even on prolonged standing there is little risk of the dressing becoming watery, so that boiled dressings can be kept longer than others. In spite of their soft character, dressings made with vegetable glue are highly viscous, solid, and strong; they fill the material well and make it pleasantly soft, dilute dressings producing a silky feel.

The chief point in the preparation of vegetable glues is the dissociation of the starch, and it is interesting to note that Zulkowsky long ago made the observation that starch is readily soluble in hot glycerine.

If 1000 parts by weight of concentrated glycerine be stirred up with about 60 parts of powdered starch, and the whole be heated, with continued stirring, in a porcelain dish, the starch granules will begin to swell up considerably. For some little time steam is liberated from the mixture, and when the temperature reaches about 130° C., the consistence increases to such an extent that stirring becomes a matter of difficulty. On raising the temperature still further, the mass becomes thinner again, and at 170° C. the starch is completely dissolved and the mass quite fluid and transparent, so that the bottom of the dish can be seen. Finally, if the temperature be raised to 190° C., the starch will pass over, more or less completely, into the soluble modification, this being tested by allowing a few drops to fall into water. If turbidity results, its intensity will afford a guide to the extent to which the process has been carried, and if the solution is perfectly clear, the transformation has been completed. On cooling the glycerine solution the starch remains dissolved, though the consistence increases considerably. On pouring the solution into water, any unaltered starch will separate out as paste, and the dissolved starch can be precipitated from the filtrate by strong alcohol. As regards the precipitation and purification of soluble starch, the glycerine solution should, preferably, be kept for about half an hour at 190° C., to complete the transformation, the solution, cooled down to about 120° C., being poured as a thin stream into a two- or threefold quantity of strong spirit. When the resulting precipitate has settled down completely, the liquid is removed and a fresh quantity of spirit is added, the sediment then becoming more compact. On removing the second portion of spirit, the starch is forced in moderate quantities through a calico filter by the aid of a force pump, and is washed in spirit until the filtrate is free from glycerine, this being ascertained by treating the filtrate in a test tube with a few drops of copper sulphate solution and a little caustic potash. A bluish coloration of the liquid above the precipitated copper hydroxide indicates that glycerine is still present. The best method of utilising the spirit containing glycerine is by distillation, the residual glycerine being then used for a second portion of starch, and the recovered alcohol for precipitating the resulting soluble starch.

To purify the product from the adherent impurities, such as sand, etc., occurring in potato starch, the preparation is poured at once into warm water, dissolved therein, filtered, and the clear solution treated with a suitable quantity of strong alcohol during filtration. The precipitate is collected on the filter and washed with stronger alcohol just sufficiently to remove all the water. The preparation is soluble in water or dilute alcohol; but the concentrated aqueous solutions soon change into a kind of jelly (paste). In drying, it shrinks into the form of hard, warty, chalky granules, and loses its solubility, on which account it must be placed in closed glass vessels as soon as washed. The aqueous solution gives a beautiful blue coloration with iodine; and the starch is precipitated by lime-water or baryta-water.

The manufacture of vegetable glue, being based solely on the dissociation of the starch granules, is a comparatively simple and easy process, though frequently regarded as a trade secret. The starch is usually made into a pulp with water, then treated with a solution of sodium or potassium carbonate, caustic alkali, ammonia, or magnesium chloride, and heated to a temperature between 70° and 100° C. until complete solution is effected, the product being suitably thinned down with water. Another way is to stir the starch up direct with the solvent salts and the requisite amount of water, heating the mixture to boiling, and stirring-in the remainder of the water.

An important part in the process is the thorough beating of the mass, and this must on no account be omitted in the concluding stage. The more the jelly is beaten, the better the product.

All vegetable glues prepared with alkalis have, naturally, an alkaline reaction, and in this condition are liable to damage or entirely change certain colours. To prevent this action the product may be neutralised with very weak organic or mineral acids, a perfectly neutral product being obtained. The acid must be extremely dilute, and added very slowly, with constant stirring, care being taken that the product does not lose its adhesive properties.

After boiling and beating, the finished vegetable glue may be strained through fine sieves, to remove all lumps and impurities. This operation must not be omitted in the case of neutralised preparations, these being specially liable to become lumpy.

The preparation of vegetable glue may be carried out in an apparatus (described later on) for dissolving gum and starch, the dimensions being modified to suit the quantities to be treated. Iron should be avoided, because it affects the colour of the product, and will inevitably cause it to turn red when salicylic acid is added as a preservative.

Metal vessels should preferably be replaced by large wooden vats, heated by steam and adapted to be fitted with stirrers. It is true that these wooden vessels suffer when magnesium chloride is used as solvent, this salt loosening the fibres of the wood and soon weakening the walls; but wood alone will allow a colourless product to be obtained in all circumstances, and is, moreover, the cheapest material to use.

Abadie uses magnesium chloride for the transformation of starch into vegetable glue, and dissolves the salt in the quantity of boiling water necessary for the transformation of the starch. After the solution has stood for a short time, the clear liquid is poured off and treated with a little sulphuric acid. It is important that the water used should be clean. The liquor prepared in this way is mixed with the starch, and the whole is boiled, being maintained at 90° C. for about an hour, by which time it will have become fluid, and is then neutralised by adding clarified lime-water. On repeating the boiling process a good vegetable glue is obtained. The transformation of 100 parts of starch requires 100 parts of magnesium chloride, 1 part of hydrochloric acid, and the amount of water necessary for dissolving the starch.

According to Angele's British Patent, 100 parts of starch are treated with 1 part of hydrochloric acid and sufficient water to form a stiff paste. This mixture is then heated at a temperature between 21° and 40° C., until a sample is found to dissolve in water without gelatinising. The mass is neutralised by washing with cold water, which may contain a little alkali carbonate, and is finally dried.

According to the *Corps gras Industriels*, an excellent vegetable glue may be prepared as follows: Potato starch is stirred with water to a milky fluid, which is passed through a hand sieve and treated with a chloride or an alkali. Calcium chloride or magnesium chloride is the most suitable, 80 parts being taken to 100 of starch; or 20 to 30 per cent. of potash or soda, preferably in the form of hydroxide, may be used. The mixture is treated either at the ordinary temperature or by the aid of heat, being mixed with stirrers in a suitable vessel, for half an hour to two hours. After this treatment the mixture is allowed to settle down and is skimmed. Neutralisation is effected with dilute acid after the mixing is completed but before stirring has ceased. This operation takes half an hour; and at the same time ½ to 1¼ per cent. of some antiseptic substance (boric acid, salicylic acid, carbolic acid) is added. If the product is desired to have more "body," it may be incorporated with barium sulphate, barium sulphide, China clay, etc.

Another recipe recommends boiling 16½ lb. of potato flour in 25 gallons of water over a gentle fire. To increase the bulk in boiling, the starch is moistened with about half a gallon of spirit, and after allowing sufficient time for the molecules of the starch to open, a portion of the water is added to effect complete dissociation. When the mass is boiling, a solution of 1¾ lb. of alum in about a quart of water is added, and boiling is continued until the whole forms a fluid, gummy mass, about two and half hours being required to attain this stage. The decoction is finally strained and left to cool.

According to Bersch, starch is stirred up with water in a vessel, and treated with a solution of caustic soda or potash, a little barium chloride and zinc chloride, a little hydrochloric acid (for neutralising) if necessary, and sometimes a little olive- or rape-oil or glycerine. This vegetable glue retains a certain amount of elasticity when dry.

Arbol Gum.

This product was examined by Horn, who found it to contain—

Maltose		24·23 per cent.
Dextrin		54·48 ,,
Starch		4·18 ,,
Water	about	15·12 ,,

the ash content was 0·81 per cent.

From the results of experiments, Horn gives the following recipe: Stir 100 parts of wheaten starch with 500 parts of water containing 10 parts of oxalic acid, heat the mixture to 90° C. for four hours on the water-bath with occasional stirring, neutralise with powdered marble and filter, the clear, pale yellow filtrate being evaporated to dryness.

Apparatine.

This starch preparation was first made by Gérard, by treating flour or starch with caustic alkalis and alkali carbonates, the most suitable proportions being—

Water	76 parts.
Potato starch	16 ,,
Potash or soda lye, 25° B.	8 ,,

The starch is mixed with the water by stirring, and the lye is poured in. The liquid clarifies and a jelly soon forms, which must be beaten—the more the better. The preparation is odourless and tasteless, and can be used in all cases where gum, paste, or gelatine find application.

Vegetable Glue Dressing.

This consists of 60 parts of water, 16 of dextrin, 16 of crystallised sodium sulphate, 16 parts of linseed mucilage, and 4 parts of tannin. It is prepared by boiling the linseed for a quarter of an hour and pouring it into a wooden vessel with a bottom of wire gauze, through which the mucilage runs into another vessel underneath. From this the mucilage is returned to the boiling pan and mixed with the Glauber salt and dextrin by stirring, the solution being filtered after these have dissolved.

PUSCHER'S VEGETABLE GLUE.

Puscher employs ammonia instead of caustic soda or potash, the basis of the preparation being wheaten flour, the gluten of which is thus utilised. The product, which is yellow in colour and has the consistence of paste, offers important advantages.

VEGETABLE GLUE CONTAINING FAT.

In the method employed by Hecht, the starch is dissociated by caustic alkali, but neutralisation is effected by a vegetable oil that is saponifiable in the cold, or by a vegetable resin. This method of neutralisation obviates the unfavourable effects of the alkalis (formation of alkali chlorides and sulphates), and furnishes a highly adhesive product which, owing to the presence of soap and the glycerine separated from the oil, is very supple, workable, and elastic.

DEXTRIN (BRITISH GUM).

Dextrin is an intermediate product between starch and grape-sugar, and consists of a number of different substances. In the pure state it is white or yellowish, is readily soluble in water, and has the sp. gr. 1·52. Solutions of dextrin rotate the plane of polarised light toward the right, for which reason this starch product was named dextrin by Biot and Persoz. When pure dextrin is heated, it turns faintly yellow at first, then brown, melts at 225° C., and decomposes with intumescence at 235° C., acetic acid and decomposition products being formed.

When treated with diastase at a temperature of 60° to 61° C., dextrin solution is gradually, and up to a certain degree, transformed into grape-sugar. Treated with an aqueous solution of iodine it acquires a wine-red coloration. It does not precipitate cuprous oxide from alkaline copper solution in the cold, though a slight precipitation occurs on warming. It is insoluble in absolute alcohol and in ether, the solubility, however, increasing with the proportion of water in the alcohol. Boiling alcohol of 95 per cent. strength will dissolve about one-third its own weight of dextrin, one-half of this quantity, however, being reprecipitated on cooling.

Concentrated hot nitric acid decomposes dextrin with formation of oxalic acid, and mixtures of fuming nitric acid and sulphuric acid induce the formation of nitro-products. Dilute acids transform dextrin into grape-sugar, maltose being formed, which latter, according to Béchamp, is another unfermentable substance, with a rotatory power inferior to that of grape-sugar. Heated with bromine at 10° C., dextrinic acid is formed, which is identical with the gluconic acid formed from grape-sugar in the same way.

Aqueous solutions of dextrin are precipitated by lead acetate and ammonia, and also by alcoholic solutions of baryta, a delicate white powder being obtained. Lead acetate gives no precipitate by itself, nor does stannous chloride, whereas ammonium molybdate and a little nitric acid produce a blue coloration. Basic lead acetate precipitates dextrin from concentrated solutions, and thus distinguishes this substance from gum arabic. Potassium chromate or chrome alum renders dextrin insoluble when exposed to light—a property which is utilised in calico-printing.

Pure dextrin is unfermentable, though when the solution also contains grape-sugar, a large proportion of the dextrin is split up, like the sugar, into carbon dioxide and alcohol during fermentation.

Commercial dextrins are seldom quite pure, being mostly contaminated with considerable quantities of starch, grape-sugar, mineral and organic acids, and adulterated with sand, gypsum, heavy spar, and talc. Foerster gives the following average composition of the commercial grades :—

	Prime Dextrin.	Highly Roasted Starch.	Brown Dextrin.	Gommelin.	Old Dextrin.	Lightly Roasted Starch.
Dextrin . .	72·45	70·34	63·60	49·78	59·71	5·34
Grape-sugar . .	8·77	1·92	7·67	1·42	5·76	0·21
Insoluble starch, ash, etc. .	13·14	19·97	14·51	30·80	20·64	86·47
Water . . .	5·61	7·68	14·23	18·00	13·89	7·95

To determine the dextrin content of a commercial sample, Roussin dissolves a weighed quantity in water, evaporating the solution to a syrup and mixing it with ten volumes of 90 per cent. alcohol. The precipitated dextrin is washed with alcohol of the same strength, and then dried and weighed. Of this product, 1 grm. is dissolved in 30 c.c. of water and treated with 30 c.c. of 56 per cent. alcohol, a few decagrams of calcium carbonate and 4 drops of a 20 per cent. solution of ferric chloride, in order to throw down any gum present. The whole is carefully mixed, filtered, and the residue washed with 56 per cent. alcohol, the dextrin being precipitated, from the filtrate, with 95 per cent. alcohol. After standing for twenty-four hours, the precipitate is dissolved in water, the solution being evaporated in a tared basin, and the residue dried and weighed.

The percentage of starch sugar in dextrin is ascertained, qualitatively and quantitatively, by means of Fehling solution; but only a very brief boiling must be given in this test, since, otherwise, the alkali tartrates transform a portion of the dextrin into sugar. Another quantitative test for starch sugar is the Barsoed reagent (a solution of 1 grm. of neutral copper acetate and 5 c.c. of 38 per cent. acetic acid in sufficient water to make 200 c.c.). On boiling this reagent with dextrin, red cuprous oxide will be thrown down by any starch sugar present, whereas pure dextrin does not reduce copper acetate.

The percentage of moisture in dextrin is determined by drying 2 to 3 grms. in a U-tube, at 100° C. in the oil-bath, until the weight is constant. It is advisable to pass air that has been dried with concentrated sulphuric acid through the tube. The loss of weight sustained by the substance gives the proportion of moisture.

If 50 grms. of dextrin be dissolved in 500 c.c. of water, and the solution be passed through a filter (dried at 100° C. and weighed), washed, dried at 100° C., and weighed, the loss in weight will give the content of insoluble matter. On incinerating the residue in a platinum dish, with free access of air, taking up the ash with ammonium carbonate and weighing, the percentage of mineral ingredients (which may have to be examined further) will be obtained.

The loss on incineration represents approximately the starch content of the dextrin, but if a more accurate determination is required, the washed insoluble portion of the dextrin is treated with sulphuric acid or malt extract, the resulting maltose being titrated with Fehling solution. If the filtered dextrin solution be evaporated, and a weighed portion of same be dried at 100° C. in a U-tube in the oil-bath, with the aid of dry-air, the sum of the dry constituents of the dextrin will be obtained; whilst incinerating the dry residue (as directed above) will give the insoluble mineral substances (gypsum especially).

If the dextrin solution have an acid reaction, a weighed quantity is dissolved in water, and the degree of acidity is ascertained by titration. Since it is very rarely that two acids are used in the preparation of dextrin, a simple qualitative test will be sufficient; and it is only when gypsum is revealed in the ash that acids, other than sulphuric acid, need be tested for.

PREPARATION OF DEXTRIN.

The manufacture of dextrin has attained very considerable dimensions, and in addition to dextrin itself, a number of imitation gums are also made, bearing a resemblance to gum arabic, the dextrin produced by the wet process forming a cheap raw material for their preparation.

An important point in the manufacture of dextrin is that the treatment of the starch should proceed only far enough to form dextrin, but not sugar, this latter rendering the final product hydroscopic, and spoiling the appearance of the clearer and finer imitation gums by making them moist and sticky to the touch.

An inferior grade of dextrin, known as roast gum, differs from the pure variety in appearance and in the method of preparation, and contains various extraneous substances.

The methods of preparation are numerous, and may be summarised as follows:—

1. Boiling starch in water with incomplete transformation into starch gum. This method has no practical value and is never employed.

2. Heating the starch in drums or on metal plates, the heat bursting or destroying the envelopes of the granules. The product is known as roast gum, Leiogomme, Leiocomme, Amidon grillé, Gommeline, Gomein, Lefebre gum, etc.

3. Treating starch with small quantities of acids at the ordinary temperature, or

4. With application of heat.

5. Treating the starch with caustic alkalis, by the aid of heat.

6. Treating starch with diastase (a peculiar substance formed during the germination of barley), assisted by heat.

Potato starch is almost exclusively used as the raw material for dextrin, as being the cheapest and the easiest to manipulate.

For manufacturing dextrin by means of diastase, 200 parts by weight of water are heated to 77° to 86° F. in a pan. Good crushed green malt—ranging from 6 to 10 per cent. of the weight of starch taken according to quality—is distributed in the water, and the temperature is raised to 212° F., 50 parts of starch being then stirred in. The mixture is kept for twenty to thirty minutes at 158° F., until the originally viscous and milky liquid gradually becomes as fluid as water. At this stage the temperature is raised to 203° to 212° F., and after a short interval of repose, the liquid is drawn off, filtered, and concentrated, the scum—containing the bulk of the starch envelopes—being removed. The concentrated liquid is poured on to metal plates to form a thin layer, and dried by artificial heat.

The preparation of dextrin from starch with the aid of hydrochloric acid fumes is carried on in a jacketed iron cylinder, heated by water or steam, and fitted with stirrers. Nearly 3 cwt. of starch are treated at a time, the cylinder being filled about one-third full. After closing the cylinder the starch is heated to a temperature of 116° to 150° C. (240 to 320° F.); and the higher the temperature, within these limits, the better the product, though the darker the colour. A thermometer may be provided for controlling the temperature. As a rule it takes about four hours for the starch to attain the requisite temperature, though the time depends chiefly on the percentage of moisture. The steam, and any vapours, etc., liberated by the starch, escape through a pipe in the upper portion of the cylinder. When the starch has reached the desired temperature, hydrochloric acid gas is admitted to the cylinder, the acid being divided, for this purpose, into two portions, each of which is placed in a glass retort. The neck of one retort is inserted in an aperture in the end plate of the cylinder, and heat is applied to the retorts, so that the fumes of the hydrochloric acid pass into the cylinder. The acid fumes mingle with the air in the cylinder and are absorbed by the starch, which must be kept stirred, and which is transformed by the acid into dextrin. The acid fumes finally escape through the aforesaid opening at the upper end of the cylinder. In order to obtain the best product possible, the acid must not enter the cylinder too quickly, about fifteen minutes being the minimum, or the starch will not have time to absorb the fumes uniformly. When the transformation is completed, the one end of the cylinder is opened and the product is taken out.

A newer method of preparing dextrin is that introduced by Pochin and Wooley. These workers dry wheaten flour, sago starch, wheaten starch, or maize starch, completely, in a suitable oven, mix the material with $\frac{1}{4}$ to $\frac{1}{8}$ part of buttermilk or sour milk, strain through a sieve, and roast the mixture at a gentle heat until the requisite yellowish or brownish colour is attained. An increased proportion of buttermilk lightens the colour of the dextrin, and *vice versa*. Sour milk and buttermilk may be replaced by a solution of lactic acid.

According to the Blumenthol method, a closed drum is filled about one-third full of starch, through a funnel. Stirrers are set in operation, and acid, contained in a measuring vessel, is sprayed, in the form of fine mist, over the starch by means of a steam or air jet. In this manner, 2 cwt. of potato starch can be incorporated with 9 oz. of sulphuric acid (40° B.) in five minutes, in a drum 5 feet long and 40 inches wide. The treated starch can be taken out through a sliding door, and roasted without any previous drying.

Gum, Gum Arabic.

The name "gum" is usually applied to all vegetable substances resembling gum arabic in outward appearance, and being completely insoluble in alcohol, but soluble in water, or at least swelling up in the latter to a thick, adhesive jelly. The essential difference between gum and dextrin is that the latter can be transformed direct into sugar, whereas gum must first be converted into dextrin before that change can be effected.

The majority of gums are obtained from varieties of acacia, trees that grow in vast numbers on the African continent. The produce is marketed under a great variety of names, gum arabic being sold as: Kordofan, Sennaar, Suakim, Gedda and Mogador, or Morocco gum; Senegal gum is classified as "up-river" (*gomme du haute du fleuve*) and "down-river" (*gomme du bas du fleuve*) gum; and there are also Gomme de Galam and Gomme friable ou salabrede. These grades of Senegal gum, however, do not come direct on the market, but are sorted into a number of classes, differing in value. In the French market these are sold as: Gomme blanche, blonde, petite sorte, Salabrede en sorte, Baquaques et marrons, gros grabeaux, moyens grabeaux, menus grabeaux and poussière grabeaux. The English grades are: Gum arabic from Turkey, East India, Barbary, Gedda, Australia and Senegal. Turkish gum includes the grades shipped from Northern Africa *via* the Levant.

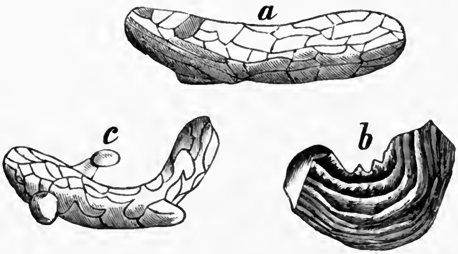


FIG. 15.—Senegal gum.
a, *b*, vermiform lump; *c*, twig form.

Acacia gum is usually sold in rounded granules, sometimes elongated, though some of the Senegalese varieties are bent in the shape of twigs, or vermiform. The surface appearance differs, and is characteristic of the species, the best and whitest kinds of gum arabic and one grade of Senegal gum being cracked all over, so as to appear opaque instead of clear. Inferior, dark kinds have a warty surface, whilst the vermiform varieties show longitudinal stripes. The fracture is vitreous, sometimes splintery, sometimes conchoidal. The gum is easily crushed and furnishes a white powder, even the dark kinds showing very little coloration. The colour of the several kinds varies considerably, being pure white, pale yellow, wine yellow, reddish brown, brownish black, but seldom orange, red, or green.

The sp. gr. varies between 1·35 and 1·62. When placed in water, acacia gum swells up slightly, and then dissolves, more or less completely, to a clear liquid, with a mucilaginous taste and an acid reaction. The best and whitest sorts leave no residue when dissolved in water, though some of the darker kinds do, *e.g.* Gedda and Cape gum. This residue is soluble in alkaline liquids, and seems to consist of a mixture of bassorin or cerasin and some resinous substance. Solution in water, especially warm water, is generally accompanied by strong frothing. Glycerine dissolves gum arabic, and the solution is miscible with aqueous solutions of glycerine.

According to Neubauer, gum arabic is chiefly composed of calcium arabinate and potassium arabinate. On combustion it leaves about 3 per cent. of ash; and in the air-dry condition it contains 12 to 17 per cent. of water.

Cape gum is collected in the Orange River State, and is said to be obtained from *Acacia Karroo* and *Ac. horrida*, though Burchell gives *Ac. capensis* as the parent plant. It forms opaque, heavy lumps of a dirty dark colour, the lumps being frequently insoluble in water and of merely low value. The gum is brought over to Europe in East Indian vessels, and is not in much request.

Indian gum comprises all the East African gums shipped to Europe in Indian vessels, and the term should not be confounded with the real East Indian, or Feronia gum. Indian gums are inferior to the Turkish grades.

On the subject of Indian gum, Prehle states that, contrary to the earlier custom, far more Indian gum than that of African origin is shipped from Bombay. The African gums are known as "Bombay pink" and "Aden pink." Scinde gum which, according to Rideal, is all consumed in the country of origin, also comes for export occasionally, Kurrachee gum being obtained from Scinde. One variety of Scinde gum is locally known as Oomarkote gum (from a small town in Rajputana), and is obtained from *Acacia Senegal*, one of the few trees that will grow in that desert region.

Indian gum is in transparent globules or lumps of varying size; it is usually almost colourless, and can readily be identified by the difficulty with which it dissolves, even in hot water. If a piece of this gum be left in water for several days, it will swell up to a viscous mass without dissolving, resembling ordinary cherry gum in this respect, though not so highly coloured. Complete solution is effected by boiling for some time under a pressure of one atmosphere.

Mezquite gum (Mignet or Musguit gum), which was described by Morfit, is said to originate from *Prosopsis dulcis*, Kunth., and is shipped to Europe from Mexico. Schumard, who examined a sample of this gum, reports that the granules are as large as hazel-nuts, and closely resemble the dark kinds of gum arabic, being also completely soluble in water and insoluble in alcohol. In addition to water and salts, it contains 85 per cent. of arabin, and being obtainable in large quantities, should find extensive application in the near future.

Australian gum (wattle gum) is in hemispherical or stalactitic lumps, with one flat side, by which the pieces—often as much as 4 inches long—have been attached to the bark of the tree. This flat side often contains embedded fragments of bark.

The lumps are red-brown in colour, translucent, and fairly homogeneous inside. The surface is smooth, with reticulated cracks. The fresh surface of fracture is wholly or partially dull, the dull portions frequently exhibiting delicate parallel markings. When dissolved, the gum has a faint sweetish taste. In spite of the dark colour, this gum is superior to the other dark acacia gums, more particularly on account of its ready and complete solubility in water.

Feronia Gum.

This true East Indian gum, obtained from *Feronia elephantum*, Corr., forms large irregular lumps with a rough surface, mostly transparent and topaz yellow in colour, though some are brown; all, however, are bright. The hardness is somewhat inferior to that of gum arabic. Iridescent lumps are often found. The gum dissolves in water as easily and completely as acacia gum, and forms a strongly adhesive solution. The water content is 12·63 per cent., and the ash 5·12 per cent.

Cherry Gum, Plum-Tree Gum.

Cherry gum occurs in the form of hemispherical or reniform lumps, pale wine-yellow to deep red-brown in colour, and is obtained from cherry and plum trees, exuding from accidental injuries. Plum-tree gum is usually paler than cherry gum, but both have the same, insipid, gummy taste, or are sweet and astringent when sugar and tannin are present. These gums are partially soluble in water, the insoluble residue forming a pale or colourless jelly. They contain 13 to 14 per cent. of water, yield 2 to 3·5 per cent. of ash, and consist of varying proportions of arabin (soluble in water) and cerasin (which swells up in water but does not dissolve), together with grape-sugar and tannic acid. The content of arabin and cerasin fluctates, peach and almond gum being almost completely soluble in water, and hence apparently consisting mainly of arabin, whereas, according to Schmidt, cherry gum contains 34·9 per cent. of cerasin and 52·1 per cent. of arabin.

Testing Gum Arabic.

The high price of gum arabic and allied products has led to extensive adulteration, not merely by the admixture of cheaper, inferior gums with cherry, plum and similar (cerasin) gums, but also by the addition of artificial products, made from starch, etc.

When the gum is in the state of lumps or granules, adulteration with inferior varieties can be detected without difficulty from what has been said with regard to their properties and by the aid of the microscope. In the case of powdered gum, however, such adulterations are difficult to prove, although chemical reactions will leave no doubt. Powdered gums may generally be suspected of containing dextrin.

The adulteration with gums containing bassorin or cerasin, such as cherry, plum, almond, or apricot gum, can be detected in many cases by simple examination or purely mechanical tests. In this case the solubility test soon removes doubt. Bdellium gum, which also is often used as an adulterant, has a greasy feel, and sticks to the teeth when chewed. In a few cases the determination of the specific gravity is useful, bdellium gum, for instance—which, moreover, is sufficiently characterised by liberating ammonia on distillation—having the sp. gr. 1·371 at 175° C., whereas that of gum arabic is considerably higher.

Adulteration with gums only partially soluble in water, can easily be detected by treating the suspected sample with water, these gums merely swelling up or only dissolving in part.

To detect the addition of cerasin or bassorin gums to gum arabic, the gum is soaked in water at 15° to 20° C. The portions containing arabin dissolve, and water is added until a very thin solution is obtained, from which the insoluble portions and impurities will settle down to the bottom in a short time. The insoluble portion is collected on a filter, to drain, and is then boiled with sodium carbonate solution, whereupon the cerasin, etc., will dissolve, leaving the impurities behind. If the gummy residue, remaining after decantation and filtering, dissolves under this treatment without remainder, no cerasin gum was present in the sample. In such event the lumpy deposit left on treating the gum with water is separated by decanting the solution, and then brought into the filtrate by the aid of much warm water, if the quantitative determination of organic and inorganic impurities has to be made. The filtrate from the portion boiled with sodium carbonate, gives a precipitate containing all the metagummic acid, when acidified and treated with 90 per cent. alcohol, if cerasin be present. It is evident that the method may also be applied for the quantitative determination of cerasin and bassorin in certain cases, provided filters, weighed and dried at 100° C., be used for collecting the several components.

Tragacanth is easily detected in powdered gum by means of the microscope, inferior tragacanth showing starch granules, and all kinds exhibiting fragments of the cell walls from which they have been derived. Flour and starch are also easily identified under the microscope.

There is also little difficulty in detecting dextrin in arabin gums, owing to its characteristic behaviour toward various reagents. Dextrin always contains more or less glucose; and a red precipitate, occuring when the sample is heated to above 70° C. with alkaline copper solution, indicates dextrin. In presence of any considerable proportion of arabin, 5 to 8 drops of a concentrated solution of ferric chloride will gelatinise 5 c.c. of an aqueous solution of gum (1 part of gum, 2 parts of water). If dextrin be present, merely a whitish turbidity will occur when the jelly is shaken up with water; and in the case of pure gum, the jelly will not dissolve.

For gum in the form of lumps, the following procedure is recommended:—

A few lumps are placed in a small beaker and treated with enough of an aqueous solution of ferric chloride (sp. gr. 1·48 to 1·484) and distilled water (in equal parts) to cover the bottom of the beaker. After stirring and leaving to stand for half to one minute, the fragments of gum will remain adhering to the bottom, whereas the dextrin will not.

Solutions of pure gum remain colourless when treated with iodine solution at the ordinary temperature, but a blue coloration is produced when starch is present, and a red with dextrin. This latter substance gives a blue coloration when the gum solution is boiled with ammonium molybdate and a little nitric acid.

To determine the amount of dextrin in an arabin gum, a weighed quantity of the substance is dissolved in water, and the solution is precipitated with lead acetate. The precipitate contains the arabic acid, whilst the dextrin is in the filtrate, in which it can be determined (after removing the surplus lead with carbon dioxide) by evaporation, and drying at 100° to 110° C.

According to Pietro Palladino, dextrin may be detected in gum arabic by boiling a sample for one minute with aniline sulphate, chlorobrucin, pure brucin, orcin, or orcein. In alkaline solutions pure gum gives a straw-yellow coloration with these reagents, a yellowish-orange or brownish-red being produced in presence of dextrin.

Gum arabic that has been bleached with sulphur dioxide often contains sulphuric acid, which is revealed by the white precipitate of barium sulphate formed on adding barium chloride to the solution.

For testing pure gums and detecting adulterations, Rideal and Youle employ the viscosity test. The quality of gum substitutes largely depends on the care and skill with which the dextrin has been prepared; and in many cases the dextrin employed contains starch. This starch gelatinises when boiled with water, and improves the quality to a certain extent. Rideal and Youle devised and used a small apparatus in which the outflow of a given volume of liquid from a glass bulb—graduated in two places where it is connected with two other small bulbs—is accelerated by exhausting the air from the vessel into which the liquid runs. This vessel is large, and is fitted with a gauge for indicating the pressure prevailing therein. In this way the viscosity of highly viscous liquids, such as concentrated solutions of gum, can be determined in a very short time. The viscosity of a dextrin solution is lower than that of pure gum arabic. The absolute viscosity of 10 per cent. solutions of gum arabic is 1·0639 to 1·1850, as compared with 1·2880 to 1·3621 for 10 per cent. solutions of gummi ghatti, and 1·1350 to 1·1760 for 5 per cent. solutions.

Hager employs for the detection of artificial, dextrinous gums in gum arabic, a mixture of ferric chloride and potassium ferricyanide solutions, this mixture forming a very delicate and reliable reagent. The solution is prepared by mixing 15 drops of officinal iron sesquichloride solution, 15 drops of a solution of potassium ferricyanide (saturated at the ordinary temperature), 5 drops of dilute hydrochloric acid (sp. gr. 1·165), and 60 c.c. of water.

If 6 c.c. of a 20 per cent. solution of the gum under examination be treated with 3 c.c. of this reagent, a clear, yellow, viscous mixture is obtained in the case of pure gum; and this will remain unaltered for eight to ten hours. In presence of dextrin, the yellow colour undergoes a change in the course of an hour, and the mixture turns blue in two to three hours.

The best reagent for ghatti gum—which is imperfectly soluble in water—is ammonium oxalate, which gives a dense white precipitate with gum arabic, but only a slight turbidity with ghatti gum. Ferric chloride gives a slight, dark coloration and a gelatinous precipitate; mercuric chloride a white precipitate, but none at all with gum arabic. Solutions of ghatti gum are yellowish or light brown, and retain their viscosity longer than the inferior qualities of gum arabic. Ghatti gum is brought to market contaminated with fragments of bark, the tannin in which has an injurious action. To eliminate this latter, the gum is treated with half the quantity of cold water needed to effect solution, and is strained through muslin, the residue being treated in the same manner.

For the detection of cherry gum in gum arabic, a consistent solution of the sample is spread over concentrated sulphuric acid, whereby an insoluble, gelatinous mass is produced, whereas, under the same conditions, cherry gum furnishes a saccharine substance.

TRAGACANTH.

This gum is obtained from several shrublike species of *Astragalus*, that are met with throughout Greece and Crete, and also in

Asia Minor and Persia. Only three of these, however, have been actually identified as the source of tragacanth, viz. *Astragalus creticus*, Lam., and *A. Parnassii*, Boiss., in Greece and Crete, and *Astragalus verus*, Oliv., in Western Asia.

Though tragacanth exudes spontaneously from the stems of these plants, the yield is frequently increased by making incisions in the stems. The best grades, which consist of foliaceous pieces, are the result of artificial interference with the plants; the inferior, lumpy masses being spontaneous exudations.

The lumps of tragacanth are either foliaceous, filamentous, or irregularly nodular in shape, depending on the nature of the exudation, whether natural or artificial.

All kinds of tragacanth are very tough, horny masses, from which thin plates can be easily separated by cutting, though they are difficult to pulverise. This distinguishes tragacanth at once from the insoluble cerasin gums.

Tragacanth is softer than acacia or cherry gum. The best kinds are white or faintly tinged with colour, the inferior sorts yellow to red-brown or even brownish black. The white foliaceous and filamentous grades are selected qualities. In appearance, tragacanth is dull, and slightly translucent; it is only very slightly soluble in water, the insoluble residue (bassorin) swelling up to a jelly. The white varieties have an insipid, mucilaginous taste, whilst the inferior, yellow and brown kinds have a disagreeable, acid subflavour.

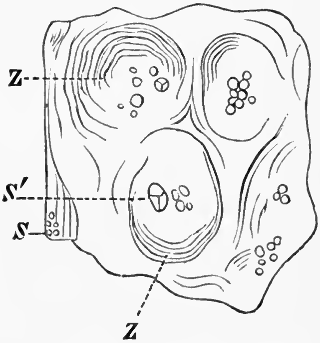


Fig. 16.—Longitudinal section through foliaceous tragacanth. *S*, simple; *S′*, complex starch granules; *ZZ*, fragments of cell walls.

The main constituent of tragacanth is traganthin or adraganthin (identical with bassorin), a gum that swells up in water, but is only sparingly soluble therein, and has a decidedly acid reaction, a readily soluble portion, hitherto known as arabin, being also present. Whilst this latter is as adhesive as gum arabic, bassorin is practically devoid of adhesive power, though it binds firmly when dry. Other substances present in tragacanth are: starch, cellulose, occasionally sugar, a bitter principle extracted by alcohol, a pigmentary substance, and mineral constituents. Analyses have shown the presence of over 50 per cent. of readily soluble gum. The more extensive the chemical metamorphosis of the tissue affected in the production of gum, the higher the proportion of soluble gum constituents, which are undoubtedly formed from the insoluble substances. As the amount of gum increases, the starch and cellulose diminish, so that only very small quantities of these latter are present in the best kinds of tragacanth. Inferior sorts, on the other hand, often contain so much free starch as to acquire a deep blue stain on contact with iodine, and can be cut with ease on account of the high cellulose content. The varieties rich in bassorin are very tough and almost impossible to pulverise, whilst those high in arabin are less tough, and seem almost brittle when an attempt is made to cut them; though even these are difficult to crush. The ash content is 2 to 3 per cent., more than half consisting of calcium carbonate. The percentage of moisture ranges between 11 and 17 per cent.

In commerce, tragacanth is classed, according to its shape, into leaves, sticks or vermicelli, and "sesame seed." The first two kinds are obtained by selection from all natural varieties of tragacanth, viz. Smyrna tragacanth (white or pale yellow, elongated leaves plainly stratified and sometimes striated); Syrian tragacanth (leaves of irregular thickness, nodular and sticklike masses, white, or more frequently yellow to brown in colour, with adherent fragments of bark and tissue); Morea tragacanth (long, thin sticks, sometimes flat and straight, at others of circular section, and twisted and curled in various shapes; of divergent colour, and many of the filaments quite equal to the best leaf tragacanth); Anatolian tragacanth (also called tragacanthone), which resembles Syrian tragacanth, but is easily distinguished by its dark colour and intensely acid-bitter flavour. The largest proportion of leaf tragacanth is furnished by the Asia Minor varieties; the most vermicelli by Morean tragacanth. Since the leaves are separated by picking, and the stalks by sifting, the latter consist of long, broken fragments of the former as well as the natural sticks. Sesame seed is the name given to the fragments obtained by sifting the vermicelli.

Red tragacanth consists of the inferior qualities left after picking, and also of the low-grade natural tragacanths. French tragacanth is the name given to the fine, white qualities, in good request in France; English tragacanth (gum tragacanth leaf) denotes larger, coloured, and less carefully selected sorts. In the Turkish trade there are three grades: Angora (best), Kurdistan, and Trebizonde (poorest).

African tragacanth (from *Sterculia Tragacantha*, Lindl., a plant met with in tropical Western Africa, from Senegambia to the Congo) forms irregular rough lumps or cavernous stalactitic masses that are colourless or yellowish, and are only transparent in very thin layers.

Tragacanth is seldom adulterated, though varieties coloured with white lead are said to come on the market from Levantine sources, and the poorer kinds, consisting of small fragments, are adulterated with inferior granular varieties of Senegal gum or gum arabic that are cheaper than tragacanth. Extensive adulteration can be easily detected by the pulverability and the relatively high content of substances that are soluble in water. Smaller quantities of these varieties of gum are revealed by the aid of alcoholic tincture of guaiacum, which gives no coloration with tragacanth mucilage, but a blue coloration with solutions of gum arabic or Senegal gum. This reagent will detect as little as 5 per cent. of gum arabic.

Vegetable Mucilage.

According to Karmarsch, the term "vegetable mucilage" comprises a whole series of bodies, of widespread occurrence in the vegetable kingdom, endowed with the property of forming a mucinous mass when mixed with water. These bodies belong to the group of carbohydrates, and are most nearly allied to the gums. They are present in large amount in marshmallow root, salep tubers, the seeds of flax, hemp, and fleawort, Carragheen moss, various algæ, and in the leaves and bark of the elm and lime. The general method of preparing vegetable mucilage is by digesting the suitable portions of the plants with water, straining the solution, and precipitating with alcohol, the ash constituents being extracted by agitation with alcohol containing hydrochloric acid.

The mucilage of marshmallow root, and that of linseed and fleawort seed, can be transformed into gum and sugar by boiling with dilute sulphuric acid. The first two kinds are probably identical, being dextrorotatory and insoluble in ammoniacal copper oxide, whereas the third kind is soluble in this reagent. Quince mucilage merely swells up in water, and does not dissolve until caustic potash is added. Boiled with dilute sulphuric acid, it decomposes into cellulose and gum, the latter afterwards yielding sugar. Quince and salep mucilage differ from those mentioned above in that they merely swell up with water, give a blue to violet coloration with iodine, and furnish only oxalic acid when treated with nitric acid, whereas the others yield mucic acid as well.

According to Kirchner and Jollens, the mucilages are glucosidic compounds of gum and cellulose, or, to use a more suitable expression, intermediate stages in the transformation of the cell membrane, exhibiting the characteristics of cellulose in addition to those of gum. Naegli and Cramer divide the vegetable mucilages in general into such as are secretion products of the parent plants, and such as are essential organs of the normal plant, as in the case with quince, linseed, and fleawort mucilage.

If quince, linseed, or fleawort mucilage be boiled with 1¼ per cent. sulphuric acid, it is decomposed into gum cellulose; further boiling resulting in the formation of sugar, of which quince mucilage furnishes the most, the other two giving merely a small yield. Quince mucilage is viscous, the other two are gummy. The gum formed on boiling with sulphuric acid is not stained red or blue by iodine, but nevertheless rotates the plane of polarisation to the right, like dextrin.

CARRAGHEEN MOSS.

This substance, also known as Irish moss or pearl moss, has been on the market since about 1830. It is obtained on the North Atlantic coasts, chiefly on the west and north of Ireland, the south-west coast of Scotland and on the coast of Massachusetts in the United States.

It consists of various lichens of the Florideæ tribe, detached from their beds by the movements of the ocean and driven to shore. When dry, the moss forms a cartilaginous mass, only slightly translucent, yellowish to brownish in colour, with occasional whitish patches. The masses are-ribbon shaped, frequently branched with dichotomous extremities. The actual mucilaginous substance of the algæ is carraghin (lichen mucus), which is soluble in water, but precipitable by alcohol or lead acetate. It is a carbohydrate, but somewhat remote from the carbohydrates (*e.g.* starch and cellulose) of other plants, though, like these, it is capable of furnishing a saccharine product when boiled with dilute acids.

According to Herberger, Carragheen mucilage contains two resins, a little fat and mineral substances, though neither iodine nor bromine. Flückiger and Obermaier detected 1 per cent. of nitrogen and 16 per cent. of mineral constituents, and showed that the mucilage, which is converted into mucic acid by nitric acid, but is neither soluble in ammoniacal copper oxide nor stained blue by iodine and sulphuric acid, dissolves in water to a neutral liquid in which no soluble gum can be detected. For preparing Carragheen mucilage, 11 lb. of the moss are placed in a pan and suffused with 15 to 20 gallons of hot (not boiling) water, 2 to 3 lb. of sodium carbonate, dissolved in hot water, being added in order to decolorise the mucilage. The latter, when dissolved, is strained through a coarse wooden or bast sieve, and the residual moss is treated with a fresh quantity of hot water (the soda being omitted), well stirred up and left for two days. The resulting solution is then added to the first one, and the moss treated again with hot water, this solution, too, being united with the others. In this way 33 to 45 gallons of mucilage will be obtained, of the proper consistence; and this is stored in closed, high vessels until required. In a cool place it will keep for a considerable time, and improve in purity and transparence, owing to clarification.

ICELAND MOSS.

This plant (*Cetraria islandica*, Ach.—*Lichen islandicus*, Lin.—*Physica islandica*, D. C.) occurs in enormous quantities in the plains of high northern latitudes, and also in many hilly districts in the temperate zone, the market being supplied from numerous sources (Sweden, Spain, Germany, Austria). The form of the plant is shrublike, up to about 6 inches in length, and composed of flat branches, curved and folded, ciliated and often curly, at the edges, with dichotomous extremities. In the fresh, damp state it is olive green in colour, turning various shades of brown when dried. The lichen is inodorous, but has a mucinous bitter taste. It swells up after prolonged immersion in cold water; and the lichenin dissolves under the influence of boiling water, leaving the remainder swollen up in the form of jelly. The percentage of lichenin is about 70 per cent.; and this substance is stained blue by iodine, like starch, with which latter substance it is identical in percentage composition, so that it has been called "lichen starch." Other constituents of the lichen are: a gum that swells up in water, sugar, a substance, thallochlor, allied to chlorophyll, a saponifiable fat—in which a peculiar fatty acid, lichen stearic acid, discovered by Knop and Schnedermann—a bitter principle, cetraric acid (sparingly soluble in water and producing the bitter flavour of the lichen), and fumaric acid. The moisture content is 11 per cent., and the ash content 1·5 to 3 per cent.

HAI-THAO.

Hai-Thao, or gelose, is recovered from a lichen of frequent occurrence in Cochin-China and Mauritius, and is in the shape of coarse, flat fibres, which are hard and tough, and about 12 inches in length. It is tasteless and inodorous, consists of a translucent, colourless mass, and is covered with a network of opaque veins, which are nothing more than folds, produced in the drying of the mass. It is insoluble in cold water, merely swelling up therein; partial solubility does not occur below 75° C., whilst completely solubility is only effected by boiling in water for about ten minutes. By this treatment all the particles in the liquid are made to disappear, a transparent, thin, dirty white solution, which is not tacky to the finger, being obtained. When the solution is cold, the Hai-Thao separates, like gelatine, as a yellow-grey jelly, which redissolves on boiling. The jelly has a neutral reaction, and exhibits no tendency to ferment or putrefy when kept, even as long as a week.

Hai-Thao dissolves in cold, concentrated sulphuric acid, hydrochloric acid or nitric acid, and is reprecipitated from these solutions by the addition of water. It behaves toward dissolved alkalis in the same way as toward water; it is entirely insoluble in both cold and boiling alcohol, and so far from being softened thereby, is actually rendered still harder, the mass being no longer translucent after the expulsion of the alcohol.

Fleawort Seed.

These seeds are obtained from a plant (*Plantago Psyllium*, L.) found on the sandy shores of Southern Europe, those coming into the French market being derived from the sub-species *Pl. areraria*, W. and K., also occurring in Germany and Austria.

The seeds are about $\frac{1}{8}$th of an inch long and $\frac{1}{25}$th of an inch across, elliptical in outline, rounded on one side and concave on the other. They consist of a husk, an albumen, and an embryo with rootlets and two cotyledons. The mucilage is contained in the epidermis, which swells up considerably in water, and surrounds the seed with a cloudy envelope. The amount of mucilage reaches up to 15 per cent.

For the preparation of dressings, the seeds are boiled for a long time with a suitable amount of water, so as to secure the dissemination of the mucilage therein. The resulting mucilage is employed to soften various dressing preparations, and is used more particularly in silk finishing, where it does admirable service.

Linseed.

The oily seeds of *Linum usitatissimum* are enclosed in a capsule about as large as a pea, and are of smooth, ovoid shape, reddish in colour and compressible. The surface of the seed grains is covered with a kind of varnish which forms with water a mucinous mass that leaves only a slight residue on evaporation. For use, the seeds are crushed, which destroys the texture of the husks, down to the sclerenchyma cells and the cells of the innermost skin. The embryo, albumen, and husk are clearly distinguishable in the seeds.

For dressings, linseed meal is boiled with water, and used as a softening agent, like fleawort.

Peru Gum.

This is a greyish-yellow powder, obtained from the so-called Peruvian root, by grinding. This root, which is of unknown origin, is about the thickness of a pencil and 1½ to 2 inches long, reddish-brown on the outside, whitish-yellow inside, with a yellow core. It has no smell, and merely an insipid flavour at first, with a bitter after-taste. It comes on the market as a powder which, for use, is stirred up with cold water to a pulp with about the same consistence as honey, and containing 16 to 18 times as much water as powder, by weight. It is said to be free from starch and also from tannin. Alcohol extracts from the powder a yellow-colouring matter, which remains behind, on evaporation, as a translucent amorphous substance.

When the pulp is treated with a large volume of water, a precipitate, entirely insoluble in water (presumably cellulose) is thrown down, the amount of which is equal to about 8 to 10 per cent. of the original substance. The statement that the powder contains bassorin is said by Wiesner to be inaccurate. So far as adhesive power is concerned, it is inferior to Senegal gum, though the thickening power is six times as great as that of the latter.

The gum soluble in water is precipitated by lead acetate, and therefore resembles the gum present in tragacanth. The ash contains lime, iron, alumina, magnesia, potash, carbonic acid, silica, phosphoric acid, and chlorine.

CEYLON MOSS.

This is the commercial name of the dried, balled mass of a seaweed (*Sphærococcus linchinoides*), of the Florideæ family, the numerously branched twigs of which are white or yellowish white in colour, and are very brittle when dry. It occurs in large quantities on East Indian coasts, and is largely shipped to England and the continent, where it is worked up in the same manner as Carragheen moss, which it closely resembles.

CANARY GRASS SEED.

Canary grass seed, from *Pularis canarensis*, which is said to be indigenous to the Canary Islands, and is at present often cultivated in the south of Europe and in some parts of Germany, is a small seed, pointed at both ends, of high lustre and straw-yellow colour. Cracked and infused with hot water, the seed is used for sizing fine cotton goods, being preferred to wheaten starch for this purpose.

ALBUMIN.

The name albumin is usually applied to dried albumin of animal origin, the vegetable albuminoids (vegetable fibrin, vegetable casein, and vegetable glue) being termed gluten.

Animal albumin is of widespread occurrence throughout the animal kingdom, but most abundantly in the eggs of birds and in the watery fluid that collects over clotted blood, and is known as blood serum, or merely serum. According to the raw material used in its preparation, albumin is divided into two classes: egg albumin and blood albumin, the latter being darker in colour and unsuitable for certain purposes, *e.g.* the application of light colours in calico printing.

Chemically, there is no difference between pure blood albumin and pure egg albumin; and blood albumin is now prepared on a manufacturing scale, of a quality that is quite equal to egg albumin.

Egg albumin forms pale yellow, almost white plates, whilst blood albumin is pale to dark yellow, even brown in colour, and translucent to opaque. Pure albumin can be heated, in aqueous solutions, nearly to the boiling-point of water without coagulating, and may be treated with alcohol, or ether without precipitation, though blood albumin is thrown down from solution by ether. On heating albumin that has been separated from the cell envelopes by beating and filtration, the clear liquid commences to become opalescent at about 59° C., isolated flakes separating out at 60° C., and complete coagulation to a white mass occurring at 62° C., the albumin being converted into the insoluble modification. In the case of very dilute solutions, the separation of solid albumin does not occur until temperatures considerably higher than 62° C., prolonged heating at 100° C. being needed to produce complete coagulation.

Owing to its very high price, albumin is frequently adulterated; and commercial samples have been found to contain gum arabic, dextrin gum, tragacanth, and even glue, which must have been added purposely. In addition to foreign admixtures, the quality is injured by defects in the preparation, especially in drying, so that the total content of soluble albumin is not so high as it should be. Some kinds of albumin contain as much as 30 to 40 per cent. of insoluble matters.

The peculiar appearance of albumin is usually taken as a criterion of purity and excellence, preference being given to large plates exhibiting high gloss, coupled with almost complete transparency and lack of colour.

The solubility test is not reliable, inasmuch as both dextrin and gum arabic are readily soluble in water. Glue and tragacanth also swell up in water and are difficult to identify in the viscous solutions of albumin.

The printing test, which is mostly applied by cloth printers to ascertain the fixing power, is carried out in the following manner: A definite weight of the albumin is taken, along with a quantity of the colour with which the albumin is to be printed (the fixing power not being the same for all colours). The albumin is dissolved and mixed with the colour, the mixture being printed on a piece of the fabric for which it is ultimately intended, and the printed sample being afterwards steamed in the usual manner and thoroughly washed. The more closely the appearance of the printed fabric, after this treatment, resembles that exhibited previous to steaming, the better the albumin.

Although this test reveals the fixing power of the albumin, it affords no guide to the existence of adulteration. Dialysis, however, enables contained saline impurities to be separated, and will also reveal the presence of added antiseptics or preservatives, such as salicylic acid, common salt, etc. It should, however, be noted that albumin is naturally rich in the chlorides of potassium and sodium.

The behaviour on the application of heat is characteristic for dissolved albumin, neutral solutions becoming cloudy at 60° C. and coagulating completely at 75° C., though a higher temperature is needed with very dilute solutious. Albumin is also coagulated by alcohol, ether, and concentrated hydrochloric acid. Coagulated albumin is insoluble in water, alcohol, ether, and dilute hydrochloric acid, but soluble in caustic potash and in concentrated hydrochloric acid, caustic alkalis converting it into alkali albuminate. A precipitate, soluble in water and acetic acid, is produced on treating solutions of albumin with sulphuric acid, nitric acid, hydrochloric acid, or pyrophosphoric acid. Precipitates are also produced by tannic acid, creosote, and by salts of mercury and several other metals. Since the commercial value of albumin is dependent on its solubility in water, its capacity of coagulating when heated to 75° C., and of precipitation by tanning agents, it is advisable to apply corresponding tests. Both egg and blood albumin are more or less completely converted into the insoluble form if the temperature in the drying-room exceeds 35° C., or if they are exposed to the sun during storage or are kept for any considerable length of time.

CASEIN.

This substance is chiefly contained in the milk of mammals, of which liquid it forms the principal nitrogenous substance. Allied to casein is legumin or vegetable casein, occurring in particular abundance in the seeds of leguminous plants.

The preparation of pure casein from milk is a somewhat roundabout process, for though it separates almost completely from the milk when the latter curdles—a condition that is easily induced—the resulting curd is by no means pure casein, but contains large quantities of butter fat, in addition to other milk constituents.

Casein is now prepared in large quantities on a manufacturing scale, and forms an important article of commerce. To prepare pure casein, milk is evaporated at a moderate temperature, the residue being treated with ether and benzol, in order to remove the fat. On dissolving the residue in water and treating the solution with alcohol, a voluminous precipitate is obtained which, when repeatedly washed, is casein free from fat, though containing alkali.

Pure casein is scarcely soluble at all in water, though it will dissolve in water containing carbonates or phosphates, alkalis or even alkali chlorides, and especially in weak lyes. These solutions, in which the casein is combined with an alkali, differ from solutions of albumin, inasmuch as they cannot be rendered cloudy or coagulated by heat. They acquire this property, however, on being treated with magnesium sulphate or when lime water is the solvent. On treatment with acids, casein solutions deposit a flocculent curd, which may consist of a compound between the casein and the acid used. A similar precipitate ensues on the addition of acetic acid, but is redissolved by an excess of the acid. A slight excess of hydrochloric acid in a dilute solution of casein will redissolve the precipitate first formed, but the precipitate comes down again when the excess of acid is increased.

Tannic acid and metallic salts also precipitate casein from solution. The natural solution of casein in milk behaves in the same manner as alkaline solutions of casein.

When casein is dried, it forms a horny, brittle, white mass, that is difficult to reduce to powder, but when in a finely divided state is a nearly white powder which gradually swells up in water, and dissolves in presence of an alkali. Casein is mainly used in calico printing, but more rarely as a dressing.

Caseo-Gum.

Caseo-gum is a solution of casein in lime water, and is used as an adhesive, though more particularly for impregnating cotton and linen goods, which then, on exposure to the air, absorb carbon dioxide, so that the fibre is animalised by the deposition of casein and can be more easily dyed.

The product is prepared by stirring 64 parts of freshly made casein (curd) with 96 parts of water at 64½° F. The mixture is passed through a metal sieve and stirred with lime water (prepared from 1·6 parts of freshly burned lime and 7 parts of water, triturated and filtered through paper). This treatment causes the mixture to thicken, but on continuing the stirring a certain amount of clarification ensues, and the desired consistence is obtained. The lime must be good, and freshly made, and neither too much nor too little water must be used in slaking. The curd must be finely distributed in the water, and the temperature must be exactly 64½° F.

Gluten.

Gluten is used as a glazing material for curtain finish, and as a thickening ingredient in dyeing and printing. It is prepared in the following manner:—

Casein, made as free from water as possible, by pressing, is triturated to a coarse, uniform powder in a roller mill, and mixed with a solution of an equal quantity of sodium tungstate, after which it is passed through the mill again, in order to crush the small particles of curd as completely as possible. The reaction begins as soon as the solution comes in contact with the perfectly dry casein, and the mass increases progressively in viscosity.

The cold mass from this treatment is placed in a water-bath, a little water being added if the mass be too dry, and is melted by stirring over a moderate fire until no undecomposed particles can be detected. A little carbolic acid and oil of clove should be added as a preservative. The uniformly melted mass is poured out, and forms when cold a more or less solid mass, according to the amount of water used.

Owing to its property of dissolving in any proportion of water, gluten possesses high adhesive powers. When once dry, it is fairly resistant to water.

It also dissolves readily in glycerine, and furnishes a fine, viscous mass, which gives a flexible coating, and becomes hard, like leather, when immersed in a solution of alum after drying.

Glue.

Glue is the name applied to the peculiar substances that are formed by allowing water, at boiling temperature, to act on certain animal tissues, viz. connective tissue, cartilage, and the allied organic substance in bone. Sinew, skin, and portions of the vascular tissue of skin, also yield glue, but contain other constituents that do not furnish this product. The characteristic feature of glue-yielding tissues—which must be classed as proteid derivatives—is that, on prolonged boiling with water, they dissolve to a more or less adhesive liquid which, on cooling, solidifies to a soft, quivering cohesive mass,—size or glue jelly,—and when completely dry furnishes a more or less coloured, solid, horny substance (glue or gelatine), that swells up in water and finally dissolves therein.

There are two different kinds of glue, viz. cartilage glue and bone glue, distinguishable by a series of characteristic reactions. Cartilage glue is prepared by boiling so-called permanent cartilage, rib cartilage, laryngean cartilage, joint cartilage, the cornea of the eye, hides spoiled in tanning, hide waste, etc.; whereas bone glue is obtained by the prolonged boiling of bones, or by freeing the glue-yielding tissue from the mineral constituents—lime and phosphoric acid—of bone, and then working up the residue into glue.

Hide glue or leather glue is chiefly made from the scraps of hide formed as waste products in tanning. Other substances also used for the same purpose are hides that cannot be tanned, hare and rabbit skins, hide wrappers, knackers' waste, etc. These materials are freed from adherent dirt, flesh, coagulated blood, and fat, and protected against putrefaction, since putrescent materials yield only very small quantities of inferior, dark-coloured, and malodorous glue. After lying in lime, the materials are treated in running water for some time, until all the lime has been swilled out. In large glue factories, special washing-machines are used.

The boiling process is very simple, the chief point in it being to use sufficient water and to boil long enough to extract all that is soluble in the material, so that the residue, which mainly consists of elastic tissues, hair, lime soaps, coagulated albumin, and blood, contains nothing further that is soluble. The materials are steeped in water until thoroughly impregnated, and are then boiled in a separate pan, with more water, until dissolved. The glue liquor is separated from the sediment by settling and skimming, or decanting, and is left to clarify. The boiling process should not be continued too long, or the glue will become less adhesive, thus losing its most valuable property, as well as its power of gelatinising on cooling. At the same time this overboiled glue is liable to burn against the sides of the pan.

When the glue liquor has clarified in the warm, it is run into long boxes to set, which done, it is placed on a bench, loosened from the sides of the box by a sharp knife, and discharged, by quickly tilting the box, on to a moistened wooden or stone plate. Here the block is cut into several horizontal layers, by a brass wire or special cutting-machine; and these again are divided into sheets of suitable size by vertical cuts. The sheets are lifted up by a wet knife, and laid singly on drying-frames, which are set up out of doors, in well-ventilated rooms, or under a shed-roof, so that air can circulate freely between and around the superimposed frames. This process is the crux of the whole manufacture, owing to the great influence of the temperature and humidity of the air on the drying and external appearance of the glue. On this account, attempts have been successfully made to remedy these defects by artificial drying in heated rooms or on heated metal-rollers or plates.

For the first few days the sheets of glue laid out to dry must be turned two or three times a day, to prevent them sticking to the netting and ensure uniform drying; but when superficially dry, one turning daily is enough. As soon as the sheets are semi-hard, they are subjected to a higher temperature in a heated room; and finally, after dipping them in water, which softens the outer surface and makes a gloss when dry again, they are ready for packing.

In making pale Cologne glue, the material, after being properly limed, is macerated in bleaching-powder solution for half an hour, the liquor being then slightly acidified by the addition of weak sulphuric acid, stirred in. After a further sojourn of half an hour in this liquor, the material is rinsed repeatedly, and finally boiled to glue. According to another method the material is steeped in river water until it begins to evolve an unpleasant smell, and is then washed, by kneading and beating under water, followed by digestion in dilute sulphurous acid (sp. gr. 1·035) in a closed vessel for twenty-four hours. After this digestion the acid is run off, the residue washed in water, and the acid treatment repeated, the material washed a number of times, pressed, and finally placed in a vat, in which it is treated at a temperature of 109° F. for twenty-four hours. The glue liquor is left to cool, in which process it sets to a colourless jelly, which is cut up and dried in the usual way.

In making bone glue, bones of all kinds are used, especially those from small and young animals—such bones being easily extracted by the boiling process—as well as horns, ivory turners' waste, etc. The bones must first of all be crushed in an ordinary iron mortar, or in an edge-runner mill, this treatment facilitating the extraction of the fat and also the dissolving of the glue constituents. The broken bones are placed in a large pan, where they are steamed for several hours. Bones that are very rich in glue, such as hoof-bones, horns, and the like, are not boiled, because this would entail loss of glue substance, whilst the amount of fat recovered would be small.

The boiled material is limed for eight to fourteen days, and is then washed with water and treated with dilute hydrochloric acid in tanks or pits. In this pickle it is left for eight to fourteen days, being stirred up at intervals, and the spent acid replaced by fresh. The acid transforms the calcium phosphate of the bones into soluble calcium chloride; and the formerly hard and rigid bones become cartilaginous, flexible, and translucent. After the acid treatment, the softened bones are placed in withy baskets or portable washing-drums, and washed clean in running water. They are then immersed for one day in lime liquor, and after being washed again, are either boiled direct to glue or dried for use later on.

The glue is in the form of plates, of various sizes and thickness, mostly elongated rectangles, on which the marks of the netting on which they are dried can be clearly seen. The plates are either quite flat, twisted, or partially rolled up, sharp at the edges, and often thicker there than in the middle. The colour varies from pale to dark yellow, light to dark brown or blackish-brown; the fracture vitreous, the glue brittle and easily broken, though on exposure to the air it readily absorbs moisture and becomes soft, flexible, and sticky. The smell is characteristic and agreeable, and should never be unpleasant, this indicating that bad leather has been used in the manufacture.

Good glue should swell up strongly in water, but should not yield up much soluble matter thereto, colour it deeply, or impart a disagreeable putrescent smell to the liquid. It should not deliquesce even after digestion in cold water from twenty-four to forty-eight hours; but, on the other hand, should begin to dissolve at 118° F., and be completely soluble at 122° F. Bone glue is often cloudy, and opalescent or milky, owing to the calcium phosphate dissolved in the glue jelly; but this does not impair the quality. White, powdered substances are also added to the glue to colour it and mask the natural shade, this being the case with the so-called Russian or white glue, which is prepared by stirring white lead, zinc white, and similar pigments into the fluid glue mass. It is evident that these additions also increase the weight in many cases.

Glue is composed of two substances—gluten and chondrin—the former originating in hide and bones, the latter in cartilage.

Glue jelly in general (before being dried), whether composed of gluten or chondrin, differs in its properties from dissolved glue, having low adhesive power and being more liable to go bad; in fact it commences to putrefy in twenty-four hours at 68° to 73° F., giving off a smell of ammonia and undergoing decomposition, whereas solutions of glue can be kept for a much longer time.

The behaviour of glue solution toward various salts is highly important. If potassium or sodium carbonate, neutral potassium tartrate, magnesium sulphate, etc., be added to a lukewarm, 15 to 20 per cent. solution of glue, the latter curdles. Lukewarm glue solution, saturated with common salt, sal ammoniac, saltpetre, or barium chloride, loses its property of gelatinising. When large proportions of alum are added to glue solutions, the glue is thrown down as a translucent, colourless mass. The addition of dilute acids to glue solution prevents gelatinisation, though that power is restored by adding common salt. Boiling with slaked lime destroys the setting properties of glue, and converts it, on dilution with water, into a colourless, gummy mass, soluble in cold water and in a saturated solution of common salt; the property of setting is also destroyed by protracted heating (for six days at 176° F.). Tannic acid forms, both with glue jelly and glue solutions, peculiar compounds that are still formed when the proportion of jelly or glue in the solutions is as low as 0·005 per cent.; hence this reagent forms an excellent means for detecting glue. When the solution is fairly concentrated, tannic acid produces a strong, flocculent, dirty-yellow precipitate, of caseous character, which turns brown in the air, and dries to a hard, brittle, pulverable mass, that is insoluble in ether, alcohol, and water, but soluble in caustic potash. Under the influence of sunlight, potassium bichromate forms with glue an insoluble compound that finds extensive application.

Dry heat causes glue to melt and give off a disagreeable, strong smell of burnt horn, the mass intumescing and leaving a charred residue which acts as a powerful decolorising agent, like bone black. Under dry distillation, glue furnishes an aqueous solution of ammonium carbonate, and a thick brown oil, consisting of a mixture of ammonium carbonate, sulphur, ammonium cyanide, etc.

It is highly important that glue should be tested before use, the tests being mainly directed to the percentage of gluten, the binding power, and moisture content.

The gluten content can be determined by precipitating the gluten with tannic acid solution, the precipitate being filtered, dried, and weighed, and the gluten calculated from the weight of glue tannate, under the assumption that 100 parts of this substance contain 42·74 parts of gluten, and 57·26 parts of tannin. According to results already obtained, the gluten content of different glues varies between 68 and 81 per cent.

The method proposed by Schattenmann is based on the supposition that the amount of moisture absorbed by a sample of glue bears a definite relation to the quality, and that good glue should increase at least twelvefold in weight on being immersed in cold water for twenty-four hours, and then dried between fine blotting-paper.

A method mentioned by Lipowitz makes use of the carrying power of the jelly obtained on dissolving 5 parts of glue in 45 of water. This power is measured by the weight required to force a cup-shaped piece of sheet-metal, about $\frac{5}{8}$th of an inch in diameter, into the jelly. The weights are applied by means of a funnel attached to the cup.

Gelatine.

Gelatine is pure bone glue, and is chemically identical with other kinds of bone glue, though prepared in a different manner.

For making gelatine, the most suitable kinds of bone, ivory and button turners' waste, horn, sheep bones, calves' feet, etc., and the large bones of horses and cattle, are broken up, care being taken to avoid any heating in the crushing process, as this leads to the development of an empyreumatic smell that is retained by the gelatine.

The bones, after bleaching in the sun, are macerated with hydrochloric acid until the greater portion of the phosphate is dissolved. The residual jelly is washed, digested with milk of lime, and dried after repeated washings, the crude gelatine being afterwards bleached over again. The usual addition of alum when boiling the fully bleached jelly, and the action of sulphurous acid on the glue liquor, are of special value in the production of very pale gelatine.

The gelatine mass is treated in the same way as glue, being poured hot into boxes, cut up when cold, and dried on netting, either in the open air or in special drying-rooms. It is considered, however, that drying in the air is the only way to obtain a perfect product.

Starch Syrup, Potato Syrup.

If starch be boiled along with dilute acids, it is transformed into a kind of sugar, and not merely into dextrin. The acid acts to some extent catalytically, without being itself decomposed, the same amount of free acid being found in the liquid after the process as before. The operations in this process are: (1) introducing the starch into the hot, very dilute sulphuric acid, and boiling the mixture until the starch has been converted into sugar; (2) precipitation of the sulphuric acid from the resulting sugar solution; (3) concentrating the sugar solution to a certain strength; (4) clarifying and decolorising the sugar solution.

Starch syrup or potato syrup is a syrupy, sweet liquid, varying in colour from dark yellow to water-white, according to the degree of purity.

Colophony (Rosin).

In all districts where turpentine is won, colophony is prepared by distilling the turpentine with or without water, oil of turpentine being liberated, and colophony left behind in the still.

The principal kinds of colophony are French and American (prepared by the aid of the most up-to-date appliances), Austrian, Spanish, Portuguese, and Grecian.

Colophony has a vitreous lustre, practically no taste or smell, and is pale wine-yellow to dark brown in colour. It softens and becomes sticky under the warmth of the hand, and melts at 275° F.; is soluble in alcohol, ether, and ethereal oils, and also partially in mineral oil; it can be melted along with fatty oils and wax, and forms rosin soaps with caustic alkalis. Cold alcohol extracts pinic acid from colophony, and sylvic acid crystallises out of the residue left on treatment with hot alcohol. Boiled with nitric acid, colophony furnishes amorphous azomaric acid and terebinic acid, insoluble in water, but soluble in ether. Under dry distillation it furnishes volatile rosin spirit, light and heavy rosin oils, and a pitchy residue.

CHAPTER IV

MATERIALS FOR SOFT DRESSINGS

GLYCERINE.

IN Nature, glycerine occurs, in combination with fatty acids, in the solid and liquid fats and oils. It can be liberated from these combinations in various ways: either by the oils becoming rancid, or by decomposing the fats with alkalis; and also by splitting up the fats by means of steam or other agencies. In the saponification of fats of all kinds, glycerine is generally recovered in the state of a more or less highly coloured, oleaginous liquid, crude glycerine, which has to be put through a process of purification.

Chemically, pure glycerine is a colourless, inodorous liquid, with an agreeable, sweet taste. It has a sp. gr. of 1·30 at 15° C., and the faculty of crystallising at low temperatures (about 18° to 20° C.), crystallisation proceeding rapidly, even at 5° C., if a crystal of glycerine be introduced into the liquid. The boiling-point is 190° C., but appreciable evaporation occurs at 100° C. It ignites at 150° C., burning with a faintly luminous flame, and can be readily distilled, by superheated steam, at 180° to 200° C. Glycerine is soluble in all proportions in water and alcohol; and in a pure state is even hygroscopic, so that it has to be diluted for medicinal purposes. It is insoluble in ether, chloroform, benzol, or arsenious acid, though it dissolves a number of metallic oxides, iodine, bromine, alkaline salts, and lime.

WAX.

The only waxes used in dressings are bleached beeswax, Japan wax, and occasionally, carnauba wax. Native beeswax spoils the whiteness of fabrics. Beeswax is brittle at low temperatures, but softens to a plastic mass under the warmth of the hand. It has an aromatic flavour, and does not stick to the teeth when chewed. It is insoluble in water or cold spirit, but is completely soluble in hot alcohol, though the greater part separates out again on cooling, leaving only small quantities in solution. Carbon disulphide, ether, benzine, and oil of turpentine, dissolve beeswax completely, as do also most of the ethereal oils; and it can be melted in all proportions along with the majority of fats and oils. The sp. gr. of pure beeswax is 0·965 to 0·972; the melting-point is 62° to 64° C., and the solidification-point 58° C. On exposure to higher temperatures it decomposes and volatilises, without, however, giving off any odour of acrolein.

Wax differs from the fats chiefly in the absence of glycerine compounds; and it can be saponified by alkalis without separation of glycerine. Beeswax is a mixture of cerotic acid (cerin)—which is soluble in alcohol—and melissin or myricin, which is only slightly soluble in alcohol. Myricin will not saponify with ordinary lye, though cerotic acid will do so; and by the employment of great care it is possible to obtain the first-named in a state of fine distribution in the resulting wax soap.

Bleached beeswax comes on the market in the form of thin round cakes. It has a faintly rancid smell, but no taste.

Vegetable waxes, such as Japan wax, myrtle wax, palm wax, carnauba wax, milk-tree wax, and also ceresine (mineral wax), are used, partly as substitutes for, and partly for adulterating beeswax.

The tests for the purity of wax are directed: (1) to the determination of the melting-point; (2) to adulterations with tallow, rosin, stearine, paraffin wax, and vegetable wax, and solid loading ingredients, such as heavy spar, chalk, etc.

The melting-point is determined by placing a sample of the wax in a small basin, and immersing this in a water-bath provided with a thermometer.

The melting-point of pure beeswax is 69° C.; whereas Japan wax melts at 40° to 45° C., myrtle wax at 43° C., palm wax at 100° C., carnauba wax at 85°·5 C., milk-tree wax at 60° C., refined ceresine at 85° C., beef tallow at 37° C., mutton tallow between 47° and 50° C.

Water is added to wax by mixing the melted wax with hot water, and stirring until cold. By this means the water is finely disseminated in the wax, and can be detected at once by the dull coarse fracture. On melting, it settles down to the bottom of the vessel, and can be easily determined by weighing the wax before and after that operation. Additions of heavy spar, chalk, etc., also settle down, but these can also be determined by dissolving the wax in chloroform or oil of turpentine.

Added tallow is readily detected by making the wax into a candle and lighting it, the smell of tallow being perceptible on blowing out the flame. With the same object, the wax may be heated with 15 times its weight of spirit until all the wax is mixed. After cooling, and pouring off the spirit, the solidified wax is heated to boiling with more spirit in a porcelain dish, and a few lumps of ammonium carbonate are stirred into the hot liquid, which is then cooled, filtered, and the filtrate treated with hydrochloric acid, added by drops until the reaction is strongly acid. If the wax contained fats or fatty acids, crystals of fatty acid will crystallise out of the liquid.

The test for rosin is performed by dissolving about 3 grms. of the wax in 10 to 12 times their weight of chloroform, adding 200 grms. of lime water to the solution, and agitating the mixture. Whilst pure wax gives an emulsion, the milk of lime causes, in presence of rosin, the separation of a turbid, yellow-brown liquid, and greyish-brown flakes of rosin will be observed floating on the surface.

Adulteration by stearine is detected by dissolving 7 grms. of wax in a ninefold quantity of chloroform, adding 340 grms. of distilled lime water to the solution, and agitating the whole vigorously, until a uniform mass is produced. If stearine be present, a loose, granular precipitate of lime soap will deposit on standing.

To test for paraffin wax, a piece of wax the size of a nut is placed in a porcelain dish with 8 times its own weight of fuming sulphuric acid, and warmed until it melts. The wax dissolves in the acid, with considerable effervescence, to a dark-brown liquid, which forms a clear mixture when poured into water. If paraffin wax be present, this separates out on the surface of the acid, in the form of oily drops, which solidify on cooling.

For testing beeswax for adulterations with vegetable waxes, especially Japan wax, various methods are used.

The wax is melted in a test-tube, and treated with 3 volumes of nitric acid, a plate of copper being introduced. Japan wax turns yellowish-brown after a short time; beeswax, on the other hand, a dirty white.

Boiled with concentrated caustic potash, Japan wax gives a cloudy, homogeneous liquid, whereas pure beeswax will not mix with caustic alkali, but collects on the surface in cooling, and leaves the liquid almost perfectly clear. A mixture of the two waxes behaves like the separate specimens. Japan wax is soluble in borax solution, an opalescent liquid being formed, whilst beeswax is insoluble.

If the wax under examination be boiled with a solution of 1½ parts of borax in 20 parts of water, and heated to boiling, a solid disc of pure wax separates out on cooling. In presence of Japan wax, on the other hand, the liquid is milky, and, if the proportion of vegetable wax be large, the liquid thickens and sets to a jelly.

Paraffin Wax.

This substance, obtained by the distillation of brown coal, bituminous shales, petroleum residuum, bitumen and ozokerite, is a mixture of solid hydrocarbons with relatively high carbon content.

In a pure state, paraffin wax is a white, translucent, foliaceous, crystalline, hard and resonant, but not very brittle mass, which feels soft and slippery, has no taste or smell, and a density of 0·870. The melting-point is between 33° and 65° C., the mean being 50° to 52° C. It melts to a colourless liquid, is completely insoluble in water, partially soluble in alcohol, readily soluble in ether, carbon disulphide, benzine, petroleum, oil of turpentine, etc. It is insoluble in alkalis, and is not attacked by them, even at boiling heat.

In dressings, paraffin wax is never met with in a saponified condition, but only in an extremely fine state of division. Nevertheless, it is capable of imparting a more or less high glaze to the fabrics, under suitable treatment (calendering).

Stearine.

This substance (more properly stearic acid) is a constituent of most fats, viz. the solid varieties being present as stearine, associated with palmitine and olein. For recovering stearic acid, the fat is mixed with 6 per cent. of sulphuric acid, at 120° C., and treated with boiling water, whereupon complete decomposition ensues. The stearic acid forms colourless, inodorous scales, with a silvery lustre, readily soluble in alcohol and ether, but not in water; has no appreciable reaction, and increases considerably in volume in melting. The alkali salts of this acid are soluble in water, but are decomposed by a large excess of that liquid. As regards its use in dressings, the remarks made about paraffin wax also apply here.

Fats and Fatty Oils.

The name, fat, is applied to certain animal and vegetable products, which feel greasy to the touch, form oily liquids when warmed (or also at the ordinary temperature), and leave on paper a transparent spot which does not disappear after long standing or when heated. The fats are lighter than water, and are quite insoluble therein, though soluble in ether, carbon disulphide, or etheral oils. They are classified, according to their consistence, into solid fats or tallows, semi-solid fats of the butter or lard type, and liquid fats or oils. The solid fats are easily melted, becoming fluid even below 100° C. At low temperatures the oils become solid.

All fats and fatty oils can be saponified with caustic alkalis, and are transformed by this process into a condition that renders them more suitable for cloth-dressing purposes. In this state they are chiefly used as softening agents.

The following fats and oils are used:—

Tallow, bone fat, wool fat, cocoanut-oil, palm-oil, castor-oil, olive-oil, and a few others; the tallows (beef and mutton tallow), cocoanut-oil, and olive-oil being the most popular and largely employed. The chief point to be borne in mind in using these fats is that they should be clean, unadulterated, and, most of all, fresh. The fats and oils are rarely used singly, being for the most part employed in combination with others. This is particularly the case with tallow, which is never used alone or in more than small quantities, its hardness requiring to be ameliorated by the use of softening fats.

Soaps.

Soaps are more or less impure fatty-acid salts of potash or soda, soluble in boiling water or in alcohol, imperfectly soluble in cold water, insoluble in ether, benzol, and petroleum spirit. The soda soaps are solid, the potash soaps soft and greasy. The larger the proportion of stearic acid and palmitic acid, the harder the soap, whilst the softness increases with the amount of oleic acid present. The potash soaps decompose many of the sodium salts, such as sodium chloride, Glauber salt, etc., with formation of the corresponding potassium salt (potassium chloride, potassium sulphate, etc.), and soda soap. The hard soaps comprise the curd soaps and semi-curd or paste soaps. When fats or oils are boiled with lye, there forms on saponification a clear liquid, soap paste, from which the curd soap is deposited by salting out with sodium chloride. The curd soaps contain all the glycerine of the fat used, and all the impurities in the fat and lye. They can be produced by the aid of cocoanut-oil and palm-oil, these being the only two fats that are able—thanks to their high percentage of laurostearin—to form amorphous soaps, that are solid even when containing a fair amount of water.

Cocoanut-oil and palm-oil can also be made into soap by simply crutching the melted fat with warm lye, strong lyes—36° to 40° B.—being required for this purpose. These soaps made by the cold process always contain free alkali, and are therefore very sharp. The semi-curd soaps (Eschweg soap) also can only be made with the help of cocoanut-oil and palm-oil. One hundred parts of fat will yield 150 parts of curd soap, whereas the yield in the case of Eschweg soap is 200 per cent. The limit of yield is difficult to fix in the case of the paste soaps, being in the ordinary kinds 300 to 400 per cent., whilst loaded paste soaps with a yield up to 1400 per cent. are met with in commerce.

In testing soaps, the chief points to investigate are the water content, the percentage of fat, and then the extraneous adjuncts used for loading.

In order to determine the percentage of moisture, Lowe recommends shredding 8 to 10 grms. of the soap exceedingly fine, drying it at 60° to 70° C. and gradually raising the temperature to 100° to 105° C. If the soap contain caustic potash, the operation must be conducted in an atmosphere free from carbonic acid. To determine the free alkali previous to drying, a small weighed quantity of finely shredded soap is placed in a watch-glass, which is then enclosed in a cylinder charged with dry carbonic acid gas, the proportion of caustic potash being determined by the increase in weight. The carbonic acid should not be allowed to act too long, or sodium bicarbonate will be formed. The difference in the weight of the soap before and after drying will give the percentage of moisture.

The following method may also be adopted:—

A saturated solution of common salt is prepared, the clear liquid being filtered from the excess of salt. The piece of soap to be tested is then carefully weighed, and boiled with 2 to 3 times its weight of the brine until the soap balls to a compact mass, which is thereupon taken out, rinsed with water, well dried, and finally weighed. The difference in the weights will give the percentage of water in the sample.

According to Krätzer, the percentage of fat in soap is determined by suffusing 5 grms. of the finely shredded soap with distilled water in a beaker, the solution being moderately warmed on a sand-bath and then treated with 25 to 30 grms. of hydrochloric acid. The whole is left in a warm place until the fat collects as an oily layer on the surface. Five grms. of melted white wax are added, and the whole is left to get quite cold, the mass of fat being pressed, dried, and weighed. The increase in weight gives, approximately, the amount of fat present in the soap; but, as a slight loss of glycerine is sustained in making the soap, the increase in weight must be augmented by one-nineteenth, in order to obtain the exact weight of fat.

Special test-glasses are also used for determining the fat content.

The percentage of free, unsaponified fat is determined by introducing a weighed quantity of dried soap into a high beaker, provided with a close-fitting cover, and extracted with benzol, assisted by warming. When completely clarified, the filtrate is decanted into a tared flask. After 2 to 3 extractions, the total filtrate is distilled, the residue is dried at 108° C., and the flask weighed, the increase in weight giving the proportion of unsaponified fat.

Admixtures, such as kieselguhr, diatomaceous earth, starch, alumina, etc., are left behind as a sediment after the soap has been dissolved, and can be accurately examined under the microscope.

Softenings.

This name is applied to a number of preparations of highly divergent composition, some being true soaps, and others merely mixtures of saponifiable fats with emulsifying salts, and also with borax, salt, sodium phosphate, etc. They are made by either boiling the finished soap with the requisite quantity of water and then adding the other ingredients, or by saponifying the fats with soda lye.

A good softening can be prepared from cocoanut-oil, 22 lb. of which are crutched with a soda lye containing 4½ lb. of caustic soda (77° B.) in 10 gallons of water. The mixture is boiled until combination has occurred, and a homogeneous mass is obtained. Two lb. of borax are next crutched in, and the whole is left to cool, occasional crutching during the cooling being advantageous. This preparation contains unsaponified fat, the presence of which is an advantage for certain purposes.

Another softening is made from 14 lb. of tallow and the same weight of cocoanut-oil, saponified with a solution of 4½ lb. of caustic soda in 10 gallons of water as above. Another good preparation is made with 14 lb. of tallow, 14 lb. of bleached palm-oil, and 7 lb. of caustic soda, dissolved in 10 gallons of water, 2 lb. of salt being added after boiling. This last recipe furnishes a completely saponified product, containing a slight excess of free alkali.

If finished soaps be used, they must be properly made curd soaps, cut into fine shreds, and boiled up with water. The following proportions are recommended as suitable: soap 28 lb., water 7 gallons, sodium phosphate or chloride 2 lb. (added after the soap and water have been boiled together). An agreeably smelling product is obtained from palm-oil soap. Thin softenings can be prepared by increasing the proportion of water; and consistent products by taking less water. Starch is occasionally added. Such a product is obtained, for instance, by distributing 5 lb. of starch in 10 gallons of water, then adding 25 lb. of shredded curd soap, and boiling the whole until a homogeneous mass is formed, the mixture being crutched throughout the process. A fine, but more expensive, softening is prepared by substituting caustic potash for caustic soda, the proportions being: cocoanut-oil 28 lb., tallow 28 lb., caustic potash (96 per cent.) 12 lb., and water 16 gallons. These potash softenings are always more fluid than those made with caustic soda, and are therefore suitable for many purposes without dilution. Mixtures of caustic potash and soda are also used, *e.g.* cocoanut-oil 28 lb., caustic potash (96 per cent.) 5 lb., caustic soda (77°) 5 lb., water 1 quart.

Another series of liquid softenings is used in conjunction with sulphate of magnesia, the ordinary soap softenings being unsuitable since they form insoluble magnesia soaps. As a rule, these liquid softenings are mixtures of magnesium chloride, starch-sugar syrup, and, occasionally, glycerine and zinc chloride. A typical recipe is magnesium chloride solution (32° to 34° B.) 10 parts, zinc chloride solution (48° B.) 2 parts, capillary syrup 5 parts, glycerine 2 parts, water ½ part.

CHAPTER V

DRESSINGS FOR FILLING AND LOADING

ALUM.

THIS substance crystallises in colourless octahedra, but is met with in commerce as irregular crystalline masses, which are transparent at first, but gradually become coated over by absorbing ammonia from the air. It is soluble in 10 parts of water at 14° to 16° C., but dissolves more readily in hot water, though insoluble in alcohol. The aqueous solution has an acid reaction, and a sweet, astringent taste.

Commercial alums are in many instances contaminated with iron; and as freedom from that metal is essential, it must be tested for by adding potassium ferrocyanide to the aqueous solution, a light blue coloration, or precipitate, indicating the presence of iron.

In dressings, alum should be regarded as a beautifying and clarifying agent, rather than as an actual dressing or loading material.

BARIUM CHLORIDE.

This salt is composed of barium and chlorine, together with water of crystallisation, and is prepared by decomposing witherite or barium sulphide with hydrochloric acid. It forms white, prismatic crystals, that remain unaltered in the air, and have a burning, bitter, repellent taste, acting as an emetic. It is poisonous, like all compounds of barium; parts with its water of crystallisation (with decrepitation) when heated, and melts at a high temperature. When calcined in a current of steam, it decomposes into hydrochloric acid and baryta. It dissolves in 2½ parts of cold, or 1½ of boiling water, to form a neutral solution. It is far less readily soluble in water containing hydrochloric or nitric acid.

Barium chloride may be contaminated with the chlorides of copper, lead, arsenic, iron, manganese, aluminium, zinc, strontium, calcium, magnesium, potassium, and sodium.

As a dressing it is of low value, though it greatly increases the weight of the fabrics on which it is used; and it is inferior in antiseptic and hygroscopic properties to other salts, such as magnesium chloride, zinc chloride, etc.

BARIUM SULPHATE.

Barium sulphate is met with native as heavy spar, and is also manufactured in the form of *blanc fixe* or permanent white, by artificial precipitation.

Native heavy spar occurs in many parts of Germany, and all over Europe in large quantities, as snow-white or coloured crystals (according to the degree of purity), and crystalline masses. The spar is sorted in accordance with its purity of colour, and is then crushed, ground, levigated, and dried, the fineness and whiteness of the powder being a criterion of quality. Heavy spar is distinguished by its neutral reaction, and insolubility in acids and alkalis.

Permanent white or *blanc fixe* is prepared by precipitating barium chloride with sulphuric acid, and is sold in the condition of paste, not as a dry colour. This precipitated sulphate is of dazzling whiteness and excellent covering power.

The use of barium sulphate in dressings is based on its pure-white colour, great weight, and absolute neutrality, so that the fabric is not affected in any way.

BARIUM CARBONATE.

This substance is met with in nature as witherite, in the form of nodules, pale grey, yellowish, or greenish in colour (rarely pure white), and with an earthy, or transparent, greasy fracture. The pure carbonate is prepared by precipitating a solution of a barium salt (usually the chloride) with sodium carbonate, and forms a white powder, insoluble in less than 15,000 parts of water, though it dissolves more readily, to form barium bicarbonate, in water containing carbonic acid, especially under pressure. It fuses at white heat, with liberation of carbon dioxide, and more readily in presence of carbon; and when strongly heated in water, it yields barium hydrate. Its application in dressings is on a par with barium sulphate.

BLEACHING-POWDER.

Bleaching-powder ("chloride of lime") is manufactured on a large scale in chemical works by saturating quicklime with chlorine gas, so far as is possible in the circumstances. In this process the whole of the chlorine, with the exception of a small quantity of by-products, is absorbed, and forms a compound from which it can afterwards be liberated by the action of stronger acids.

Good bleaching-powder forms a fairly loose powder, containing only a few lumps, and turns soft and greasy on exposure to the air. In the fresh state it smells of chlorine, but later on gives off a peculiar odour, attributed to the hypochlorous acid liberated by atmospheric carbon dioxide. When stirred up with a little water, it forms a thick, viscid pap; and by using more water, nearly the whole of the bleaching compound can be extracted, leaving the excess of lime as sludge. It is upon this feature that its application as a loading material is based.

Lead Sulphate.

Lead sulphate is precipitated from lead solutions by sulphuric acid, and is obtained in large quantities as a by-product in dyeing and calico printing, during the preparation of aluminium acetate from lead acetate and alum. It forms a white, crystalline powder, of sp. gr. 6·2, almost insoluble in water; quite insoluble in water containing sulphuric acid, and in dilute alcohol; slightly soluble in water containing nitric acid and in concentrated sulphuric acid, and readily soluble in solutions of ammonium tartrate or acetate, sodium hyposulphite, caustic potash, or caustic soda.

Gypsum.

Gypsum is hydrated calcium sulphate, a mineral of foliaceous, granular, fibrous, dense, and earthy structure, which readily parts with its water of crystallisation when heated, and sets rapidly, with moderate increase in volume, when stirred up to a paste with water. Commercial gypsum is a more or less pure-white powder, the finest quality being alabaster gypsum. When mixed with a large quantity of water, gypsum loses its property of setting, and it is only by reason of this peculiarity that its application in dressings—in which it acts as a covering and filling agent—is possible.

Calcium Chloride.

This salt is obtained by treating limestone with crude hydrochloric acid, and also as a by-product in the manufacture of sal ammoniac, ammonia, carbonic acid, the decomposition of manganous chloride liquors by means of quicklime, in the preparation of chlorine. It is also recovered from the mother liquors of salt works, and from Stassfurt "waste" salts (potash and magnesium salts that were formerly discarded). A solution of pure calcium chloride can be obtained by treating an excess of marble with pure hydrochloric acid, and digesting the filtrate with milk of bleaching-powder.

A distinction is drawn between crystallised, fused, and chemically pure calcium chloride. The crystallised variety is a dry, white powder of crystalline appearance, and bitter, salt taste; it is soluble in alcohol, and particularly so in water; and lowers the temperature considerably on passing into solution. When heated, it melts in its own water of crystallisation, and at 200° C. becomes the fused salt.

Calcium chloride has been proposed for keeping fabrics damp, and dispensing with the damping-machine. For this purpose it was preferably added to the dressing preparation, the material being calendered after starching and drying. A fair amount of success was attained, but the fabrics were spoiled by mould on storage; and on repeating the experiments with smaller quantities of calcium chloride, the fabrics were not sufficiently damp, the dressing remaining hard and stiff, so that the process was not found suitable to replace machine damping. Still more unfavourable results were obtained on using calcium chloride by itself as a loading agent, so that its employment has been generally abandoned. If calcium chloride be used along with magnesium chloride in dressings, care must be taken to see that no carbonate of soda or magnesium sulphate is present.

Magnesium Chloride.

Anhydrous magnesium chloride is obtained from the final liquors in the treatment of Stassfurt carnallite. The fused commercial product is not anhydrous, but contains 45 per cent. of water that cannot be completely expelled by further heating, this treatment inducing decomposition.

Magnesium chloride is readily soluble in alcohol, and very soluble in water. In the crystalline state it is translucent, and readily melts in its own water of crystallisation. The density of magnesium chloride solutions increases rapidly, being 1·0859 for a 10 per cent. solution at 15° C., 1·178 for a 20 per cent. solution, 1·279 for a 30 per cent. solution, and 1·334 for a 25 per cent. solution. The 30 per cent. solution boils at 115°·6 C.

Magnesium chloride was first recommended, as an adjunct to sizes, by Townsend, and it not only prevents the tendency to become mouldy, but also considerably improves the air of the workroom, by absorbing the ammonia given off in the exhalations from the operatives.

The following points are mentioned by Romen in connection with the use of magnesium chloride:—

1. Despite its antiseptic action, magnesium chloride alone cannot prevent the formation of mould and fungi in the case of fabrics treated with heavy dressings, especially such as contain much fat, flour, and starch, and particularly when the treated stuffs are (*a*) kept in a damp place; (*b*) are taken from warm rooms into extreme cold; (*c*) exposed to rapid changes of temperature;

(*d*) contain a high proportion of moisture, as the result of over damping or defective calendering during manufacture; or, (*e*) have been pressed, calendered, or dried, at too high a temperature.

2. Fabrics dressed with magnesium chloride, alone or in conjunction with pure (non-acid) starch, will never become mouldy.

3. Fabrics dressed with magnesium chloride and zinc chloride will never fall a prey to fungoid growths, whatever the amount of flour, tallow, etc., in the dressing.

4. When used in the right proportions, magnesium chloride is an excellent dressing ingredient. It can replace fats and oils to a certain extent; imparts the already known properties of the fabrics dressed therewith, ameliorates the action of calendering and mangling; the crushed threads stand up again; and it helps these to close the meshes by maintaining uniform moisture in the fabric. For the same reason it facilitates the production of a watered effect, and is largely used on this account in England, especially for mangled goods, which give watered and moiré effects in the hydraulic mangle.

5. Fabrics treated with magnesium chloride and zinc chloride will not lose their dressing in the form of dust.

6. On the other hand, such loss is not precluded when the fabrics are beaten or thrown about, if clay, chalk, etc., has been added to the dressing, and the goods are (*a*) too dry; (*b*) kept too long on the mangle; (*c*) have been beamed and beaten too many times; or, (*d*) have not been firmly beamed—all of which points should be borne in mind in the treatment of white goods.

Moreover, they do not bind these loading ingredients as is so often erroneously assumed; and even properly loaded fabrics may exhibit the defect so common to white goods, that the dressing can be pushed out from between the threads by the pressure of the finger, or drawn out by scratching with the finger-nail. If, however, the correct proportion of moisture be imparted to the goods loaded in this way, whether by damping or hanging, and the fabric be passed through the mangle properly, there will be no tendency of the dressing to dust off.

7. Piece goods that have been overloaded, even those starched by pressing, are found on examination by transmitted light, to exhibit sinuous markings, especially in cases where the dressing was starched in the cold.

The chief peculiarity rendering magnesium chloride suitable for dressings is its property of absorbing and retaining moisture, so that stuffs dressed with a large quantity of starch always feel soft, in spite of a certain firmness. Some English shirtings contain only 40 per cent. of cotton, and 60 per cent. of dressing, and therefore would break like a board, were it not that the dressing is made supple by the presence of a hygroscopic ingredient. Magnesium chloride finds somewhat extensive employment, though it is often used for no particular reason, and solely with the idea of increasing the weight of the material by attracting moisture, both in the case of woollens and other fabrics. The hygroscopic power of magnesium chloride is utilised hygienically in fine weaving. It was formerly the practice, in order to reduce the tendency of the yarn to break, to place the looms in cellars, or else to humidify the air of the weaving-shed by constant spraying; but now, by steeping the yarn in magnesium chloride, it can be made to remain supple, from absorbed moisture, even in comparatively dry rooms.

Sodium Sulphate, Glauber Salt.

In nature, sodium sulphate is found, anhydrous, as Thenardite (rhombic crystals), and as nodules in Peruvian guano; whilst it occurs in the hydrated condition as mirabilite, and as an efflorescence on rocks, etc. As a double salt it forms glaucerite, reussin, etc., and also the saline lacustrine deposits consisting of a mixture of sodium sulphate, carbonate, and chloride. In solution, it is a constituent of numerous mineral waters, and is recovered on a large scale as a by-product in the manufacture of hydrochloric acid.

Glauber salt is not much used by itself in dressings, being mixed with magnesium sulphate, or with this latter and magnesium chloride. It gives dressings of medium softness. The pure salt alone must be used for certain dyed and printed goods, on account of its inert character, whereas impure sulphate attacks delicate colours during storage.

Magnesium Sulphate, Epsom Salt.

This salt occurs as kieserite and reichardite in the Stassfurt beds; as an efflorescence in mines and collieries, and as a constituent of a large number of mineral waters. It crystallises, from aqueous solutions, in different forms and with different percentages of water, according to the concentration and temperature of the solution.

Magnesium sulphate imparts a certain hardness and firmness to textiles, and must therefore be used only for such stuffs as are required to exhibit this peculiarity. It is largely used for dressing Oxford shirtings, but is unsuitable for soft finish unless accompanied by some fatty oil or softening salts.

The object of using magnesium sulphate is to impart firmness, and to imitate the quality and weight of goods that actually contain more substance. The fabric is passed through concentrated solutions of magnesium sulphate, and then slowly dried. The acicular, soft, and silky crystals of the salt become firmly embedded in the fibre and improve its lustre; but the first washing will convert the apparently close fabric into a loose, insignificant rag.

Specimens of stuffs dressed with magnesium sulphate only, lost 53 per cent. of their weight on being merely swilled in distilled water, and contained only 40 per cent. of actual cotton. When the fabric still contains chlorine, from the bleaching process, it becomes brittle on drying, especially if dried on drums, owing to the formation of free hydrochloric acid.

MAGNESIUM CARBONATE.

Crystalline magnesium carbonate occurs in nature as magnesite or bitter spar. From this material, magnesium carbonate can be prepared by dissolving in acid, followed by precipitation; and also by dissolving the finely powdered material in water charged with carbonic acid, the bicarbonate thus formed being afterward decomposed again by heat. The carbon dioxide, liberated, serves for dissolving a fresh quantity of the mineral. Mother liquors from the treatment of sea-water, or from mineral waters, are also used. Magnesium carbonate comes on the market as loose blocks weighing about $\frac{1}{4}$ lb., and furnishes, when crushed, a soft, very light, and white powder, which appears under the microscope to consist of tiny interwoven prismatic crystals.

Magnesium carbonate, being an extremely light, porous substance, is not adapted for loading and filling the fabrics on which it is used, or for contracting the pores of the fabric and thus throwing the woven pattern into prominence. It is very difficult to work, and is destroyed by vegetable blue and greatly weakened by mineral blues. Moreover, it is very liable to come away from the fabric as dust, and, finally, is too dear to find employment.

MAGNESIA WHITE.

This preparation is obtained by treating magnesium sulphate solution with quicklime or caustic baryta. It is pure white in colour, and consists of a mixture of calcium—or barium—sulphate, and magnesium hydrate. It is also used as a filler.

MAGNESIUM SILICATE.

This compound, which is often found native, and is also formed as blast-furnace slag in the smelting of iron, has been recommended as a filler for dressings, without possessing any prominent advantages therefor.

CHINA CLAY (ALUMINIUM SILICATE),

also known as Chinese white, is a porcelain earth (kaolin) distinguished by its dazzling whiteness and plasticity. It is obtained at St. Austell (Cornwall), and many other places. It has a high covering power, imparts a mild and greasy feel to the dressings, and on this account is often used, more particularly since, being inert, it has no injurious action on the fabric.

Zinc Chloride.

Zinc chloride has only recently come into use as a dressing. After being first employed in dressing silks, it was applied to the loading of other fabrics, mostly in association with magnesium chloride. The quantity of zinc chloride in the mixture, however, must not be anything like so much as the magnesium chloride, but rather only about 10 to 15 parts to each 100 parts of the latter. It is a highly hygroscopic substance, is very soluble in water, and, in the case of heavy dressings, must be solely regarded as an antiseptic, being a perfect preventive of mould in even the heaviest dressings. Like calcium chloride, it was proposed at one time as a damping agent, but this idea has now been abandoned entirely.

Alkali Silicates, Water-Glass.

Some years ago von Fuchs observed that by fusing silica and alkali together, a glassy product, soluble in water, was obtained, to which he gave the name water-glass. The proportions taken were: powdered quartz 45 parts, anhydrous soda 23 parts, and powdered wood charcoal 3 parts. Later on, experiments were made to replace the relatively expensive soda by cheaper sodium compounds; and it has been found, for example, that common salt can be decomposed by silica at a high temperature and in presence of steam, to form water-glass, hydrochloric acid being liberated. Water-glass may also be prepared by the wet method, by treating amorphous silica with caustic alkalis.

Potash water-glass (potassium silicate) is prepared by fusing 45 parts of powdered quartz, or pure quartz sand, with 30 parts of potash and 3 parts of powdered wood charcoal, the powdered melt being dissolved by boiling with water.

Double water-glass (potassium-sodium silicate) may be made, according to Dobereiner, by fusing together 152 parts of powdered quartz, 54 parts of calcined soda, and 70 parts of potash, or 100 parts of powdered quartz, 28 parts of refined potash, 22 parts of calcined soda, and 3 parts of powdered wood charcoal.

The solution obtained by boiling finely powdered, solid water-glass with water, forms the "prepared water-glass" of commerce. It is sold in varying strengths, expressed as percentage degrees of solid silicate in the solution, 33°-water-glass, for instance, containing 33 parts of solid alkali silicate and 67 parts of water, whilst the 66° solution contains 66 and 34 parts respectively.

Water-glass has a strong alkaline reaction and taste, varies in consistence according to the percentage of solid silicate, and in colour from water-white to yellow, and even brown, and dries in the air to a hard, solid glossy film. Mixed with fats, it forms soaps that are capable of absorbing large quantities of water—a property utilised in the manfacture of loaded soaps.

All acids, even the weakest, decompose water-glass, the silica being precipitated as a jelly. The same result is produced by atmospheric carbon dioxide, so that water-glass must be stored in tightly closed receptacles.

In presence of earths and metallic oxides, the silica forms insoluble compounds, chalk, for instance, forming with water-glass solution a very compact mass that dries nearly as hard as marble.

The action of sodium silicate on cotton fibres has been reported on by F. Crace-Calvert, who mentions that textiles sized with that substance and afterwards packed in bales and shipped to South Africa, were returned as spoiled and unsaleable. An examination of the goods revealed a partial decomposition of the sodium silicate into sodium carbonate and insoluble silica, probably by atmospheric influences.

CHAPTER VI

ANTISEPTIC DRESSING INGREDIENTS

It was mentioned in the introduction that all dressing preparations, especially those containing fats or fatty oils for special purposes, must also contain certain additions of antiseptic agents in order to prevent the development of mould and fungi, to which these substances are very liable.

At the same time a number of these agents were specified; and a fuller description of them may be omitted here, more particularly since certain of them have already been dealt with in the chapter on Loadings and Fillers, whilst others are more or less unsuitable for our purpose.

The following antiseptics are suitable for use: the chlorides of barium, zinc, aluminium, magnesium, potassium, and calcium; but on the other hand, the mercury compounds, and most of the compounds of cyanogen, arsenic and arsenic acid, strychnine, and picric acid, must be excluded unconditionally. Tannin can only find restricted application, since it acts on the size in the dressing; and the sulphates of iron, copper, alumina, and zinc are only suitable now and again, the first two especially being quite out of the question for white dressings.

Carbolic acid, creosote, and salicylic acid are undoubtedly the best antiseptics, the last-named being adapted to displace all other preparations.

With regard to the employment of salicylic acid in the textile industy, von Heyden reports that although the chief textile materials are not liable to decomposition of themselves, yet, in conjunction with fatty and gelatinous substances, and especially under certain conditions of warmth and moisture, they form, in time, a favourable substratum for the growth of micro-organisms, coming under the generic term of mould, a disagreeable smell being also produced. These inconveniences mostly appear long after the fabrics have left the factory, and have changed hands, perhaps a dozen times in commerce.

An addition of about 1 part of salicylic acid per 1000—more or less, according to the external conditions—of the gelatine, size, etc., used in dressing, will prevent any obnoxious smell and keep the goods from spoiling. About the same proportion of salicylic acid in the dressing preparation will also prevent any future complaints as to mouldiness, stains, etc., on the goods.

Foreign wool, washed before shipment, contains the germs of mould, which frequently develops after the wool has arrived in Europe, but might be prevented by adding 1 part of salicylic acid to 2000 parts of washing water and 500 parts of soft soap. The main superiority of salicylic acid over other antiseptics formerly introduced into the textile industry is, that only a very minute quantity is needed and the acid is inodorous and non-corrosive.

CHAPTER VII

DYEING AND BLUEING AGENTS

Dyeing agents are occasionally added to dressings intended for coloured stuffs, in order to mask the whitish cast produced on dark fabrics by the use of loaded dressings. A variety of dye-stuffs may be used for this purpose, *e.g.* logwood decoction with copper acetate, ferrous sulphate or potassium chromate, for black cottons; turmeric extract, for linen kerchiefs padded with yellow; and Paris blue or indigo, for dark blue. These coloured dressings, however, are seldom used.

Blueing agents, on the contrary, are largely used for white goods, especially ultramarine blue, which has now displaced other blueing agents, such as indigo, Paris blue, smalt, etc., almost completely. Although these other agents can be used to great advantage, owing to their solubility or infinitely fine distribution (practically equal to solution) in water, the completely insoluble ultramarine is nevertheless preferred, because it is affected to a merely slight extent, if at all, by the other ingredients in the dressing, and will retain its blue colour in presence of alkalis, and even in weak acids, provided an acid-fast blue be used, which will resist the action of acid for a certain time, whereas the tone of all ultramarines is modified by acids.

Ultramarine Blue.

Ultramarine is a substance of still unknown chemical composition, prepared by calcining alumina, soda (potash), silica, and sulphur. It is non-poisonous, very fast to light, with a high colour intensity and power of resisting alkalis; and is distinguished by beauty and brightness of colour. It is decomposed by acids, the colour being destroyed and sulphuretted hydrogen evolved. It is insoluble in water. There are three kinds of ultramarine blue, differing in composition and method of production: pure blue, blue with red tinge, and blue with greenish-blue tinge. The pure blue kind is lowest in silica, and is produced by calcining clay, Glauber salt, and carbon, with or without an addition of soda and sulphur (sulphur ultramarine). Green ultramarine is obtained as the first calcination product, and on recalcination with sulphur, furnishes the pure blue grade. This ultramarine is decomposed by acid salts and by alum.

The examination of ultramarine is chiefly directed to the colour shade and dyeing power, by comparison with standard samples. The colour intensity, which depends in large measure on the fineness of division, is tested by noting how much kaolin (or other white substance) has to be mixed with a given weight of the sample in order to match the standard shade obtained, by mixing the same weight of normal ultramarine with a certain quantity of kaolin. To determine the extent to which ultramarine is fast to acid, 200 parts of starch are stirred up with 1 part of the ultramarine and cold water, diluting the mixture to the requisite extent and boiling it to obtain a thin paste. To be suitable for use, the ultramarine must retain its colour unaltered both during boiling and on recooling. Fastness toward alum is tested by shaking 0·65 grm. of ultramarine into a cold saturated solution of alum in a test-glass, and noting the time required for the destruction of the colour. It is advisable to make a check experiment with an ultramarine of known quality in this respect. Ultramarine is adulterated with clay, gypsum, barium sulphate, and also with syrup and glycerine.

In order to prevent the ultramarine in dressing preparations from turning grey under the action of acids, all dressings that have a tendency to turn sour, or contain acid dextrin, gum, glycerine, or the like, must be carefully neutralised with soda before the ultramarine is added.

Paris Blue.

Paris blue is a blue iron-cyanide colour, of very dark, almost blue-black tone, and mostly exhibiting a coppery bronze when rubbed with the finger-nail. It frequently contains inert adjuncts, such as starch, heavy spar, gypsum, kaolin, or chalk, and consequently varies considerably in external appearance, whilst retaining the characteristic tone of the pure blue. The quality cannot be judged by the external appearance alone, specimens with an equal content of the actual pigment differing in appearance owing to the varying covering power of the admixtures aforesaid. Starch may be added in large amount without making the blue appreciably paler, though the weight is reduced; whereas heavy spar, owing to its greater covering power, will lighten the colour much more, whilst increasing the weight. Gypsum and burned clay lessen the weight and lower the colour. The principle of the preparation of Paris blue is the production of a white precipitate from solutions of potassium ferrocyanide and a ferrous salt, this precipitate then turning blue on oxidation. Certain rules must be followed in order to obtain the white precipitate in question, chief among them being an exact adherence to the specified quantities of the ingredients, the character of the ferrous sulphate, etc. The blueing of the white precipitate is effected by oxidising agents: nitric or sulphuric acid, chlorine, hydrochloric acid, and potassium bichromate. The precipitates obtained from solutions of ferric salts and potassium ferrocyanide furnish Paris blue direct, but the products are not so handsome and bright, when dry, as those from ferrous salts.

Soluble Paris Blue.—The following method of preparation is based on the observation that Paris blue treated with acids in the ordinary manner is transformed into soluble blue when digested for several days with potassium ferrocyanide, or preferably the ferricyanide, the action being accelerated by heat. A boiling solution of 110 grms. of potassium ferricyanide is treated gradually to an addition of a solution of 70 grms. of crystallised ferrous sulphate in warm water (*i.e.* about one-half the amount of this salt necessary for precipitation). After boiling for two hours, filtering, and washing with pure water until the washings become quite blue, the product is dried at 100° C. This blue is extremely rich in colour, and is soluble in water. The pure soluble blue is readily obtained by introducing an excess of purified blue, in the form of paste, into a saturated solution of oxalic acid. On standing for two months, the filtered liquid will deposit the blue and become colourless. The sediment is filtered and washed with dilute alcohol; and the dried blue is soluble in water. The same result is obtained at once by precipitating the solution in oxalic acid with 96 per cent. alcohol, or with a concentrated solution of sodium sulphate, the precipitate being washed in weak alcohol. The solution in oxalic acid may also be replaced by one in ammonium nitrate or oxalate. If the solution in oxalic acid be boiled, the ordinary insoluble blue is thrown down under the influence of the acid; and the same result attends the boiling of the pure soluble blue, with the addition of a little oxalic acid. Dilute sulphuric acid has a similar effect in the cold. Molybdic acid will dissolve large quantities of Paris blue. If a mixture of molybdic acid and Paris blue be heated with water and filtered, a dark blue liquid is obtained that does not change on boiling. The solution is not precipitated by glue, though it is by sulphuric acid, nitric acid, etc. The precipitate, washed with weak alcohol, is soluble in pure water. Ammonium molybdate and tungstate also dissolve Paris blue with ease.

INDIGOCARMINE.

Indigocarmine is a mixture of sodium-indigo-mono- and disulphonate, obtained by neutralising a deep blue solution of indigo in sulphuric acid. The sodium sulphate formed at the same time, facilitates the precipitation (in flakes) of the sulphonates, which are soluble in pure water. The precipitated salts are collected on a filter, washed with great care, and freed from water as completely as possible, by pressing. Indigocarmine is put on the market both in the form of paste, containing 70 to 90 per cent. of water, and also in the dried state, under the erroneous name of "indigotin." In addition to water, the blue carmine contains varying proportions of sodium sulphate, which cannot be completely eliminated, and is the cause of efflorescent crystals appearing on the dry surface of the carmine.

Indigo and its preparations are adulterated with a variety of mineral substances, resins, starch, gum, dextrin, glue, sugar, dye extracts, and pigments (Paris blue).

CHAPTER VIII

VARIOUS DRESSINGS

New dressing preparations are brought out at intervals by chemical manufacturers and others; but these preparations, although claimed to possess special advantages, frequently prove inferior in practice and rarely make headway, users preferring to employ the dressings they know to be reliable. A few of these special dressings are described below.

Endosmin.

This preparation, made by Baerle & Spannagel, Berlin, is a thick, colourless mass, which can be diluted in all proportions with water, according to the kind of dressing desired, and may be used as an adjunct to other dressings, such as potato starch, wheaten starch, dextrin, Carragheen moss, China clay, etc.

It forms a good filling material for cotton and linen yarns and fabricsis, completely absorbed by the fibre, and increases the weight of the threads and fabric without affecting the dye or the natural gloss of the latter, the finished goods having a very attractive appearance, and handling full and soft.

Endosmin is suitable for "natural finish" in white and coloured fabrics (fast colours), and also for heavy fillings in conjunction with starch and mineral ingredients, a loading of up to 80 per cent. being attainable.

This product is capable of replacing up to 60 per cent. of starch and other dressing preparations, and particularly the greater portion of the fat, soap, and wax, which are otherwise indispensable in heavy dressings and are very expensive ingredients.

Eau de Crystall.

This preparation consists of magnesium sulphate, magnesium chloride, and dextrin (very little of the latter), and is sold at a disproportionate price.

Crystallfixe.

This product is placed on the market by the Stassfurt Works, for use as a filler in dressing preparations. It is said to possess the following advantages: an excellent loading material for yarns and fabrics; imparts to cotton goods the "feel" of linen; and greatly facilitates the weaving of yarns by rendering them supple.

Crystallfixe has the following chemical composition:—

	I.	II.
Insoluble substances . .	0·043	0·040
Magnesium chloride . .	45·714	48·340
Magnesium sulphate . .	3·640	1·728
or		
Sodium sulphate . .	2·719	1·940
Potassium chloride . .	1 to 2 per cent.	1 per cent.
Sodium chloride . .	1 to 2 ,,	1 ,,
Water	50 to 53 ,,	49 ,,

LUKON.

A commercial article under the above name is met with as a yellowish-white, agglomerant powder, of tallowy smell and sharp taste, resembling salt and alkali. Under the microscope it is seen to contain many grains of potato starch, and particles of sand and clay.

In round figures, the preparation contains: water, 8 per cent.; starch (partly dextrinised), 54; fat (tallow), 5; lime clay and sand, 25; anhydrous soda, 8 per cent.

In presence of iodine solution, the aqueous solution gives a fairly strong red coloration. Cold water dissolves 18·3 per cent. of the powder, including 8·6 per cent. of ash constituents. When boiled with a little water, the powder forms a paste smelling of tallow, a thinly fluid product being obtained by boiling with a larger quantity of water.

The preparation is chiefly intended for use in cloth-making.

ALGIN.

This name has been given by C. E. Stanford to a dressing material obtained from marine plants. It is prepared by suffusing fresh or dry marine plants with dilute sodium carbonate solution, and then boiling or steaming for six hours. The insoluble residue, which consists of a special form of cellulose, is separated, and the solution is acidified with hydrochloric or sulphuric acid, which throws down crude, soluble algin, this being then pressed and dried in the air. The residual solution is diluted with lime, the liquid portion being separated from the deposited calcium sulphate, and evaporated until the sodium salt has separated out. On removing this and evaporating the liquor to dryness, a residue is obtained, which, on calcination, forms a substitute for kelp. Algin combines with bases, to form salts. Alkali alginate and magnesium alginate are soluble, whereas the compounds of most of the other metals with algin are insoluble. A few alginates exhibit characteristic colours, the copper compound being blue, the iron salt brown, and so on. The salts of algin can be used for a variety of purposes, the alkali salts, for instance, serving to stiffen woven fabrics; the magnesium salt being used as a mordant; the copper, zinc, cadmium, chromium, cobalt, nickel, uranium, and platinum salts for making waterproof articles; the alkaline earth salts for imitation bone; the iron, cobalt, copper, nickel and chromium salts for horn substitutes; and the sodium or ammonium salt, mixed with an ammoniacal solution of shellac, as a substitute for gutta-percha.

Paramentine.

This sizing preparation, invented by Torlotin, consists of 100 parts of gelatine glue dissolved in a minimum of water and mixed with 70 parts of dextrin, 20 of glycerine, 20 of magnesium sulphate, and 20 parts of zinc sulphate, the whole being thoroughly incorporated, and dried in moulds.

According to Trappel, the same product may be prepared by dissolving 100 parts of glycerine (20° B.), 1 part of carbonate of soda, 0·01 part of alum, and 0·01 part of borax, and mixing the solution with 10 parts of potato or wheaten starch. Gelatine, soaps, stearine, gum arabic, or tragacanth, can be added as desired.

Cream Softening.

This dressing preparation is used as a softener in place of fat, tallow, oils, glycerine, etc. It is used with particular advantage along with dressings containing flour, dextrin, gum, starch, and glue, and prevents the growth of mould and fungi. Cream softening is a pure article, perfectly neutral, immediately soluble in water, has a softening and disinfectant action, and may be used in all sizings and dressings containing dextrin, glue, gum, flour, starch, etc., for linens, unions, woollens, silk, velvet, and cottons.

Norgine

is also a preparation from seaweed; an adhesive, which is capable—in the form of paste or solid tablets—of advantageously replacing the ordinary dressings. It serves to prepare yarn for weaving, for smoothing and sizing, for waterproofing flax, linen, jute, wool, and cotton, for dressing silks and velvets, etc. A special property of norgine is, that it will keep indefinitely without change, neither fermenting nor becoming sour or mouldy. It is put on the market by the Société Française la Norgine, Paris, whose works are in Brittany.

Dressing Soaps.

Insoluble soaps, such as lime, alumina, zinc, and other soaps, are stirred to a homogeneous mass with fats or hydrocarbons, at a high temperature, loading ingredients, such as talc, kaolin, etc., being added if desired. The insoluble soap may be manufactured separately, or made by the reaction of a fatty acid and a metallic hydroxide during the mixing process. It imparts to fabrics and paper a dressing that is highly insoluble, and also offers resistance to mechanical influences.

Gum Tragasol

is a gum prepared from carob seed, and appears to have a future before it as a dressing material.

Senegalin.

Senegalin, a vegetable glue, put on the market by W. Pohl, of Breslau, forms an almost colourless, thick gelatinous, elastic mass, exhibiting a slight whitish sheen. It is almost perfectly neutral, and can be used in nearly all dressings for cottons and linens, either alone, for the production of so-called natural finish, or in conjunction with starch, and mineral or other filling ingredients. These latter are fixed better when senegalin is used than when flour or starch alone is employed, the finished goods having a smooth appearance and not allowing the dressing to fly off in the form of dust.

With senegalin alone, or in conjunction with certain other colourless adjuncts, such as starch syrup, glycerine, Turkey-red oil, magnesium sulphate, etc., the brightest dyes preserve their original brightness and freshness, which is not the case when most kinds of starch are used. The sparing solubility of senegalin (which requires boiling for ten to fifteen minutes) is an advantage, since fabrics treated therewith will retain their stiffness to some extent after repeated washings, a property which is not imparted by any of the ordinary dressing preparations. When magnesium sulphate or chloride is used with senegalin, care must be taken not to exceed the ratio 4:3, since a higher proportion of the magnesium salt will throw down the senegalin as a flocculent precipitate. This peculiarity, however, is shared by all other vegetable glues and all starches, so that it is advisable to replace senegalin by dextrin for all goods (*e.g.* light-coloured fabrics) which are desired to have a very stiff finish. Dextrin will stand any quantity of magnesium salts without precipitation; and as much as 100 parts of magnesium sulphate are used to 10 to 12 parts of dextrin for very stiff dressings.

Monopol Soap.

The monopol soap put on the market by Stockhausen and Traisar, of Crefeld, is a preparation closely allied to Turkey-red oil, and may be regarded as a solidified oil of this class, distinguished by a higher content of fats. It also possesses the property of not giving any precipitate of lime or magnesia soap when used with hard water; and it damps the fibres thoroughly, so that the dressing with which it is used readily penetrates them.

Liquid Size for Dressing Bleached and Coloured Fabrics.

Von Baerle & Co., Worms, have introduced a neutral, stable product, which permeates the fabric and, in addition to increasing the weight, imparts suppleness and gloss. It takes the place of the usual fatty substances employed in dressings, viz. soaps, stearine, wax, etc.

The preparation is added to the starch on boiling, and it readily unites with China clay, etc. For coloured fabrics, up to about 15 per cent. of this size is recommended, in place of a corresponding quantity of the fat generally used. For white goods, such as shirtings, dowlas, calicoes, satins, etc., this preparation is also highly suitable, and may be used up to 20 per cent. of the ordinary dressing, the quality of which is thereby improved and softened, whilst the fabric is firmly loaded.

Vegetable Gum Dressing.

The same firm also makes this preparation, which is claimed to be a very good dressing for linen, cotton, and wool, imparting a mildness of feel and a silky lustre, whilst filling and loading the fabric without affecting the dyes. The preparation, which is a vegetable glue, can also be used on silk, in place of fat, wax, soap, glycerine, and other adjuncts. Finer fabrics or yarns may be dressed and loaded with this preparation alone, their durability being increased thereby. When used for piece goods on a large scale, about 20 per cent. of the preparation may be used in place of the usual dressings and fats, a finer finish being obtained, and the threads filled better, with less of the dressing lying on the surface.

This vegetable gum is dissolved at a temperature of 68° F. in the water destined for boiling the starch, the solution being well stirred, mixed with the starch, and boiled in the usual manner. A medium temperature is most suitable for storage, protection against frost being essential.

Gum Substitute.

This preparation, also a vegetable glue, is successfully used in many works as a dressing, and forms an excellent substitute for starch, gum, glue, gelatine, etc. Owing to its moderate cost, it seems capable of replacing the substances hitherto employed for dressing, sizing, and in dyeing.

S. Size.

Under this name, a preparation has been introduced by J. Schrader (Ochtrup, Westphalia) for sizing warp yarns, and principally as a bind for the other ingredients used in yarn sizes, in order to fill the threads better, whilst rendering them elastic and supple. With this preparation the yarn may be sized up to 100 per cent. and more.

Puntschart's Vegetable Glue.

This product, made by G. E. Puntschart, Vienna, serves for sizing and dressing, and is said to render undyed yarns very strong and supple for weaving, whilst a special variety for weaving coloured goods imparts a very handsome and silky finish to the goods when calendered, or an extremely soft, woollen feel when raised. The dyes are not affected.

The general advantages of this preparation for dyed and undyed fabrics are asserted to be as follows: (1) It makes the warps run easily and enables the loom to be worked at a higher speed than hitherto possible; (2) it increases the weight of the fabric up to 10 per cent.; (3) a saving in the consumption of potato starch, up to 25 per cent., is obtained; (4) fat and other adjuncts are no longer required.

The special advantages for coloured fabrics are: (1) the goods are rendered silky by calendering; (2) the lustre is heightened; (3) the goods dressed with this preparation are very easily raised, the threads being left soft, so that the carding-pins act with greater ease than when ordinary size is used, which renders the threads hard and brittle.

Several different qualities are supplied for sizing and dressing, according as the yarns are grey, bleached, or dyed with fast colours. All kinds of yarn (cotton, linen, union, etc.) can be treated, and a saving of up to 30 per cent. of starch is effected.

Vegetable Glue and P. Size.

A series of preparations under these names are put on the market by the Pflanzenleimfabrik, Speyer. Vegetable glue AB[1] and AM[1] are recommended for sizing yarns dyed with fast or fugitive colours, a small proportion of oil or tallow being employed. The saving of starch is said to be 30 per cent. P. Size P S F B gives a loading of 10 to 30 per cent., attainable only with the use of fillers.

In using vegetable glue as a dressing, it is preferably thinned down slowly with a little cold or lukewarm water, being stirred continually to prevent lumpiness, and afterwards strained. The dressing is prepared in the usual manner, except that the amount of water employed for stirring up the starch (China clay) is diminished by about the quantity used for thinning the vegetable glue, in order that the dressing may not be too thin. Another necessary precaution is to reduce the quantity of starch by one-third, when 1 part of vegetable glue is taken to 2 parts of dressing. By adding the vegetable glue to the starch previous to boiling the latter, the glue acts on the starch in the boiling process and causes it to increase in volume.

In preparing the dressing, when the ingredients have been mixed and placed in the boiling pan, steam is admitted, and as soon as the mass becomes thick, the diluted vegetable glue is run in, and the whole is boiled for the usual time. The fats are added either to the cold, or boiled mass, the main thing being to ensure good combination with the starch. This object would not be achieved if the diluted vegetable glue were boiled in admixture with the cold-loaded dressing and the fats, for if these have been already combined with the starch, the salts in the vegetable glue can no longer react on the compound. In this case, also, it is permissible to use soaps that were hitherto precluded; and the vegetable glue can be applied to a number of purposes for which it is otherwise unsuitable, soap being essential for the production of certain classes of finish.

CHAPTER IX

THE PREPARATION OF DRESSINGS

All dressings consist of substances that are either soluble in water or merely capable of being disseminated in that liquid; and the first stage in the preparation of dressings is to treat the ingredients accordingly. Such of these solid substances (mineral substances especially) as will not liquefy in the hot aqueous solution, must be used in the state of very fine powder or in paste form.

This latter condition is preferable, since it obviates the troublesome operation of preparing pulverulent substances and passing them through sieves, a lengthy and expensive process; and by setting up a suitable grinding-machine, with bronze, or preferably stone, rollers instead of iron, the necessary quantity of these filling ingredients can be prepared in a state of fine levigation. Where, however, this is impracticable, for local or financial considerations, the old-fashioned method of passing through sieves, after stirring up with water, must be retained; and this operation must be performed in a thorough manner, since large solid particles will remain on the dressed fabrics and produce roughness and patches.

The most important ingredient of the dressings for white goods, linen, and cotton—which are mostly dressed—is starch, which has already been fully described in a previous chapter. The most important point to bear in mind is the class of dressing for which the starch is intended, this consideration determining, not only the method of steeping, but also the duration of the boiling process and the temperature employed. With regard to the action of the different starches on the fabrics which they are employed to dress, it should be mentioned that potato starch, or potato flour, acts as a filler, makes the fabric supple, and gives it a soft feel. Rice flour, on the other hand, makes the fabric heavy, and, unlike the other varieties, does not remain on the surface, but sinks into the pores and gives a transparent, glazed finish. Wheaten starch imparts firmness and a solid feel, whilst American maize starch makes the fabric unduly stiff, the finished goods being extremely hard, stiff, and quite unusable, a condition that is not removed by even a considerable proportion of added fats, so that this starch has been comparatively little used. This starch was treated with chlorine, and consequently underwent a change; but latterly a pure white maize starch, prepared without any artificial bleaching, has been put on the market, and will probably find more extensive application.

The usual method of treating starches is to stir them up carefully with water to a viscous mass, passing the mixture through a fine sieve as a precautionary measure, and then transferring it to the boiling pan, which is already charged with saline and insoluble mineral substances. The ordinary method of making paste—and dressing preparations are nothing more than paste—viz. by stirring up the starch with cold water and then adding boiling water until gelatinisation occurs, is impracticable for our purpose, because, on the one hand, lumps are readily formed, and on the other hand, it is difficult to incorporate the heavy mineral matters uniformly with the swelling starch.

The case is different with flours, these—except potato flour—also containing gluten, and requiring different treatment according as it is desired to obtain the gluten more or less dissolved in the dressing. Many finishers soften the flour in water overnight, and boil it the next morning; whilst others proceed to boil it at once. It will be evident that no solution of the gluten can occur in the latter case. Other finishers, again, leave the flour to soak for several days, and thereby obtain partial solubility of the same, so that a far harder finish can be produced. Opinions on this point diverge widely; and the duration of soaking depends on the kind of dressing required.

The length of time and the temperature of the boiling process are influenced by the purpose for which the product is intended. As it is the general practice merely to scald the starch when the dressing is wanted solely as a filler—that is to say, when the starch need not be gelatinised—whereas for transparent and glazed finishes—in which no covering is intended—the starch is boiled until completely gelatinised, it is clear that an infinite number of points of difference exist between the two classes of dressing, and that an innumerable series of dressings can be obtained that differ from each other in a merely insignificant degree. The gelatinisation of the starch proceeds to some extent already during the scalding process, the so-called soluble starch being produced in this way. A higher degree of solubility is obtained by boiling for several minutes; but it is only by prolonging the operation for several hours that the starch can be brought into a condition that furnishes perfectly clear and glaze finishes.

Moreover, alterations in the starch are produced, not only by boiling, but also by the alkalis by means of which the liquid and solid fats are combined with the mass—as already mentioned—and these changes are highly important.

If starch be boiled for a considerable time at a high temperature, soluble starch is formed at 130° to 158° F.—according to the kind of starch—the temperature at which this change occurs being known as the gelatinisation temperature. On boiling being continued further, quite different products, such as maltose, archroodextrin and amylodextrin, are formed, dextrin being obtained by boiling for four to five hours. Wheaten starch requires more, and potato starch less, time for the formation of these transformation products, so that no definite time can be specified. Maltose, archroodextrin, and amylodextrin are of particular importance in dressings prepared in this way, whereas the formation of dextrin must be avoided as far as possible, since this substance can only serve as a thickening ingredient. In general, therefore, the time of boiling should not be less than one and a half hours, to secure the requisite transformation products, and not more than three and a half hours, to avoid the formation of dextrin. Whilst it is difficult, theoretically, to fix these times exactly, it is easier in practice, because definite quantities of starch and filling ingredients are taken.

The ingredients for the preparation are introduced in succession into the dissolving or boiling pan, the heavy mineral matters first, then the lighter ones, and finally the flour or starch, the whole being industriously stirred and mixed together while the fire is made up or steam turned on. If possible, the stirring should be continued throughout the process, in order to prevent the deposition of the heavy ingredients, and also, when fire heat is used, to prevent the contents from sticking to the walls of the pan and burning thereon. As a rule the fats and fatty oils are not added until the mass has already begun to grow hot; and they should be added in small quantities, to facilitate solution. It is preferable to prepare the fatty adjuncts separately, and only incorporate them, by continued stirring, after the rest of the ingredients have been sufficiently boiled. Fats that saponify with alkalis will dissolve in the preparation, whereas wax and paraffin are unsaponifiable and are distributed uniformly, in an extremely fine state of division, through the mass.

The formation of lumps in the dressing indicates insufficient working during the boiling process, and such lumps must not, of course, be allowed to remain in the mass, but must be rubbed down in the metal sieve, or (preferably) ground in a mill.

The addition of more or less gum water (1 part of gum to 2 of water) to boiled starch for dressing cottons or linens renders the dressing hard, and sometimes papery and glassy, a condition that is not always desirable. Dextrin in dressings for cottons fills the fibres internally, and thickens them, so that an addition of this substance to starch paste imparts a harsh feel to the fabric if dried strongly after dressing. When used alone, dextrin—the solutions of which penetrate the fibre more than any other liquids and protect the brightness of the dyes—imparts a solid, woolly appearance and feel to cotton fabrics, for example, black and white discharge stuffs.

Glue and gelatine, which are sometimes mentioned in dressing recipes for the purpose of increasing the cohesion of starch paste and binding the filling ingredients, make the dressing harder; but as they give rise to the formation of patches of mould and impart a disagreeable smell to dyed fabrics, the quantity used must be small. Vegetable mucilages are intended for mild dressings.

Soap, cocoanut-oil, castor-oil, olive-oil or Turkey-red oil, glycerine, tallow, and other fats are added to make the fabric supple and soft, and to give cotton fabrics the cold, smooth feel of linen. Many recipes specify glucose for softening and loading the fabric; but this substance is disagreeable, from its hygroscopic properties and tendency to mildew, and may even be dangerous to the fabric.

Starch, paraffin, spermaceti, beeswax, Japan wax, rosin, ozokerite, and borax are added to dressings when the goods are to be glazed and lustred on the hot calendering machine. These ingredients are generally used along with soap or other softening materials, in order to combine gloss and mildness in the same dressing.

Barium sulphate, which is used as a filling and loading ingredient, is readily liable to fall out of the fabric in calendering, owing to its low covering power. Magnesium sulphate is preferred in England for loading rough cottons that are sold by weight.

Creosote and phenol gradually lose a portion of their antiseptic power by evaporation; and salicylic acid may be recommended as the best adjunct to dressings. Zinc chloride is used in England, and zinc sulphate in France, as an antiseptic and also as a loading ingredient, the last-named substance presenting the advantage of being less hygroscopic and of not decomposing when heated.

Flour is specially preferred as a dressing ingredient when large quantities of undissolved mineral substances are to be brought on to the fabric, for the purpose of filling up the wide meshes of an open fabric or increasing the weight of light goods. The gluten in flour paste binds the insoluble mineral substances with the thickening on the one hand and with the linen or cotton threads on the other. Unfortunately, there must be set against this advantage the tendency of flour dressings to cause mildew in the fabrics during prolonged storage, unless the warehouse be perfectly dry; and these dressings also readily turn sour when kept in the starch vat.

Flour gives a viscous pap of high-covering power, and on this account is still largely used.

Starch paste is less viscous, and consequently has a lower binding power than flour, though possessing sufficient internal cohesion to take up an adequate amount of insoluble mineral substances.

Vegetable mucilages, while less liable to become sour or watery, produce a more solid and stiffer finish on linens and cottons than can be obtained with ordinary starch paste. For dressing the under side of the fabric, their cohesion renders them almost indispensable, no other dressing preparation being able to distribute so uniformly over the smooth copper rollers of the starching machine, whence the dressing is transferred to the fabric.

Thin solutions of gum arabic are used in dressing tulles and silks.

With regard to other adjuncts to dressing preparations, it should be mentioned that dextrin should be thoroughly dissolved in water beforehand, albumin being dissolved in water at 122° F.; and the dressing to which this solution is added must also be cooled down to that temperature, to prevent coagulation.

Glue should be soaked in cold water for twelve to twenty-four hours, and slowly dissolved at a temperature of 122° to 140° F. Dissolving the glue in pans or vessels by direct fire heat should be avoided, the glue settling down to the bottom, where it melts and easily burns on to the walls. This can, however, be prevented by placing the proper amount of glue in a wire basket, which is suspended in the water, the hot water laving the glue continuously, and quickly furnishing a perfectly clean and clear solution, which should preferably be strained through a cloth. This method prevents the quality of the glue being impaired by boiling.

Gum arabic and tragacanth must be dissolved with great care, since the former, unless of the best quality, contains large amounts of foreign admixtures which would contaminate the dressing. Solution is best effected with cold or lukewarm water (the gums being preferably crushed to facilitate solution), with repeated stirring, the solution being left to settle, and the light, floating particles of wood separated by straining.

An excellent apparatus for freeing gum solutions from adherent impurities is that shown in Fig. 17, viz. Körting's filter aspirator. This consists of any convenient number of air-tight filter pots (arranged side by side) into which the fluid gum solution is poured, and is then aspirated through into the vessel *B* by means of a partial vacuum, so that the impurities are retained on the filter. In setting up this apparatus, the internal diameter of the steam and air-pipes should not be smaller than specified by the makers. In the case of long pipes and very thick solutions, the pipes should be correspondingly wider. To prevent condensation, the steam-pipes should be well lagged; and care should also be taken to draw off any condensed water in front of the apparatus, its admission to the liquid being generally undesirable. This can be accomplished properly by a steam-trap mounted close to the filtering apparatus.

Isinglass is quickly dissolved by cutting it up with the scissors, suffusing it with a little water, boiling the whole and straining it through a linen cloth. A small quantity of weak alcohol should also be added.

Purity of all the materials used is a fundamental condition for all classes of dressing preparations.

Antiseptics, unless forming integral constituents of the dressings, are stirred in (like blueing materials) to the finished preparations, and distributed as uniformly as possible therein. This is particularly important in the case of blueing adjuncts, in order to prevent the formation of patches.

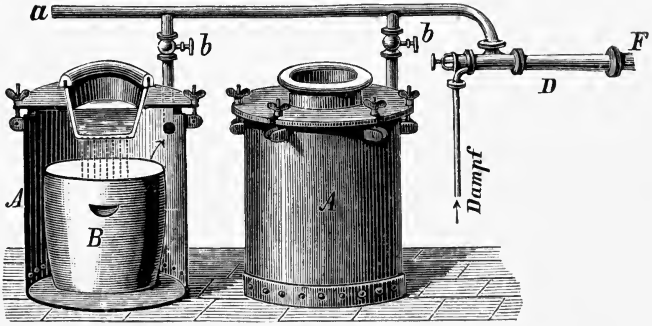


Fig. 17.—Körting's filter aspirator.
A, filter pots; *a*, common aspiration pipe, with *b*, stop valve; *D*, aspirator.
(Dampf = Steam.)

CHAPTER X

VARIOUS ADJUNCTS TO DRESSING PREPARATIONS

1. Fatty Adjunct.

It is advisable to make a large quantity of this adjunct beforehand, and then simply incorporate it with the dressings. For this purpose, 9 gallons of water are heated in a copper or iron vessel of sufficient size, heated by fire or steam, 1 lb. of finely shredded stearine being added and melted. The stearine should be soft, not brittle and vitreous, the latter being harder to melt and less suitable. About 3½ lb. of lard and 10 lb. of cocoanut-oil are then added and allowed to become liquid, which done, 2¼ lb. of shredded white Marseilles soap are introduced and boiled with the other substances.

Next, 4½ lb. of ordinary soda crystals and 1 lb. of bicarbonate of soda (previously dissolved in water) are added, and the whole is allowed to boil for a short time. To this preparation, which is intended solely for bleached fabrics, are added about 3½ gallons of dried China clay, the whole being well stirred up and boiled for a short time. This addition of China clay (or other mineral substances) is for the purpose of increasing the consistence of the fat—so that it is more easily got out of the storage vessel when cold—and also to conceal the nature of the mass and prevent its detection when used.

The still hot mass is filtered through a correspondingly coarse sieve or linen cloth. Owing to the fact that cocoanut-oil, in particular, is often contaminated with impurities that could not be eliminated on boiling up with the starch, the fatty adjunct must be purified or strained by itself. It is left to cool in the vessel to which it has been transferred, from which 6 to 9 lb. are taken out for use with about 33 gallons of starch dressing. The capacity of the vessel should be ascertained previous to filling, in order to facilitate the manipulations. Since the ingredients specified above will contain only about 22 lb. of actual fat, the weight of the water and China clay must be taken into consideration, the addition of 6 to 9 lb. of fatty adjunct to 33 gallons of starch dressing being therefore very moderate.

For moiré finish on shirtings, 1 to 2 lb. of white wax should be added to the dressing, as well as the fatty adjunct.

2. Potato Starch and Rosin Adjunct.

(*a*) Thirty-one gallons of water and 15½ lb. of soda crystals are boiled in a roomy pan, and 28½ lb. of finely powdered pale rosin are stirred in briskly until completely dissolved, the whole being then kept gently boiling for another hour. The mass is afterwards strained through a suitable sieve or filter cloth, into a deep wooden vessel, which is covered up when cold, and set aside for storage. Before any of the mass is taken out for use it must be stirred up. Care should be taken that, as soon as the rosin is added to the soda solution in the pan, the contents are gently boiled and constantly stirred; and as the mass is liable to boil over, a supply of cold water must be kept at hand. Of this preparation, about 1 to 1¼ gallons are taken to about 50 gallons of dressing, the addition being made after the latter has been boiled to a finish, the rosin being therefore stirred in at the last and only boiled for a few minutes before pouring out the mass.

In the case of dressings for shirtings the preparation is modified, the following being recommended: 35 gallons of water are raised to boiling, 9 lb. of soda crystals being dissolved therein, and 15½ lb. of finely powdered pale rosin added and completely dissolved, followed by 3¼ lb. of white wax, and 14 to 15 lb. of fat adjunct. The whole is boiled until all the ingredients have united, whereupon the hot mass is poured through a sieve into a cask. About 4½ gallons of this preparation are taken to 44 gallons of starch dressing, the mixture being boiled and well stirred for about half an hour.

(*b*) Sixteen lb. of potato flour are boiled in 25 gallons of water over a gentle fire, the swelling up of the starch being facilitated by a previous moistening with about 5 pints of spirit for a short time before pouring on the water. When the mass is boiling, 1½ lb. of alum, dissolved in a quart of water, are added, and boiling is continued until a fluid, gummy substance is formed, this generally taking about two and a half hours. Burning being inevitable, the mass is next poured through a fine sieve, left to cool, and stored in covered receptacles. Since the preparation keeps well, a large quantity can be made at a time.

The prolonged boiling and the addition of alum change the potato flour into a gummy or gelatinous substance, the sulphuric acid liberated from the alum decomposing the starch, which thereby acquires a water-white, mucilaginous character.

The alum, thus rendered basic, assists in keeping the dressed fabrics free from stains, whilst, in conjunction with Carragheen moss, it preserves the eye from the action of air and light, and leaves no trace of starch when applied to the face of the material.

3. Dressing Composition.

This composition, which serves as a surrogate for size in dressing dimity, consists of: water 60 parts, dextrin 16, crystallised Glauber salt 16, linseed mucilage 16, and tannin 4 parts. It is prepared by boiling the linseed for half an hour, and pouring it into a wire sieve placed over a vessel in which the mucilage collects. The latter is poured back into the pan and employed to dissolve the Glauber salt and dextrin, the mixture being stirred frequently. The solution is finally refiltered, and is then ready for use.

Hai-Thao Dressing.

Experience has shown that this dressing must be used in a boiling hot condition. One part of Thao in 300 parts of water is sufficient to impart a perceptible finish to the fabric immersed in the solution; and if the strength of the solution be increased to 1 per cent., the goods are improved in body, without any increase in stiffness, handling supple. In comparison with dextrin, the 1 per cent. solution of Thao makes the fabric firmer than a 5 per cent. solution of dextrin, though less so than a 10 per cent. solution of the latter, whereas greater stiffness is imparted by a 5 per cent. potato-starch dressing. Both dextrin and potato starch, however, fill the threads less effectually than Thao, and make the fabric much drier and rougher. The suppleness and strength of the finish produced by Thao can be increased by addition of glycerine, also when a little potato starch is used. The addition of mineral dressings, or filling ingredients like talc, pipeclay, etc., produces a greasy feel, the goods also feeling softer and finer than when dressed with dextrin or potato starch. Unlike dextrin and starch dressings, Thao does not soften when the fabric is immersed in cold water. It can never be used without ultramarine, on account of the yellow tinge it imparts to cottons; and even with ultramarine a greenish tint is perceptible. Finally, when applied to twilled fabrics, it exhibits the property of causing the twill to contract and become less prominent.

Heilmann, who carried out experiments with Hai-Thao, found that it is only suitable for fine fabrics that are desired to feel soft but solid; but it is not adapted to replace dextrin or potato starch where a stiff, heavy finish is required.

CHAPTER XI

APPLIANCES FOR THE PREPARATION OF DRESSINGS

Any dressing preparation may be boiled in any convenient manner, any kind of pan being suitable; but when working on a large scale it is by no means a matter of indifference what shape and size of apparatus is used, or whether the heating is effected by direct fire or steam. In all large works where sufficient steam is available, steam-heated pans are unconditionally preferable, since, on the one hand, they enable surplus steam to be utilised and save fuel, whilst on the other, they are cleaner in working and the mass is not liable to burn on the pan like it does with fire heat, so that a far purer product is obtained. Another important point is that the temperature can be more uniformly maintained with steam heating.

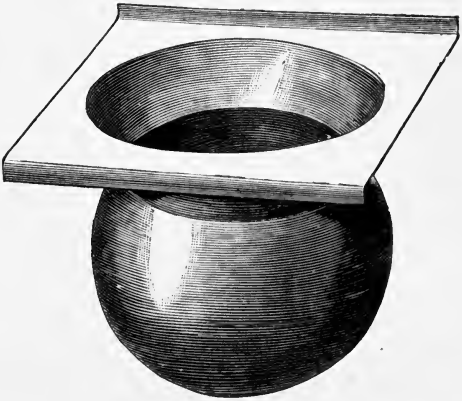


Fig. 18.—Pan for boiling starch.

In the following, a number of appliances are described for the preparation of dressings—that is to say, for boiling the starch and the various adjuncts, dissolving gum and various saline materials; but it is evidently impossible to find space here for all the various apparatus used in practice.

Figs. 18 and 19 illustrate boiling pans of the kind recommended by Grothe, that in Fig. 18 being for fire heat, whilst that in Fig. 19 is equipped for boiling by steam. The pan is made oval on account of the smaller face presented to the direct action of the flame, and to facilitate stirring. The rather narrow opening at the top is to restrict the access of air, and prevent the incursion of dust and impurities, thus preserving the purity of the contents.

There is no other inducement to select this form of pan; and apparatus of different shape will be described below.

A boiling pan, well adapted to the purpose, is formed by a jacketed vessel, with a wide, open top, and made of good boiler plate, the whole resting on a strong frame. The pan is fitted with steam, feed, and exhaust pipes, a safety valve and tap for draining off the water of condensation, as well as with stirrers mounted on the roof of the workroom. By means of a steam pressure of 3½ to 4 atmospheres, the contents of the pan can be heated to 257° F., this being the extreme limit, though lower temperatures can be obtained by checking the flow of steam, and thus reducing the pressure.

Fig. 19.—Steam-heated pan for boiling starch.

The starch-boiling pan shown in Fig. 20 is for preparing large quantities of dressing, and was first introduced by Tulpin ainé of Rouen, and Pierron & Dechaitre, Paris, but afterwards manufactured by English, Belgian, and German firms. *A* is the copper pan, measuring about 17 inches across and 25 inches in depth, and intended to contain about 17 gallons or 2 cwt. of starch mass. The pan is suspended almost concentrically in a cast-iron outer pan *B*, and connected with the latter by means of the riveted copper flange *d*, in such a manner as to leave a space *O*, between the two vessels, for the circulation of the steam. A steam-tight junction is made between the two pans by means of the wrought-iron ring, *e*, and the bolts, *f*, which are provided at intervals of about $2\frac{1}{2}$ to 3 inches. To facilitate emptying and cleaning the pan, the outer pan (and therefore the inner one as well) is suspended by means of two thick, hollow trunnions, *C* and *J*, in two trestle bearings, *E* and *F*, so that it can be easily tilted. On the upper rim of the copper pan, midway between the two bearings, is a wide pouring lip, to prevent the starch running down the sides when the pan is being emptied. The pan is tilted, for emptying, by the aid of a crank *K*, the shaft *L* of which carries a 4-inch worm *M*, engaging with a worm wheel *A* keyed on one of the trunnions *J*, so that the operation of tilting proceeds quietly, with certainty and ease, and it does not slip out of its position for the time being, when the crank *K* is released. Steam is admitted through *s*, passing through the pipe *P*, packed in the stuffing box *t*, in the hollow journal of the outer pan, and enters the space *O*.

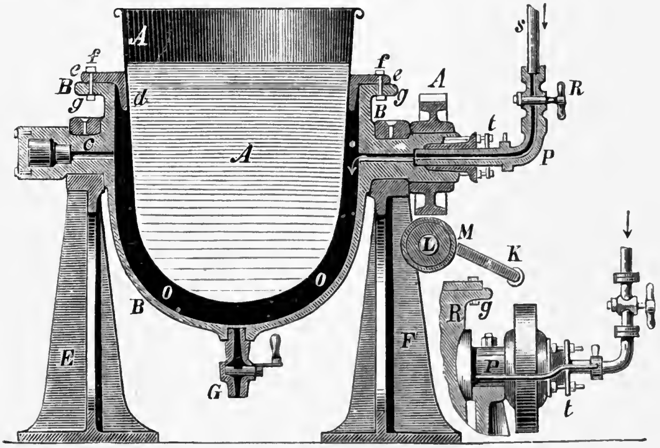


Fig. 20.—Pan for boiling starch.

Heat is applied uniformly over the whole extensive periphery of the pan. As the pan is subjected to heavy pressure strains, the steam pressure admitted must not exceed $1\frac{1}{2}$ to 2 atmospheres; and the sheet copper of which the inner pan is constructed must not be less than $\frac{1}{12}$th of an inch thick, or it will be liable to collapse under the pressure. The cock *R*, in the feed-pipe *s*, enables the steam to be shut off entirely and also to be regulated, as regards pressure and quantity. The bearing for the shaft *L* is cast on the trestle support *F*; and the crank *K* is arranged so far out of centre with the apparatus as not to be in the way when the pan is tilted into the horizontal position. The water condensed between the two pans is drawn off through a cock *G*.

The closed pan shown in Fig. 21 is for boiling starch with naked steam, and is constructed by E. & P. See, Lille. It consists of a pan *A*, secured to a plate bolted on to the wall. The pan is charged with starch and water through a funnel *B*, by opening a valve *P*. Steam is then admitted to the pan through the valve *H*, and at once raises the contents to boiling point. The operation is completed in four to five minutes, without any production of dextrin, the yield being therefore about 15 per cent. higher than in open pans exposed to the air. The temperature employed is about 284° F. When the boiling is completed, the valve *H* is closed and

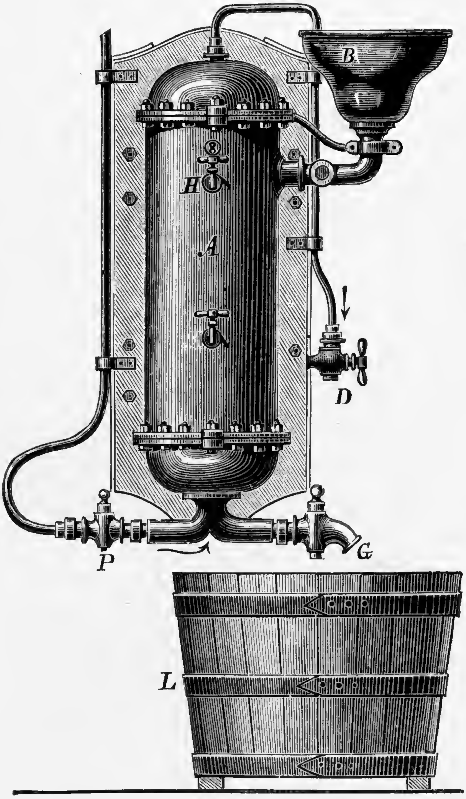


FIG. 21.—Starch-boiling pan by E. & P. See, Lille.

the valve *G* opened, the steam thereupon forcing the finished starch out of the pan into the tub *L*. To accelerate recharging the pan with starch, steam can be admitted into the funnel *B* through a small pipe in the dome of the pan. Air is admitted to the pan through the cock *D*.

Huber's pan for boiling dressing preparations (Fig. 22), consists of an inner copper pan *D*, and a cast-iron outer shell *C*, the latter being provided with cast-on trunnions. The two pans are bolted together steam-tight, the junction being protected by a double rim, so as to form one piece with the inner pan.

Two angle valves—the one bore of which is in the same direction as the uprights, and the other (with the stuffing boxes) arranged axially with regard to the trunnions—are provided in the hollow trunnions. One valve serves to admit steam, the other admitting water to accelerate the cooling of the finished dressing. The effluent valve for steam and water is placed at the bottom of the outer shell. The stirring mechanism, the upper bracket of which also carries the shafting, is thrown in and out of gear by bevel pinions and lever. The stirrers in the pan are made of copper, and can be easily detached, to facilitate rapid and thorough cleaning.

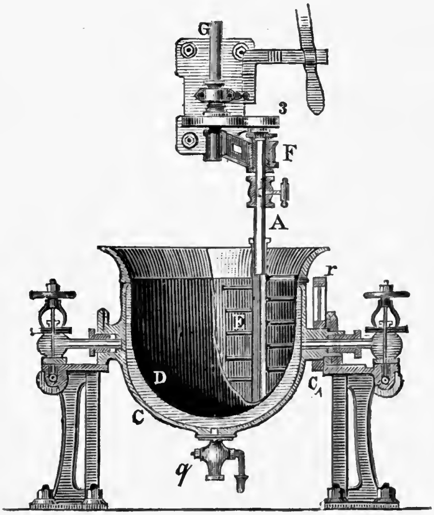


Fig. 22.—Huber's boiling pan (section).

To enable the pan to be conveniently emptied at any angle, a quadrant *r*, and pawl, are arranged on one of the trunnions.

These pans are made in all sizes, the smaller ones being fitted with a simple lever and ratchet-tilting device. The pan is fixed in the upright position by means of a separate locking-catch under the trunnions. The traverse, or crank *F*, is keyed on to the shaft, as is also the upper pinion, while the stirrer shaft *A*, with the keyed-on wheel 3, rotates freely in *F*.

A really excellent apparatus for dissolving starch and other dressing materials is constructed by the Koerting Co. of Vienna. It consists of an open iron trough (Figs. 23 and 24), along the bottom of which is laid a perforated steam-pipe, provided with a Koerting injector in its external upward extension. This steam agitator, which replaces mechanical stirrers, obviates the defects of these latter completely. Its effect is based on the circumstance that when a current of steam issues from a nozzle pipe into a wider one, it carries onward with it the surrounding air, and imparts thereto a velocity capable of overcoming the pressure of a column of water up to 8·2 ft. in height. The air, escaping vehemently from the holes in the pipe at the bottom of the vat, sets the surrounding liquid in violent, surging motion, and energetically stirs up all the sediment or additions lying on the bottom.

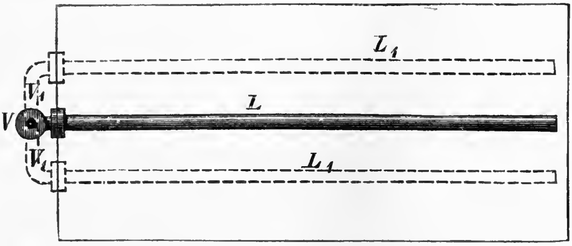


Fig. 23.—Bottom of the vessel.

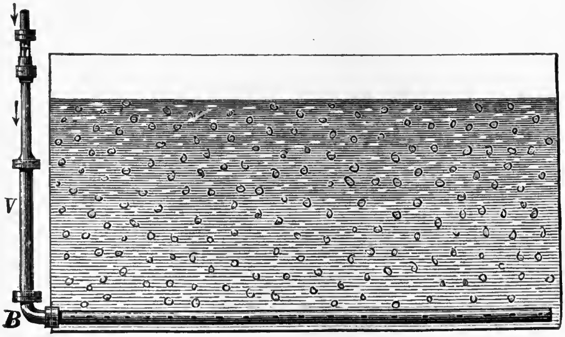


Fig. 24.—Starch-dissolving apparatus with steam injector.

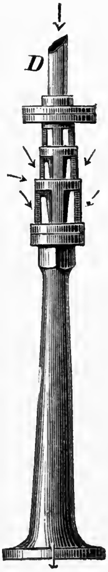


Fig. 25.—Koerting injector.

This apparatus possesses considerable advantages over all kinds of mechanical stirring appliances.

In mounting the apparatus, the injector is arranged by means of the connection piece *V*, at such a height that the lower edge of the intake-air openings is above the highest level of the liquid.

The air-pipes L_1 L are screwed on to the injector in the manner shown in the figure. They must not be of smaller internal diameter than experience has shown to be necessary. The air-pipes are provided with perforations on their under-side, not less than $\frac{2}{5}$ths of an inch in diameter; and the number of these perforations must be such that their total sectional area is not less than double that of the pipe. The air-pipes are placed about $2\frac{1}{2}$ inches above the centre of two sloping boards on the bottom of the trough, these being provided for the purpose of bringing the material that is to be distributed or dissolved into renewed contact with the injected air. When the trough is more than 27 inches wide, a single pipe will no longer be sufficient, and in such case additional pipes must be provided at intervals of 20 inches. The diameter of the steam valve and suction pipe must not be less than the prescribed dimensions. The action of the blower is regulated by the steam valve.

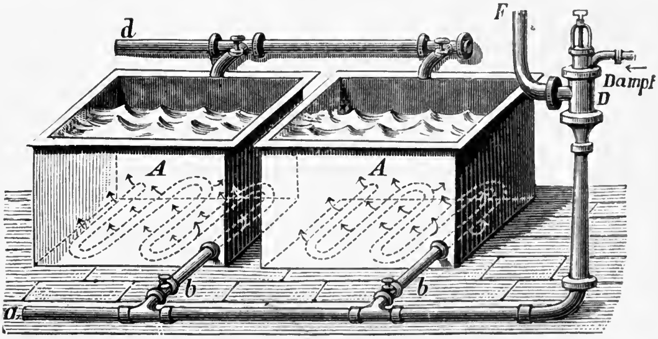


Fig. 26.—Compressed-air agitator.

Another suitable apparatus for securing intimate admixture of the various ingredients of dressing preparations is that, operated by compressed air, shown in Fig. 26. Here *A* is the tank containing the dressing preparation, *D* is a compressed apparatus, *a* is the air-pipe with branches, *b*, passing into the tank. The air is delivered through small perforations in a pipe situated in the bottom of the tank, and the ascending air-bubbles bring the entire liquid into a state of violent agitation, so that the several components are intermingled far better than by mechanical stirrers.

The compressed-air apparatus can be mounted in any convenient position; horizontal, vertical, or inclined.

It is a general rule with compressed-air apparatus that the pressure exerted by the blower increases with the steam pressure and the extent to which the spindle is screwed down. The delivery orifice for the air must not be too narrow, in order to avoid useless back pressure; and constrictions in the suction pipe are also disadvantageous. When the air escapes through a number of orifices, the total sectional area of these must not be less than 1½ times that of the pipe, as specified in the maker's list.

STARCH COOKER.

This apparatus (Fig. 27) differs from many others by its conical bottom. The starch, water, and any other ingredients are introduced into the cooker through a manhole in the cover, the valves, H_1 and H_2, of the steam circulation and external communication-pipe being open, and the discharge valve H_3 and steam-inlet valve closed. When the cooker is charged, the cover is fastened down tightly, and the steam-inlet valve is opened, whereupon the circulation of steam and liquid through the apparatus commences. This circulation is effected by means of a steam injector, arranged between the two valves H_1 and H_2, or else by an elevator, which forces the contents of the apparatus in a continuous manner through the circulation pipe from the bottom hopper to the top of the apparatus. The object of the conical bottom is to make sure that the starch granules collecting there shall not evade the uniform action of the steam and of the circulation. On reaching the top, the liquid falls on to a domed, copper disc, from which it drops, in the shape of a bell, into the cooking chamber. Should the elevator soon become choked in the case of very thick dressing, the valve H_1 is closed, and steam then enters the bottom of the apparatus through the valve H_2 and completes the boiling of the dressing. Finally, to empty the cooker the valves H_1 and H_3 are opened,

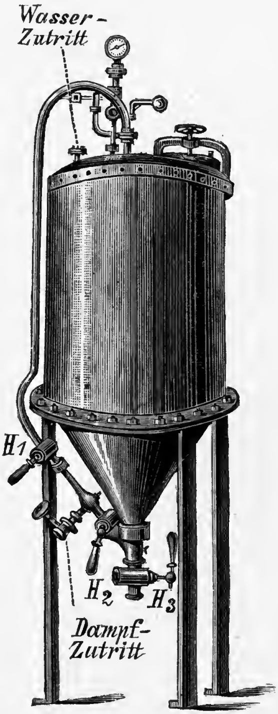


FIG. 27.—Starch cooker.
Wasser-zutritt = Water inlet.
Dampf-zutritt = Steam inlet.

but H_2 is closed, in order that the steam may enter the top of the apparatus and force the contents through the bottom outlet. A special connection for the admission of water, a pressure gauge, safety valve, and air valve, are also provided on the cover, as shown in the drawing.

Hampel's Cooker.

Hampel uses a closed pan (Fig. 28) for boiling dressing preparations, and works with a pressure of 5 atmospheres.

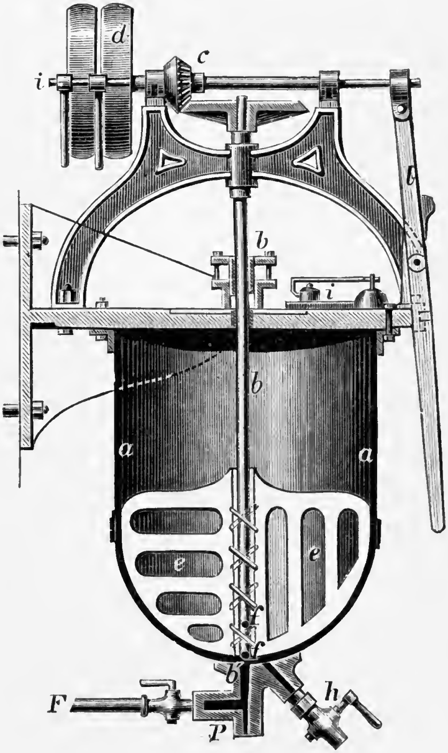


Fig. 28.—Hampel's starch cooker.

For this purpose the starch is introduced into the copper pan *a*, through an opening in the cover, which is also fitted with a safety valve and pressure gauge. The vertical shaft *b*, with the stirrers *e*, is then set going at a speed of 30 turns per minute, by means of the intermediate motion, and at the same time steam at a pressure of 5 atmospheres is admitted through the pipe *F* in the bored-out bottom shaft *b*. This steam issues through the perforations *f*, into the starch, and greatly facilitates uniform mixing. By this means a perfectly limpid starch paste is obtained in about three-quarters of an hour, and is then drawn off through the tap *h*.

PRÜFER'S STARCH COOKER.

The apparatus shown in Fig. 29, for boiling sizing preparations, consists of a cylindrical copper pan mounted on a cast-iron frame. A coiled pipe, arranged inside the pan and connected with the steam valve, prevents the particles of the sizing preparation from settling at the bottom, as well as ensuring uniform boiling. The most important part of the apparatus, however, is the mechanical stirring device, two patterns of which are made; a belt-driven rotatory set for thin dressings, and a reciprocating set, operated by a crank, for thick or thin preparations.

FIG. 29.—Prüfer's starch cooker.

The metal stirring device is formed of a vertical shaft, with horizontal stirring rods and inclined paddles. Between these rotary stirring rods are provided a number of fixed spiral coils of wide metal. On starting the stirrers, the paddles raise the heavy ingredients of the mass, so that they can be worked about by the stirring rods, which force the whole against the flat spirals and cause it to take a sinuous course, the materials being incorporated in this way with a saving of about 20 per cent. of starch, size, etc.

The internal temperature is recorded by a thermometer inserted from the outside. The pan is not hermetically closed, and consequently the inside is readily accessible, and the condition of the dressing can be inspected by way of the two top covers, which are fastened with hinged screw clamps, the operation being at the same time entirely protected from danger. The mass can be stirred and mixed at temperatures up to boiling-point, and also without the admission of steam.

Of great importance for makers of yarn size and dressings is a special form of apparatus, for boiling sizes made of potato starch and glue. This is a jacketed pan, and as no direct steam is admitted, the mass remains of uniform consistence, the stirrers completely mixing and incorporating the glue with the dressing, a point of great importance for the quality of the product. The apparatus being of the covered-in type, no cleaning out is required, beyond scalding it out with water and setting the stirrers to work.

Rushton's Size Boiler.

The apparatus (made by G. Rushton of Darwen) is based on an entirely different principle from the ordinary boiling pans, and bears some resemblance to an injector, inasmuch as it chiefly consists of a strong copper pipe into which the cold starch solution is forced by a pump. The pipe is mounted close to the sizing trough, and is provided at the bottom with a steam-inlet pipe, in addition to the pipe connection for the crude size. At the top, the pipe is situated in the size tank. The pump forces the crude size down in the cylinder, where the starch solution comes into direct contact with live steam. Thus boiled, it passes through the upper branch pipe to the machine. The requisite pressure is supplied by the pump; and, in order to ensure all parts of the solution being brought into contact with the steam and thoroughly boiled, the copper cylinder is divided into a number of separate compartments by perforated partitions, through which the steam and starch solution have to make their way. The pipes are fitted with valves for regulating the flow of steam or crude size; and a pressure gauge is provided for controlling the steam pressure.

Sifting Machine.

To render the dressing preparations perfectly homogeneous, and more especially prevent lumpiness, the preparations are passed through a sieve or sifting machine. One of these machines, illustrated in Fig. 30, consists chiefly of two brass pans, with gauze-sieve bottoms, mounted on an iron frame and revolving at uniform speed. This rotary movement is imparted by toothed crowns at the bottom of the sieves, engaging with the driving pinions. Each sieve is provided with a brush, the bristles of which act on the gauze, and the brush itself receives an eccentric reciprocating motion, so that it is brought in contact with all parts of the sieve in succession. The machine is driven by a fast-and-loose pulley attachment on the side of the frame.

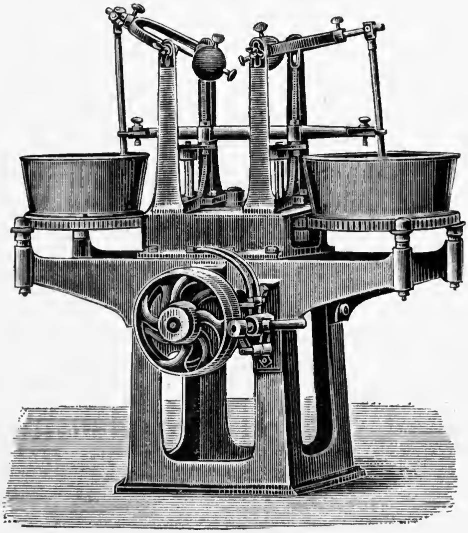


FIG. 30.—Sifting machine.

CHAPTER XII

RECIPES FOR DRESSINGS

DRESSINGS FOR LINEN AND COTTON.

AT one time the finishing of linen goods was a simple operation, and even now there are certain fabrics that are sold in the same condition as they leave the loom. Many receive a full finish, like cotton goods, and for this purpose are treated with dressing in a starching machine. A great number of linens and unions, however, are not put through the starching machine, for which, as a rule, the fabric has been prepared by sizing the yarn. The dressing used is some dilute preparation, often merely highly diluted alkali silicate, and the goods are then left in a heap for some time to allow the liquid to permeate the fabric thoroughly. The next step in the production of an ordinary gloss, such as is given to many unions and particoloured fabrics, is to pass the goods through a hot calender, or else mangle and calender them alternately. Fine crashes, damasks, and the like, and also vat-dyed linens, are simply passed through the old box-mangle a sufficient number of times, to firm the threads, without flattening them, and to impart a moirè or watered effect. The whiteness of the goods, however, must not be impaired by the use of imperfect warp size.

The introduction of cotton brought into existence entirely new ideas in connection with finishing, and led to more systematic procedure. Cotton, which at first was only used in admixture with flax yarn, had to struggle hard in competition with linen. Endeavours were made to imitate the appearance of the latter by giving the cotton a "linen finish," the chief features of which are a cold, smooth feel, moderate gloss, firmness, and unflattened threads. Starch dressing for imitating linen finish contains various adjuncts, such as dextrin, size, vegetable size, vegetable mucilage, and also some fatty ingredients like fat, soap, stearine, wax, etc., together with such mineral substances as kaolin, China clay, talc, and the like. For "full finish" the warm mass is applied to both sides of the fabric, which is then hung up to dry or put through a drying machine, and in some cases put through a cold calender with very low pressure. In any event, however, it is mangled like linen, this treatment leaving the threads round. Dressings for chiffon and shirtings are compounded and applied in the same way, except that mangling is omitted, the goods being flattened in a more or less hot calender. Cottons intended to have a rough, woolly, matt appearance, *e.g.* cretonne finish, are dressed with dextrin solution, alone or mixed with thin starch paste, but no fat, except that, to improve the mildness of feel, a little soap is added. After starching and drying, goods for dull finish are not damped, but rolled and unrolled several times, and put through a finish breaker or cold calender, the metal bowls of the latter being covered with cloth, or surrounded by an endless cloth backing, in order to prevent glossing the fabric.

To impart high lustre and feel to dyed or printed cottons, mollinos, Texas, etc., they are treated with a starch dressing rich in fat, with or without filling ingredients, and after being dried are well damped and put through a hot friction calender, *i.e.* glazed or lustred.

For a high gloss, the goods, starched in the above manner, are put through a waxing machine before frictioning; or else they are calendered without friction, and then (especially mollino handkerchiefs) are passed under the agate bowl of the glazing calender.

Bookbinders' calico, linings, accordion-pleat fabrics, etc., are starched repeatedly with fatty dressings and dried after each passage, to enable them to take up a maximum of dressing, this being essential in view of the subsequent moiréing. They are then damped after the second or third drying, and lightly calendered to impart smoothness, then damped and passed through the moiré machine, the rollers of which are heated by steam, gas, or wood embers. This class of calender is provided with an iron bowl engraved with longitudinal, cross, or diagonal lines, fine dots, checks, or similar patterns, which are impressed into the fabric and dressing of the cloth passing between this bowl and a second iron bowl, thus producing twill, and other patterns in relief. An irregular pattern engraved on the bowl produces a lustrous watered effect on stiff-finished goods.

Satin fabrics with soft, glossy satin finish, will successfully imitate silks. The dressing for this purpose consists mainly, if not wholly, of soap solution, mixed with dilute vegetable mucilage and a little glycerine. In the absence of starch, it is sufficient to pass the dried and damped goods repeatedly through the hot calender, with heavy pressure, in order to obtain the requisite combination of gloss and softness. Fabrics of similar character to percale or calico, treated with thin satin dressing containing potato starch, wax, or paraffin in addition to soap, vegetable mucilage, and glycerine—to which are sometimes added a little borax and Glauber salt for the lustre of silk, and common salt to impart scroop—will come out too stiff after drying and calendering, and must therefore be put through a finish-breaker, and finally beetled, to produce the requisite soft and mild feel (satinising).

With jaconnets, batistes, muslins, and organtines—fine and not very closely woven cotton fabrics—drying before and after starching plays a not unimportant part. In order to maintain, or rather restore, the natural breadth of these fabrics and the proper alignment of the warp and weft threads, so that the roundness of the latter may not be impaired, they are dried on stenting frames (like heavier fabrics) instead of on drying cylinders. By providing the chains of the stenting frame with an intermittent, reciprocating movement, so that the selvedges of the cloth can be made to move forward and backward parallel with the warp threads, the dressing is prevented from settling in the meshes of the fabric, and at the same time the dressing adhering to the threads is broken in the drying process, so that the goods have an elastic ("broken") finish instead of being stiff.

A characteristic feature of "back finish" is that the face of the goods is soft and natural, whilst the back is firm and leathery without gloss. It is owing to this peculiarity that back finish is applied to white and undyed fabrics, as well as printed goods. This finish also leaves intact the raised patterns of brilliantines, piqués, twills, etc., because the patterns are not squeezed flat, as they would be between the heavy metal bowls of the ordinary finishing machine. These goods are merely beamed, and not calendered, after starching.

The dressing preparation for fustians and similar goods with single and double pile, consists of dextrin or size with a little Turkey-red oil. After drying and damping, the goods are put through the raising gig once or twice, to raise either one or both sides, and restore the pile that has been flattened down by the previous treatment. For the same reason, the goods on leaving the gig are not wound on rollers but left flat.

In the finishing of linens the determining factors are the maintenance of the prescribed width, the production of the degree of dampness requisite for calendering and mangling, and the retention of the pristine brightness and purity of the colour. It is a source of great inconvenience to both finisher and manufacturer when the goods come out wider or narrower than they should be according to the calculations of the weaver.

Any variation in the treatment of the fabric, even in the same calender, affects the width in different ways. Damping before calendering increases the tendency to contract in the width; and this is intensified when the damped fabric is hot calendered under heavy pressure. A portion of this lateral contraction is due to the increased pressure, which tends to produce longitudinal stretch. On the other hand, dry or only slightly damped goods lose very little in width. It is thus evident that the calculations of the designer must take into account the kind of finishing process the goods will have to undergo, though, on the other hand, the finisher has various means available for preventing lateral contraction. It is, however, impossible to lay down any hard and fast rules, so much depending on the character and quality of the fabric. A remarkable difference in the effect of finishing will be observed between dry and damp-calendered or mangled goods. Whereas the former are dull and limp, the latter handle fuller and more glossy, no matter whether they have been dressed with starch or dextrin, or merely damped. In damping, the most important point to be considered is the hygroscopic character of linen fibre. Very dry fabrics often need damping with 3 to 4 per cent. of moisture, and since the dry fibre absorbs water greedily, the damped material will appear perfectly dry again in a few hours, without having lost in weight at all subsequent to damping. Simple exposure to the air results in the absorption of about 2 per cent. of moisture by linen fibre in a short time; and in such event no further damping is needed for finishing, an excess of moisture being attended with unpleasant results, for even though mangle creases and other injuries do not always occur, the resulting "sweating" makes the colour dull, the threads no longer stand out, and the surface is uneven and scarred.

The tarnishing of the colour in mangling is a defect of frequent occurrence. When very pronounced, the surface of the goods seems to be coated with a dirty film or blackened. According to one expert, the starch used for sizing the warps undergoes partial decomposition, being converted into dextrin, which contributes to make the goods look tarnished and brownish. Starch is known to undergo transformation into dextrin easily, at a comparatively low temperature, a circumstance explaining the observation that iodine will give a far more intense blue coloration with unfinished goods than after finishing. It is also possible to detect whether the warps have been sized, or the fabric dipped in, or merely sprayed with, starch solution. This last method of applying starch is the best, being cheaper and giving purer colours.

The tarnishing of colours during the finishing process is also in part certainly attributable to the presence of certain agglutinant substances in flax, which have not been completely eradicated in bleaching, and indeed, in the case of certain flax yarns, cannot be so eliminated. In better-class makes this defect is obviated by passing the goods more quickly through the mangle, and repeating the operation several times at the same velocity. Inferior mixed fabrics (unions), with cotton warp and strong flax or tow wefts, cannot well be stiffened in finishing. To produce a good effect in these fabrics it is necessary to draw the cotton warps very tightly in beaming, owing to their elasticity and liability to stretch. The best way to finish these goods is to damp them moderately, calender well, mangle for seven to ten minutes, damp slightly, re-calender, mangle again, and leave for twenty-four hours to cool. Thus treated, the finish will be good, and the appearance similar to pure linen goods.

Finally, the twist of the weft threads also has an influence on the finish. Goods made of hard-twisted weft never have the same handsome and close appearance as those made with lightly twisted or softened weft. If the goods be damped and left twenty-four hours before mangling, the particles of starch and adhesive substances swell up more easily and fill the interstices between warp and weft, so that they thicken under the heat of mangling, and impart to the fabric a handsome gloss and agreeable feel, which is not the case with fabrics made of hard-twist yarns. A very widespread mistake is to suppose that machines of the same construction will also invariably produce an equal effect, this not being the case; and it is often found that each machine has its peculiarities, as the result of being used for a long time on a certain class of goods requiring a heavy or light pressure. In many cases, calender bowls made of papier maché undergo alteration under heavy pressure, and become softer. Goods calendered by these bowls acquire a thick, spongy feel, whereas well-hardened paper bowls produce a thin, parchment effect.

"Linen-Finish" Dressings for Cottons or Linens.

	Parts by weight.
Water	100
Florida earth	6¼
Potato starch	3¾
Wheaten starch	3
Blanc fixe	3¼
Wheaten flour	1¼
Fatty adjunct	¾

Finest wheaten starch	16
Water	250
Alum (free from iron)	¼
Glue water	2½
Carragheen mucilage	3

Water	120
Wheaten starch	30
Water	84
Potato starch	2½
Finest wheaten starch	2½
China clay	2½
Carragheen mucilage	2½
Magnesium carbonate	¼
Tallow	¼
Marseilles soap	¼

	Parts by weight.
Water	150
Best wheaten starch	2
Potato starch	2

Water	150
Potato starch	3½
Wheaten starch	2½
Mineral white	2
Blanc fixe en pâte	1½

Water	150
Wheaten starch	1½
Potato starch	1½
China clay	2
Mineral white	2
Gelatine	0·1*
Marseilles soap	0·1*
Carbonate of soda	0·1*
Tallow	0·15*
Stearine	0·15*
Cocoanut-oil	0·2*

* Boiled separately and added to the dressing.

	Parts by weight.
Water	140
China clay	5
Lead sulphate	7½
Mineral white	4
Tallow	2
Wheaten starch	7½
Fatty adjunct	2½
Potato starch	12½

Water	150
Wheaten starch	2½
Potato starch	1
Wheaten flour	1
China clay	2½
Mineral white	4
Glue	0·1
Fatty adjunct	0·4
Rosin ,,	1

Water	150
Potato starch	2
Wheaten starch	2

	Parts by weight.
Rice flour	1½
China clay	2
Mineral white	2
Gelatine	0·1*
White wax	0·15*
Stearine	0·15*
Cocoanut-oil	0·15*
Marseilles soap	0·15*
Carbonate of soda	0·15*

Water	150
Wheaten starch	2
Potato starch	2
Wheaten flour	2
China clay (in paste)	3½
Mineral white	3½
Blanc fixe (paste)	3½
Glue	0·1
Stearine	0·1
Cocoanut-oil	0·1
White soap	0·05
Carbonate of soda	0·05

* Dissolved separately and added to the dressing.

DAMASK DRESSING.

	Parts by weight.
Water	100
Wheaten starch	1½
White wax	⅛
Stearine	⅛
Pure dressing soap	¼
Ultramarine	0·3

The wax, stearine, and soap are boiled in water by themselves until dissolved, then stirred in with the mixture of starch and cold water, and the whole is boiled for five to ten minutes from the commencement of ebullition. If the fabric be so close in texture that it requires little or no dressing, it should at least be sprinkled with a small quantity of suitable dressing preparation, in order to impart a fine gloss and prevent woolliness. An approved recipe for this purpose is the following:—

	Parts by weight.
White beeswax	500
Stearine	750
Dressing soap	125
Gelatine	125
Soda crystals	15
Wheaten starch	500

The ingredients are boiled until dissolved, and are then mixed with the starch.

Whilst still hot, the mass is thinned down with 70,000 to 80,000 parts of warm water (not below 109° F.), with constant stirring. The fabric may be damped with this liquid either by means of a brush or machine, care being taken in the former event that the liquid is uniformly distributed in very small drops. If the liquid is not for immediate use, but has to be stored for a few days, it should receive an addition of 0·01 to 0·02 per cent. of salicylic acid.

Damask that has been well mangled, and eventually beetled, will be improved in appearance by a passage between a pair of wooden, paper, or cotton rollers.

Dressings for Shirtings.

Water 150 parts, wheaten starch 1½, potato starch 1½ parts.

Water 150 parts, wheaten starch 2, potato starch 2, wheaten flour 3½, China clay 3½, mineral white 3½, barium sulphate 3½, gelatine or pale glue 0·15, stearine 0·15, cocoanut-oil 0·15, white soap 0·10, soda crystals 0·05 part. The gelatine and other small adjuncts are dissolved before being added to the rest.

Water 150 parts, wheaten starch 1½, potato starch 1½, wheaten flour 1, China clay 1½, mineral white 1½, glue 0·3, barium sulphate 1, stearine 0·075, cocoanut-oil 0·1, soap 0·15, soda 0·075 part. The glue, etc., to be dissolved separately before adding to the dressing.

Water 120 parts, wheaten flour 2½, China clay 2½, mineral white 0·01, cocoanut-oil 0·4, Marseilles soap 0·25, soda 0·125 part.

Water 150 parts, potato starch 2½, wheaten flour 1½, China clay 1½, mineral white 2½, cocoanut-oil 0·15, white soap 0·2, soda 0·075 part. The last three to be dissolved first.

Water 120 parts, potato starch 6¼, mineral white 3¾, blanc fixe 2½ parts.

Water 120 parts, wheaten starch 6½ (steeped in 2 parts of spirits), potato starch 7½, rice meal 2½, soap 0·25, stearine 0·25, white wax 0·25 part.

Protamol Dressings.

1. Protamol is stirred up with 12 to 16 parts of water, and boiled for five minutes or longer, the dressing penetrating the fabric better in proportion as boiling is prolonged. An addition of about 5 parts of soda per 1000 of dressing will improve the solubility. In dressing fabrics, the colour of which would be effected by weak alkaline solutions, it is advisable to neutralise the mass with acetic acid until it no longer gives a blue colour reaction with red litmus paper.

2. For Light Finish: 60 to 70 parts of protamol are stirred up with cold water and boiled for twenty to thirty minutes with about 940 parts of water.

3. For Heavy Dressing: 80 to 100 parts of protamol are stirred up with cold water, and boiled for twenty to thirty minutes with about 900 to 920 parts of water.

To prepare 2 cwt. of dressing, 13 to 15 lb. of protamol are stirred with water and made up to 20 gallons (the rest being furnished by the condensation of steam). The mass is then boiled for twenty to thirty minutes. The longer protamol is boiled the better. When a very thin protamol dressing is desired, 1 to 2 parts of sal ammoniac per 1000 of water are added at the commencement of boiling.

Dressings for Lining (without loading): Protamol 70 parts, water 930 parts. Protamol 70 parts, paraffin wax 2, wax 5, water 923 parts.

Muslin Dressings (Indigo, grey, or black): Protamol 70 parts, sulphate of magnesia 50, monopol soap 5, water 875 parts.

Protamol 70 parts, sulphate of magnesia 50, glucose 50, Turkey-red oil 5, water 825 parts.

These two dressings are also suitable for blue print.

Cotton Beaver: (*a*) for heavy goods—protamol 25 parts, Turkey-red oil 3, water 972 parts; (*b*) for light goods—protamol 70 parts, Turkey-red oil 3, sulphate of magnesia 50, water 877 parts; (*c*) for light sizing—protamol 60 parts, water 940 parts; (*d*) for heavy sizing—protamol 70 to 80 parts, sulphate of magnesia 50, Turkey-red oil 3, water 777 to 767 parts.

CHIFFON DRESSINGS.

Water 120 parts, potato starch 2½, wheaten starch 1½, wheaten flour 2½, China clay (paste) 2½, mineral white 2½, talc 1½, cocoanut-oil 0·25, stearine 0·25, Marseilles soap 0·125, soda 0·125 part—the last four dissolved separately.

Water 140 parts, wheaten starch 2½, potato starch 2½, wheaten flour 4, China clay (paste) 7½, mineral white 5, cocoanut-oil 0·25, white soap 0·25, soda 0·125 part—the last three dissolved separately.

Water 120 parts, potato starch 4, China clay 5, wheaten starch 4, rice meal 5, mineral white 2½, talc 1½, stearine 0·25, soap 0·125 part.

Water 120 parts, wheaten starch 1½, potato starch 2½, wheaten flour 1½, China clay 2½, mineral white 2½, Venetian talc 1½, stearine 0·25, soap 0·125 part.

Water 75 parts, wheaten starch 1, white wax 0·2, stearine 0·2, Marseilles soap 0·3, soda crystals 0·15 part—the last four dissolved separately.

DRESSING FOR "GERMAN LEATHER."

Glue 30 to 35 parts, softening 2½ parts, with a sufficient quantity of water. Bone or leather glue is not so good for this purpose as hide glue, the fat in which renders it particularly applicable. The smell of the glue in hot weather can be obviated by adding a small quantity of sodium arsenate, salicylic acid, carbolic acid, acetic acid, or artificial oil of bitter almonds. The glue should not be boiled too often or too long, this treatment spoiling its property of gelatinising on cooling.

This glue dressing is applied to the fabric by means of a starching calender, the two rollers (wood or brass) being wrapped with muslin. The copper trough for the dressing is provided with a jacket bottom, so that the dressing can be heated by steam under pressure.

The rollers are loaded by a suitable weight, no lever or pressure being needed. The fabric is passed through the liquid and over the roller in the vat, so that both sides of the fabric absorb dressing; after which the stuff is conducted to the lower roller and pressed. The dried pieces are soaped, to improve the softness and feel, and to loosen the nap stuck down by the dressing.

About 1 lb. of Marseilles or other perfectly neutral soap is dissolved in 11 gallons of boiling water, and sufficient of the strained solution is put into the vat to wet the bottom roller, the goods being then passed once through the soap solution, so that the face of the fabric comes in contact with the roller, the direction of movement coinciding with that of the pile. The goods must not be creased, or the pieces will have to be washed. After the passage, the goods are lightly raised, to loosen and smooth the pile before drying.

The next stage is shearing in a 2-cylinder machine with round table, the construction of which is important. The dried, raised, and dressed goods are improved in appearance and feel by the shearing process, so that great stress is laid on the operation.

Dressings for Bleached and Printed Cottons.

Water 224 parts, potato starch 10, wheaten flour 5, China clay (paste) 5, mineral white 6, Venetian talc 2½, carbonate of magnesia 2, stearine 0·25, soap 0·125 part.

Water 120 parts, potato starch 6, wheaten starch 2½, wheaten flour 1½, China clay (paste) 2½, mineral white 2½, Venetian talc 1½, Marseilles soap 0·25, stearine 0·25 part.

Water 840 parts, wheaten starch 6, potato starch 7½, wheaten flour 3¾, China clay (paste) 7½, mineral white 5, Venetian talc 1½, stearine 0·35, Marseilles soap 0·25 part.

Water 170 parts, wheaten starch 2½, flour 5, China clay (paste) 6, mineral white 6, stearine 0·5, cocoanut-oil 0·25, Marseilles soap 0·5 part—the last three dissolved separately.

DRESSINGS FOR LIGHT, THIN SHIRTINGS.

Water 840 parts, potato starch 9, wheaten flour 5, China clay (paste) 7½, mineral white 6, tallow ½ part.

Water 110 parts, fine wheaten starch 10, alum 0·5 part.

Water 120 parts, wheaten starch 6, potato starch 2½, mineral white 5, carbonate of magnesia 1 part.

Water 140 parts, wheaten starch 6, potato starch 7½, wheaten flour 3, mineral white 7½, olive-oil 0·5, stearine 0·5, soda crystals 0·25 part—the last three boiled together and added to the rest.

BIELEFELD DRESSING (FOR COTTON-LINEN UNIONS).

Water 300 parts, pale dextrin 10, wheaten starch 20, sulphate of magnesia 10, talc 5, Turkey-red oil 1, carbonate of soda 0·3 part.

The starch and usual adjuncts are boiled for an hour.

The goods are first calendered under half-pressure in the cold, and after being starched are left for a day to cool thoroughly. They are then damped well with cold water, and calendered twice, hot, under heavy pressure. Before calendering, the goods must be left to get uniformly damp, which takes at least six to nine hours. To obtain higher gloss, 3 parts of stearine melted in 0·3 part of alcohol must be added.

KEERN & STENHOUSE'S DRESSING.

Nine parts of kaolin are mixed with 5 parts of calcium sulphate and 5 of dextrin (or 8 parts of kaolin, 2 of calcium sulphate, and 7 of dextrin), 5 to 10 per cent. of fat being added. For use, the mass must be boiled with sufficient water to give it the desired strength.

DRILL DRESSING.

Water 100 parts, wheaten starch 4, dextrin 6, sulphate of magnesia solution (8° B.) 10, palm softening 2 parts.

The goods should be cold calendered, and folded with the pattern inside. The dressing must be boiled for at least two hours.

SOFTENING, STARCHING, AND LOADING PREPARATION FOR FABRICS.

Use is made of a bath prepared by dissolving casein and oil (or in the case of yarns and finished fabrics, casein alone) in a solution of soap, and adding the loading ingredients desired. For example, the bath is made up of casein 16 parts, soap 8, mineral or other oil 60, water 300, loading materials 200 parts. The casein must be free from acid impurities.

GOUCHE'S DRESSING.

Best potato starch is mixed with sufficient indigo sulphate to impart the desired shade of colour, then dried, left for forty-eight hours in a drying chamber, and treated to an addition of 0·4 per cent. of white wax. On stirring the mass up with warm water and pouring it into boiling water, a blue, clear paste is produced, which, without corroding or spoiling the goods, will give them a lustre and enduring white on being ironed with a hot iron or calendered.

FOR COTTON DIMITY.

Water 100 parts, dextrin 6, Turkey-red oil $\frac{1}{4}$ part, applied once to the face of the cloth, which is then dried, damped, raised once or twice, but not beamed or the nap will be spoiled.

FRENCH NATURAL FINISH FOR BLEACHED SMOOTH CALICOES.

The pieces are calendered in the wet state and starched in a machine, the upper roller of the calender being only lightly weighted in order to leave the threads as round as possible. The following preparation is used for filling:—

Five parts of potato starch, 7$\frac{1}{2}$ of wheaten flour, and 5 of wheaten starch are boiled for some time in 250 parts of water until all have united, 10 parts of China clay, in paste, being added with 10 parts of French mineral white. After re-boiling, a solution is added consisting of $\frac{3}{4}$ part of cocoanut-oil, $\frac{1}{2}$ part of white soap, and $\frac{1}{4}$ part of carbonate of soda, in 3 parts of water. The mass is turned into a vat containing 15 parts of potato starch in 75 parts of water, the addition being made gradually and with continued stirring. A further 5 parts of potato starch, mixed with a little water, are stirred in, and after adding a small quantity of blue, the dressing is ready for use.

The starched goods are dried in the drying-room or machine, then damped in the machine, and rolled up under considerable pressure, being left on the roller all night. Cottons dressed in this way have no gloss, but feel very soft and delicate, can be easily folded, and exhibit the character of natural finish.

LINEN FINISH.

It is easy to understand that the attempt to impart to high-grade cottons the appearance of linen fabrics, should have led to the introduction of a number of various methods calculated to accomplish the purpose in view.

The simplest of these is to treat the dry goods in the mangle or in the calender at a low pressure, to prevent the threads from being crushed too flat, and then damp them with water containing a specially prepared dressing. This dressing consists of separately prepared solutions of wheaten starch, glue, and Carragheen moss.

One part of best wheaten starch is boiled in 15 parts of water, so as to produce a moderately consistent paste when cold, 0·15 part of alum being added during the boiling. The mass, covered up lightly, is stored in a moderately warm room, until it exhibits a slightly acid reaction. For the glue solution, 1 part of glue is taken to 15 of water. The water used for damping consists of 15 parts of lukewarm water, 5 parts of starch in course of fermentation, 2 to 4 parts of the above glue solution, and 5 to 10 parts of Carragheen mucilage, the separate solutions being mixed together and with the water. The goods are damped in the machine, left for twelve hours tightly bound up, then mangled and beamed, the operations being repeated several times. The glue water stiffens and glazes the fabric, the moss mucilage softens it, and the starch gives the filling.

Another linen finish is produced as follows:—

The fabric coming from the bleaching process is transferred in a drained or squeezed condition to the starching machine, starched, dried in cold air, damped, mangled, damped again, and mangled a second time.

The dressing is prepared by mixing 20 parts of wheaten flour with 112 parts of hot water, the mixture being boiled and mixed with a decoction of 20 parts of wheaten starch in 70 of water. Another 20 parts of wheaten starch are mixed with 70 parts of slightly warm water and a little indigo laundry blue, the mass being used hot for starching. The resulting preparation contains on the whole 60 parts of starch, and when made up with the lb. as unit weight, will suffice for thirty 77 yd. pieces of material, so that 2½ lb. of dressing will be in each yard of stuff—a fairly large amount.

Another linen-finish dressing is prepared as follows:—

Fifteen parts of a drained paste of lead sulphate or barium sulphate and 10 parts of China clay are stirred with a little lukewarm water and placed in a boiling pan containing 210 parts of water. To this should be added 7½ parts of mineral white, 2½ parts of white clay, and 15 parts of wheaten starch, the whole being suitably boiled, after which 5 parts of palm-oil are added, and boiling is continued for a short time. Next, 12½ parts of potato starch are mixed to a paste with 140 parts of lukewarm water, blued with ultramarine, and suffused with the aforesaid liquid, boiling hot. The dressing contains 420 parts of water, 37½ parts of solid mineral substances and 27½ parts of starch, and impregnates the fabric with comparative ease. Finally, the goods are damped with lukewarm water, containing a little soap, left to draw for ten to twelve hours, mangled 2 to 4 times, with frequent turning, and are then ready for dispatch.

For Calicoes Made of Strong Yarns.

These goods are finished by a full starching with the following preparation: 12½ parts of bleaching earth (boiled by steam and mixed with soda crystals) are dissolved with 6½ parts of potato starch, 5 parts of wheaten starch, 2½ parts of flour, and 1½ parts of any convenient fat, and boiled, the fabric being impregnated with the mass, and mangled 3 times after drying.

For Cottons.

These goods are generally wet calendered, starched while wet, dried in a steam drying machine, and damped well with condensed water, wound under heavy pressure, left to draw, then calendered under gentle pressure on a lukewarm roller, and when cold, re-calendered with a rather hotter roller. They are next damped on the right side with soap solution, beamed very tightly, and put through the mangle backward and forward 5 to 6 times. To give them the appearance of best shirting, they are turned, face inward, after the first mangling, and mangled 3 to 4 times, then reversed and mangled again.

German Dressings.

Water 250 parts, potato starch 7½, wheaten starch 3½, wheaten or rice flour 3½, China clay 10, mineral white 5, stearine ½, and Marseilles soap ¼ part, are boiled together, and a sufficient quantity of ultramarine is added to the finished dressing.

Saxon Dressing for Coloured Cotton Trouserings.

The dressing consists of 7 gallons of warm water, 7 gallons of moss mucilage, 7 gallons of potato starch gum, and 1 lb. of glue, all boiled together.

The goods are starched on one side in the machine, and dried at once, to guard against the colours being dissolved and smeared by the water in the starch. According to the desired amount of stiffness and body, a greater or smaller pressure is applied in starching. When dry, the goods are calendered, without heat, and under moderate pressure.

Dressing for Shirtings or Shirt Calicoes.

Wheaten starch 50 parts, potato starch 50, white clay 50, mineral white 40, white glue or gelatine 2⅜, white wax 7½, stearine

7½, white soap 5, and soda crystals 2½ parts, are boiled in 2500 parts of water. The goods are starched with this dressing, and then dried, damped with soap solution, left to draw, and calendered under heavy pressure, or mangled.

Dressing for Coloured Jaconnets and Similar Fabrics.

These cold-dyed materials are treated with cold dressings in order not to dissolve out the dye. The dressing consists of 280 parts of water (coloured with a little logwood decoction), 10 parts of potato starch, 6 parts of wheaten flour, 1 of yellow wax, 1 of palm-oil, and ½ part of tallow. The ingredients are melted together; and after being allowed to cool down partially, are treated with 0·375 part of tartaric acid, and 6 parts of dissolved rosin. After the goods are dressed they are dried on steam cylinders (very sensitive colours being dried in the air), and are passed one or more times through a 3- or 5-bowl calender, the hot roller being strongly warmed.

Bohemian Finish for Figured Cottons.

The squeezed fabric is starched, wet or dry, under heavy pressure, dried on steam rollers, damped, and the stiff finish broken by winding the goods up tightly in a damp state. Finally, they are put through the mangle.

The dressing is composed of: water 330 parts, wheaten starch 10 to 12½, potato starch 5, mineral white 7½ to 10, carbonate of magnesia 1½ to 2 parts, and a little ultramarine blue. For goods that are to be heavily mangled, white wax and stearine are added.

Dressing for Rough, Unbleached Calicoes.

Goods of this nature, for army use, being usually of very low quality, are loaded and faced, which treatment imparts a soft finish without lustre.

To 35 gallons of finished dressing take 15 lb. of wheaten starch of low quality, 10 lb. of potato starch, 15 lb. of China clay, 10 lb. of lenzinite or sulphate of baryta, and 2½ lb. of glue, all of which are boiled along with the starch dressing, 2¾ to 3½ gallons of rosin solution being then stirred in. About ¾ to 1 gallon of calcium chloride may be added to improve the soft feel of the goods. After starching, dry in the cold, or over steam-heated rollers, break the finish on wooden-breaker rollers, or damp well and wind up tightly to draw.

The finish must not be broken in a calender, since this would flatten the threads and produce an undesired gloss, the goods being intended to be soft, dull, and easily folded.

JEANNOLLES'S DRESSING FOR BLACK GOODS.

Ordinary dressings do not impart any colour to dyed goods, and sometimes even lighten the colour of dark goods, especially in the case of black fabrics. Jeannolle therefore proposed to employ a coloured dressing for these latter, in order to increase their depth of colour instead of the contrary.

The dressing consists of a substance containing tannin, oxidised by copper sulphate, and mixed with an albuminoid substance. This gives an insoluble, dark-coloured dressing, which imparts body and firmness to the fabric without injury to the colour. As an example, chestnut-wood extract, copper sulphate, and ox blood may be taken and mixed together, the thick, mucilaginous substance being applied to the goods, on which it forms a kind of varnish when dry, the coating being insoluble in water, increasing the depth of colour and producing a certain amount of gloss.

ALSATIAN FINISH.

The Alsatian finishing process consists in drying the bleached and gassed fabric, starching, drying under fairly heavy pressure, damping with soft water, beaming under heavy pressure, and leaving to draw for six to ten hours. Finally the goods are passed through a calender with 6 to 7 layers of backing, under moderate pressure, and with the hot roller at a moderate temperature.

PARISIAN DULL FINISH FOR PLAIN COTTONS.

For this finish the goods are tightly beamed and passed through a straightener consisting of two fluted iron rollers covered with caoutchouc, the flutings being arranged to engage together and stretch the goods, the amount of stretch being accurately adjustable. The fabric is then damped, wound up, and left to draw, partially dried on a 3-roller steam-cylinder drier, put through the stretching machine, then re-dried, stretched a third time, and finally put through the drying machine again, the speed of the latter being regulated so that the goods are not completely dry until the third passage. In this somewhat roundabout manner, Parisian finishers obtain a peculiar, natural finish, the goods retaining their original width without any sign of having been stretched by force. The chief difference between Parisian and Saxon finish is that in the latter the goods are not stretched, and that the drying is completed in one operation over several steam cylinders.

Parisian finish is specially employed for upholstery fabrics desired to retain the original softness of the material and exhibit no trace of stiffening. In order to load the goods, the damping water is treated with an addition of glue, gum, starch, or dextrin solutions.

Scroopy Finish for Imitation Linens.

Unions will acquire the cold feel and scroop of pure linen if treated with the following dressing: water 1000 parts, wheaten starch 30, potato starch 100, China clay 100, white soap 15, white wax 5, tallow 5, glycerine (28° B.) 40, common salt 10, magnesium chloride 4 parts.

The treatment is the same as for union aprons (*q.v.*), except that, instead of double calendering, the goods are put through a box-mangle. In the absence of the latter, the goods are calendered again, cold, the next day.

High Gloss Finish for Cottons.

Calico linings, upholstery stuffs, and others that are to have a high gloss, smooth surface, and feel hard and stiff, are finished by one or two calenderings in the dry state, each side of the fabric coming in contact with the hot roller, and are then starched with dressing preparation. This is followed by calendering, treatment with a thinner dressing, drying, damping, and glazing on a friction calender, strongly heated and under heavy pressure, whereby the goods acquire the stiff, hard, smooth, and glazed finish.

The dressing preparation is compounded as follows: 12½ lb. of wheaten starch, 5 lb. of potato starch, 2 lb. of white glue, 5 lb. of white clay, 5 lb. of finest levigated China clay, 5 lb. of mineral white, 1 lb. of stearine, and 1 lb. of yellow wax are boiled in 14 gallons of water, 4 to 5 lb. of potash water-glass and 1½ gallons of rosin solution being stirred in to the finished decoction.

Swiss Elastic Finish for Fine Cottons.

This finish differs from similar methods, the goods are subjected, between the starching and drying, to a series of manipulations which complete the beautifying of the fabric. These operations consist in energetically working the fabric in all directions, drawing it to and fro, beating, kneading and squeezing, and turning, the object being to press the dressing as completely as possible into the interior of the threads, so that not only the latter but also the fibres of which they are composed are impregnated and enveloped. Whilst apparently simple, the treatment entails much practice and care, in order to avoid injuring the goods; and with this object in view, the whole of the work is done by hand, without the use of machines.

Bodice and Corset Twills.

1. Wheaten starch, best, 25 lb., potato starch 10 lb., talc 2 lb., dressing oil (soluble in water) 0·4 gallon, Marseilles soap 1 lb.,

salicylic acid 5 oz., white starch syrup 10 lb., and sufficient water to make 45 gallons, the whole being boiled ten to fifteen minutes. The goods are starched on the face side in a strong starching machine, better qualities being starched on both sides. They are then dried straight in the drying room or on a stenter, cooled down previous to damping, and then passed through a box-mangle. If to be made up full width, they are passed through the twill damper, and mangled, two pieces together, in the box-mangle.

2. Potato starch 15½ lb., wheaten starch 15½ lb., China clay 10 lb., stearine 5 oz., Marseilles soap 2¼ oz., ultramarine 5 oz., and water 35 gallons, are boiled together. The goods are dressed on the back in a padding machine and are then dried, face upward, on a cylinder machine.

Dressings for Coloured Calicoes, Jaconnets.

Water 178 parts, potato starch 7½, wheaten starch 5, glue 1¼, yellow wax ½, tallow ½, palm-oil, ½ (these three being boiled together first), and soda ⅜th part.

Water 140 parts, potato starch 20, China clay in paste 5 parts.

Water 120 parts, potato starch 6¼, wheaten flour 2½, China clay 2, palm-oil ½ part.

Water 150 parts, wheaten starch 15, gelatine ¾ part.

Water 150 parts, wheaten starch 33, white wax 1, gelatine ¾ part.

Water 140 parts, potato starch 7½, wheaten flour 2½, China clay in paste 3¾, palm-oil 1½, tallow 1½ parts.

Water 140 parts, wheaten flour 12½, potato starch 5, pale glue 2, talc 5, China clay 5, mineral white 5, stearine 1, yellow wax 1, rosin adjunct 15, potash water-glass 5 parts.

Water 150 parts, wheaten flour 30, gelatine 3, white wax 1½, gum solution 6 parts.

Water 110 parts, potato starch 6¼, wheaten flour 2, palm-oil ½, yellow wax ¼, tallow ¼, soda ¼ part. (The last four boiled and added to the dressing.)

Water 70 parts, fine wheaten starch (previously moistened with spirit) 1½, potato starch 12, gum solution 2, white wax ½, Marseilles soap ½, olive-oil 1, soda crystals ½ part. (The last four boiled together and added to the dressing.)

Glycerine Dressing for Drill.

White glycerine (28° B.), free from lime, 500 parts, gelatine 50, carbonate of soda 10, alantin 1½, alum 1, borax 1, oil of peppermint 0·1, alcohol 0·1 part.

This preparation is diluted four- to twelve-fold with water, according to the quality and feel required. The oil of peppermint serves to mask the insipid smell of the glycerine.

Dressings for Printed Cottons.

Water 100 parts, wheaten starch 2½, potato starch 1½, wheaten flour 2½, pale glue ¼, stearine ¼ part.

Water 150 parts, wheaten starch 5, potato starch 5, wheaten flour 2½, glue ½, white wax ¼, palm-oil ¼, soda crystals ¼ part (the last four melted together and added to the dressing), rosin adjunct 6 parts.

Two hundredweight of finely ground, bolted rice meal, as free as possible from gluten, are suffused in an upright vessel (about 5 ft. high, and large enough to accommodate about twice the above quantity of meal) with lukewarm water, a bung hole being provided a few inches above the surface of the meal, for the escape of the separated husks and other portions of the rice meal. After the impure first water has been run off, a fresh quantity of lukewarm water is added, and the meal is stirred up for the separation of further impurities, whereupon a solution of about 3½ lb. of carbonate of soda is added to facilitate separation and fermentation. After a few days have elapsed, this liquid also is run off, and boiling water is poured on to the meal, this water containing a similar amount of soda. The preparation may also be used for white goods, shirtings in particular. For printed goods, it is mixed with scalded potato starch, prepared China clay, or other adjuncts, and boiled, being used in the lukewarm state for starching. The rice-meal dressing should be prepared in large quantities in vats of suitable size, a more complete fermentation being obtained in this way. Rice meal is a non-facing, heavy material that does not alter the colours, and is largely used by English finishers in combination with China clay. It requires rather long boiling in order to render it elastic, being otherwise "short."

A useful dressing is obtained by mixing 14 gallons of potato starch decoction with 3 gallons of mucilage, prepared by suffusing 2½ lb. of powdered gum arabic, 1½ lb. of tragacanth, and 2½ lb. of Carragheen moss, with twelve gallons of hot (not boiling) water, stirring the mixture well and leaving it to stand. At the same time 1½ lb. of glacè leather scraps are boiled with 3 gallons of water and 1½ lb. of soda crystals, until a mucilaginous solution is obtained, this solution being then stirred, boiling hot, into the former one. After standing for a few days, with frequent stirring, the preparation is stored in a suitable vessel.

DRESSING FOR COLOURED BEDDING MATERIALS.

(*a*) Sulphate of magnesia dressing: 50 lb. of sulphate of magnesia are dissolved by the aid of direct steam and diluted in another vessel to a density of 4 to 25° B., according to requirements, the diluted solution being treated with an addition of Turkey-red oil, as required (*e.g.* 1 gallon of the oil to 25 gallons of the 20° B. solution). The actual amount of the oil and the density of the salt solution must be ascertained by experiment. If the oil does not dissolve well, magnesium chloride and soda crystals must be added. A large number of dressings can be easily, cheaply, and reliably prepared with magnesium sulphate.

For a more consistent finish, 1 to 2 lb. of potato syrup or dextrin may be added to each 10 gallons of the magnesia solution, a little ammonia being added, if necessary, in order to clarify the preparation. The Turkey-red oil may be replaced by glycerine-wax, palm-oil softening, or alantin.

(*b*) Water 10 gallons, dextrin 10 lb., sulphate of magnesia 2 lb., Turkey-red oil 1 lb., carbonate of soda ½ oz. This dressing is for unmangled or uncalendered goods.

(*c*) Water 10 gallons, dextrin 3 lb., wheaten starch 3 lb., sulphate of magnesia 2 lb., stearine 5½ oz. For calendered goods.

(*d*) Water 10 gallons, dextrin 14 lb., sulphate of magnesia 18 lb., Turkey-red oil 1 lb.

PUSCHER'S DRESSING.

A cheap glaze finish is obtained by mixing 1 lb. of fine wheaten flour with 6 lb. of cold water to a uniform pap, into which is stirred 1 oz. of ammonia, which causes the mass to turn sulphur-yellow in colour, and to swell up considerably. It is next diluted with half a gallon of cold water, and heated to boiling with continued stirring. The resulting yellow, transparent paste, from which the surplus ammonia has been expelled by the boiling, forms an excellent preparation for dressing linens and cottons.

GRUNER'S DRESSING FOR POINT NET AND MARLY (SCOTCH GAUZE).

Point net is bleached for ladies' hat shapes, and then (Marly also) carefully starched, the material being placed in an elastic frame and carefully stretched. Whilst in the damp state, it is strewn with the finest powdered-starch meal, through a fine hair sieve, so that, whilst the meshes remain open and clear, the starch adheres to the threads, but with a softness not attainable by any other method. The frames and fabrics are next placed in a tightly closed box, traversed longitudinally by a finely perforated pipe for the escape of hot steam. The box being closed and steam turned on, the steam causes the threads to swell up, rendering them more porous and therefore better adapted to absorb more starch solution, the unabsorbed particles of starch being at the same time transformed into a jelly, which adheres to the threads. When this has been sufficiently attained, which can soon be recognised after a little practice, the steam is turned off and the frames are taken out of the box, the fabric being sprayed with cold water until the gelatinised and solidified starch begins to re-dissolve and assume a glazed appearance, whereupon the frames are returned to the box and steamed under a full head of steam until the fabric has become transparent, clear, and glossy. When this stage is reached, the treatment is at an end, and the frames are taken out and exposed to the air, in order to completely dry the fabrics.

Watered Finish for Coloured Calicoes.

The fabric is well starched on one side, squeezed, dried, starched again (though not so heavily), and re-dried. It is next damped with water containing a little glue, left rolled up for some time to enable the liquid to permeate it uniformly, and is mangled several times, re-beamed, and mangled twice, full width. It is then doubled and wound, mangled several times, damped, and mangled twice in the doubled condition; then turned again, mangled, turned once more, and mangled several times, being then in a finished state.

The dressing is prepared from 50 gallons of water, 10 lb. of potato starch, 10 lb. of wheaten starch, 5 lb. of stirred and boiled wheaten flour, 2¼ lb. of dissolved glue, 1 lb. of wax, 1 lb. of palm-oil, 1 lb. of tallow, 1¼ oz. of chromate of potash, 1½ oz. of copper sulphate, and 2¼ oz. of logwood decoction (the last two ingredients being used only for black goods).

The production of the watered effect requires no special machine or engraved rollers, but is due solely to the peculiar reflecting surfaces set up by the enormous pressure of mangling.

When a piece of cotton fabric is wound tightly on an iron roller and passed between the tables of a mangle, no watered effect can ever be produced, because all parts of the fabric are subjected to the same pressure, which merely produces flat surfaces. If, however, the iron roller be replaced by a wooden one, the fabric is pressed into the depressions in the wood under the enormous pressure of the mangle, and will exhibit the structure of the wood in a very decided manner. Where the wood is soft, the fabric will remain smooth, whilst the rings of growth will produce the same effect as an engraved roller and give the fabric a figuring in relief and intaglio. The figuring will differ, of course, with the kind of wood in the roller, Hungarian ash and oak being particularly adapted for the production of these effects. Soft wood (pine and fir) is unsuitable, since it has no handsome grain, and is too soft.

English Watered Finish.

A very fine watered finish can also be obtained with the beetling machine, without mangling, the result being known as English watered finish. The fabric is wound, as tightly and closely as possible, on a smooth, hard wood roller, which revolves slowly on its axis, and is at the same time moved to and from longitudinally, during which movement it is acted upon by a number of wooden stamps that rise and fall slowly, thus setting up sufficient pressure to force the wooden roller into the fabric and impress it with the watered figuring.

The goods are dressed in a machine with a preparation consisting of: water 230 parts, wheaten starch 12½, potato starch 6, rice meal 5 parts (or wheaten starch 10 parts, white sugar 1, and 0·1 part of smalt—for blueing). The pieces are transferred to a drying machine, and dried until they are just damp enough to stretch well transversely. They are starched in a machine, fitted with a bottom roller of maple, and a brass upper roller (caoutchouc, for embroidered goods). On issuing from the machine, they are taken off by means of a reel. The wooden roller is covered with calico, the brass one being left bare.

French Lawn Finish.

This is a very stiff, brittle finish for fine cottons, and is produced by drying on fixed stretching frames, so that the threads retain their full stiffness, being unable to rub together as when calendered. The dressing is prepared from: water 10 parts, finest wheaten starch 4, gelatine ½, white gum arabic 1½, and spermaceti ¼ part, and is applied in the hot state, the goods being then dried as quickly as possible and at a high temperature, so that the threads appear firm and glossy.

Brisé, Organtine, or Elastic Finish.

This is a special finish for fine cottons, such as jaconnets, muslins, and organtines, and is carried out with great care, the chief feature being that the dressed goods are dried on iron or wooden stenters, and kept in motion (to and fro) the whole time. This prevents the fabric from getting stiff, whilst keeping the threads perfectly round, so that they show up well. There is no covering or filling of the interstitial spaces, the dressing penetrating right into the threads and not remaining in the meshes.

Dressing for Cotton Trouserings.

Water 300 parts, potato starch 3, magnesium chloride 3, glycerine 3 parts. The goods are starched and finished on the back.

Dressing for Cheap Cotton Trouserings.

China clay 80 parts, curd soap 12, tallow 15, glycerine 5, boiled in 200 parts of water; 100 parts of glue dissolved in 800 parts of water, followed by adding 1000 parts of cold water after the steam is turned off; and finally 100 parts of potato starch, stirred up in 200 parts of cold water, are crutched in, the whole being boiled for twenty minutes.

Velvet Finish.

This effect is produced on cottons, the fabric being starched on the back and then dried in a steam-cylinder machine, the surface being afterwards lightly brushed. When the ground fabric is strong enough to dispense with the support of the dressing, the threads are straightened by means of a powerful jet of steam. The steam-pipe is perforated with a closely set series of holes, for a distance equal to the width of the fabric, and the steam issues from these holes against the passing fabric, which it penetrates with considerable force, driving out and straightening the threads. Fine velvets are starched by hand, with a sponge, and not on the machine.

Whewell's Dressing.

Whewell gives the following recipe for a dressing said to be used in one of the largest works in Manchester:—

840 lb. of flour containing 12 per cent., or 100 lb., of gluten, are mixed with water at 70 to 80° F., and left to ferment for six weeks. The fermented mass (density 34° Tw.) is mixed with 255 lb. of zinc-chloride solution (90° Tw.) and 112 lb. of magnesium chloride solution (50° Tw.), and warmed to 80° F. In a separate vessel, 896 lb. of China clay are boiled for twenty-four hours with water; 192 lb. of talc, 24 lb. of wax, and 10 lb. of common fat (melted with China clay) being added and boiled for twenty-four hours. The fermented flour mixture, at a temperature of 80° F., is added to the China clay decoction, and cooled. Another 200 lb. of starch are dissolved in water and gradually raised to 150° F. during a period of six hours. The dressing is made ready for use by adding the starch docoction to the rest, heating it to 150° F., and stirring energetically.

Dressing for Italian Cloth and Zanella.

A mixture is prepared of 90 gallons of soaked glue and 10 gallons of water by boiling, and to this is added, shortly before use, 1 gallon of Turkey-red oil per 12 gallons, diluting with 90 gallons of water. The goods are dressed in a padding machine, full width (the dressing being warmed to 100° F.), and are not put in the hydro-extractor after, but run through a machine under a pressure of 1 cwt., a treatment producing uniformity in the feel of the material, when black goods are in question.

For other colours the operations are the same, except that Turkey-red oil must not be used, this ingredient being replaced by soft soap (about $\frac{1}{2}$ lb.) dissolved in water, and added direct to the glue solution in the padding machine, diluted with a suitable amount of water, as before the same loading weight being employed.

Gum Dressing.

The preparation, which forms a quivering jelly, is applied to linens, cottons, and silks. Being insoluble in cold water, it prevents the formation of water spotting on the finished goods. To make the dressing, two to three handfuls of bran are stirred into about 12 gallons of soft water, and after standing to clarify, the supernatant liquid is poured off into a pan, the gum being added, and the whole raised to boiling, with continued stirring. When the mass has become viscid it is ready for use, and imparts firmness, suppleness, gloss, and delicacy to the fabrics on which it is used.

Dressing for Rough Cottons (Inlets).

Rough inlets are damped with starch water, calendered hot, and if too stiff, are gently softened in the mangle. A good starch dressing, which imparts a good feel to the goods, is prepared as follows:—

Wheaten starch 58 lb. and potato starch 58 lb. are stirred up cold with 22 gallons of water, and passed through a fine sieve. On the other hand, 13 gallons of lye (10° B.) are diluted with 20 gallons of water, and stirred slowly, during the space of an hour, into the cold starch water. The starch swells to a thick mass, which is then left at rest for half an hour, to complete the action of the lye, before beginning to neutralise the paste with 10 lb. of sulphuric acid (60° B.) to 22 gallons of water.

The dilute acid must be added slowly and in small quantities, the mass being tested to see whether neutrality has been attained. The paste is next thinned with about twice its own volume of water, to fit it for use in the damping machine, so that the drops of water falling on the fabric may be neither too thick nor heavy. For weak fabrics, the dressing is treated with 40 lb. of dextrin, dissolved in 8 gallons of water before the final dilution. This damping liquid, made with cold prepared starch paste, will keep far longer than boiled starch, and imparts a particularly strong feel to the goods when hot calendered.

Very weak inlets must be actually pressed out, for which purpose one-half the above starch paste must be diluted with 11 gallons of water, and mixed with a solution of 1 oz. of dextrin and $2\frac{1}{2}$ lb. of glue, in 8 gallons of water. This dressing is applied to the goods in a starching machine, the pieces being then dried as hot as possible and put through a lukewarm calender, the iron roller of the latter being covered with rough cotton, to prevent any gloss being imparted to the goods.

Wash-proof Dressing.

To give a wash-proof starch dressing to vegetable yarns and fabrics, the materials are dressed with starch in the usual way, and then entered in a concentrated bath of zinc chloride at a temperature of 59° F., the bath also containing 1 part of sulphuric acid and 1 part of water. The bath is contained in a trough, in which is mounted a revolving shaft, immersed to nearly half its depth in the liquid, and surmounted by a squeezing roller which revolves in the opposite direction to the lower shaft. Between the two, passes the fabric to be impregnated, and this is damped on the under side from the bath and receives from above the pressure requisite to ensure penetration of the liquid. In the case of heavy fabrics, the under shaft is wholly submerged in the bath, in which case the impregnation takes place on both sides; but squeezing rollers are still necessary, in order to force out the superfluous zinc chloride, which runs back into the bath. On leaving the trough, the fabric drops direct into running water, from which it is removed at once, to be squeezed and dried.

Owing to its capacity for resisting water, this dressing is also claimed to have the advantage of imparting greatly increased lustre and richness to printed and steamed fabrics, especially indigo blue from the cold vitriol vat.

Koechlin's Dressing Recipe.

The following combination furnishes an excellent dressing, 500 parts of uncrushed linseed are boiled for an hour with 250 parts of acetic acid, 1000 of water, and 8 to 10 parts of hydrogen peroxide (12 per cent. strength), and then strained. The linseed can afterwards be employed for the extraction of oil.

Dressing for Lace.

Borax 400 parts, shellac 2000, and water 20,000 parts, are boiled together, the solution being thickened, if necessary, with starch or isinglass. A very good preparation is furnished by mixing equal parts of the above gum solution and gelatine solution. The lace is passed through the dressing by unwinding it from a reel or reeling machine, and then smoothing it in a mangle.

Rough Dressing for Cottons.

This dressing is the only one giving a rough, sandy feel to cottons, a strong sizing being a good preliminary treatment. The dressing must contain a large proportion of dextrin. For example 12 parts of dextrin and ½ part of glue are dissolved in 50 parts of water, and neutralised with soda solution until the liquid no longer reddens blue litmus paper. If the neutralisation be omitted, the acid in the dextrin will decompose a portion of the ultramarine added to the dressing, so that the white portions of the fabric will appear grey instead of bluish, and the whole will have a muddy look.

On the other hand, 4 parts of fine English tulle starch and 4 parts of potato starch (together with a filling ingredient if necessary), are dissolved in 70 parts of water and mixed with the above dextrin solution, together with a little fine ultramarine. A prime essential is that the starched goods should be dried very quickly, since, if dried in the air, they become limp and soft. If dried on laths in a hot drying tower, the pieces must be suspended in such a manner that the horizontal lines of check patterns coincide exactly with the horizontal edges of the wooden laths, in order that the pattern may remain straight when dry. If drying cylinders be used, care must be taken that the wet, starched fabric runs true from the stretchers on to the first hot cylinder. Similarly, in the first stretching machine, it is necessary to see that it grips the fabric in such a manner that the perpendicular lines of the check are parallel with the sides of the machine. If, in exceptional cases, calendering is undertaken in order to remove creases, the pressure applied must be only slight, and the iron bowl of the calender must be thickly covered with linen. It is, however, preferable not to flatten out the threads by either calendering or mangling.

Dressing for Muslins and other Fine Fabrics.

The dressing for muslin is prepared by boiling 8 to 12 parts of starch with 60 parts of water for an hour on the water-bath, and then adding a sufficient quantity of powdered azure blue. The fabric is kneaded with the requisite amount of dressing until thoroughly impregnated. To remove the particles of starch from the meshes of the fabric, the goods are placed in a room, heated by steam to 68 to 77° F., where they are unfolded, swung to and fro in the air for a short time, and refolded as before, in order to wring them without forcing out the dressing, after which the whole operation is repeated. During the swinging process, the warm air penetrates the material and dries the starch paste, which is thereby fixed on the fibre. The refolding retains sufficient moisture in the goods to enable the swinging to be repeated without the dressing being completely desiccated. The result is, that the dressing is completely removed from the meshes of the fabric and accumulated on the threads, which contract in consequence, and become finer. When this stage is reached, the goods are still slightly damp and sticky, but quite transparent. The threads having been somewhat displaced by this treatment, they must be straightened by gentle pulls in the right direction. To stretch muslin and complete the drying process, the goods are treated in a room heated to 77° F. by means of a suitable stretching machine, so as to stretch longitudinally, transversely, and diagonally. This result may be produced by placing two hands, one on either side of the frame, but not exactly opposite each other, each of them taking hold of one edge of the fabric, and the one pulling the fabric while the other holds it tightly. This treatment is repeated transversely, the drying of the fabric being completed at the same time by a fan or other means. Finally, the piece is stretched diagonally, 2 or 3 times, according to the degree of dampness.

HEIM'S DRESSING RECIPE.

	Light Goods.	Medium Goods.	Heavy Goods.
Wheaten starch . .	150 parts	100 parts	200 parts
Potato starch . .	150 ,,	100 ,,	75 ,,
Wheaten flour . .	75 ,,	50 ,,	75 ,,
China clay . . .	250 ,,	100 ,,	200 ,,
Mineral white . .	250 ,,	100 ,,	150 ,,
Barium sulphate . .	100 ,,	25 ,,	—
			Fatty adjunct 20 to 30
Size	10 ,,	5 ,,	
Stearine . . .	10 ,,	7½ ,,	
Cocoanut-oil . . .	10 ,,	10 ,,	
White soap . . .	5 ,,	5 ,,	
Soda crystals . .	5 ,,	5 ,,	

CURTAIN DRESSINGS.

The curtains are freed from dust, soaked in water overnight, and then worked in a washing machine for a short time in lukewarm soft soap and water (this being done by hand if no machine is available). White curtains are washed again with white soap, whilst cream curtains are rewashed in a second bath of soft soap. This treatment is followed by rinsing, the white curtains being laid for several hours in clean water, after which they are blued with ultramarine, dried in the hydro-extractor, starched, and stretched, cream curtains being dyed accordingly. The dyes used consist of cutch or coal-tar dyes, the latter giving the best effect. A very weak solution of tropeolin is employed, either as an addition to the starch, or in a fresh bath with a little alum. Yellower shades may be produced with phosphine, chinolin-yellow, or other soluble yellow dyes. After starching, the curtains are stretched and dried on a frame, four to six of equal size being treated at once.

Another good dressing for curtains is prepared from a mixture of equal parts of wheaten starch, maize starch, and good talc. The starch is stirred up with water to a thick pulp, so that all the particles are disseminated, whereupon the requisite quantity of water is added and the talc is stirred in, the mixture being boiled for a short time, thinned down with water, and used hot. The talc is insoluble in the water, but is fixed mechanically on the goods by the starch. This dressing makes the curtains feel and look like new.

DRESSING FOR PRINTED CALICOES (APRON STUFFS, UNIONS, ETC.)

1. Water 50 parts, wheaten starch 20, white dextrin 100 parts.
2. Water 150 parts, magnesium sulphate 10, best levigated talc 5, Turkey-red oil 1, potash ½ part (dissolved in 3 parts of water).

The two solutions, without the potash, are mixed together hot, and when incorporated, the potash solution is stirred in.

WATERPROOF DRESSING.

Potash alum 100 parts, glue 100, gallo-tannic acid 5, water glass 2 parts.

The potash alum is dissolved in 100 parts of boiling water, and the glue is soaked in cold water until it has taken up twice its own weight of same, the superfluous water being then poured off and the swollen glue heated to boiling, the concentration of the solution being kept constant by adding water to replace that evaporated. The goods are entered for half an hour, at a temperature of 176° F., and are then spread out flat for six hours, after which they are dried on a frame in a room heated to 133° F., or in the open air. A calendering at 122° F. completes the treatment. Coloured goods treated in this way retain their colour completely, but for light shades the glue solution and alum must be as pale as possible, the latter being free from iron or other pigmentary substance, and the glue pale and inodorous.

DRESSING FOR RAISED DOUBLE PIQUÉS.

One hundred parts of water, 5 parts of wheaten or maize starch, and 2 parts of blanc fixe are well mixed and boiled, 1 part of cocoanut-oil being stirred in, and the whole strained and used hot. The extent of dressing imparted to the fabric is regulated by the position of the doctor, the dressing being thinned down with water if required. The subsequent operation of raising must be borne in mind in carrying out the treatment.

Chaudet's Dressing Starch.

Water 200 parts, flour 50, olive-oil emulsion 5 to 10, barium chloride, 10 to 20 parts, with sufficient Glauber salt to precipitate the latter ingredient. The preparation is used direct. For commercial purposes a mixture is prepared of dry Glauber salt and barium chloride, the two being ground together, since they do not react until brought into contact with water. Other barium salts may be used instead of the chloride, and other alkali salts instead of Glauber salt.

Dressing for Dark Cottons.

Water 2000 parts, wheaten starch 500, tallow 20, yellow beeswax 5, stearine, in cakes, 5 parts. The mass is boiled for half an hour by direct steam, and is then mixed with a solution of 100 parts of gum arabic in an equal weight of water containing 1 part of soda lye (36° B.).

Dressing for Linings.

An emulsion of 800 parts of potato starch in 1000 parts of water is added to 10,000 parts of water at 140° to 160° F., followed by 26 parts of powdered pale rosin, 26 of beef tallow, 15 of Marseilles soap, 15 of spermaceti, and 40 of beeswax.

The mass is stirred continuously and raised to boiling for one and a half hours, being strained through a hair sieve if found lumpy.

Senegalin Dressings.

Dressing for White Goods: Cheap Cretonnes.

For 33 gallons of starch dressing: China clay $13\frac{1}{2}$ lb., maize or wheaten starch $16\frac{1}{2}$ lb., senegalin $13\frac{1}{4}$ lb., glycerine $1\frac{3}{4}$ pints, Marseilles soap 1 lb., borax 1 lb., blanc fixe $8\frac{3}{4}$ lb., and ultramarine 1 oz.

The China clay must be soaked for several hours in advance. The senegalin is boiled and the China clay added thereto, followed by the starch (suspended in water) and the other adjuncts, the mass being boiled from two to two and a half minutes. The goods are treated in the damp state, as they come from the water calender, and are dressed on both sides.

DRESSING FOR HOLLAND.

For 200 parts of starch dressing: senegalin 7½, wheaten starch 10, potato starch 4, China clay 10, tallow 1, cocoanut-oil 1, blanc fixe 5, Marseilles soap ½, ultramarine $\frac{1}{10}$th part. The goods are dressed damp on both sides, dried, treated again with the same dressing, cooled, damped, left for several hours and mangled.

RAISED CORD.

To make 150 parts of starch dressing: senegalin 6 parts, wheaten starch 7, Marseilles soap ½, and ultramarine $\frac{1}{10}$th part. The damped goods are dressed on the back and then dried and raised.

For better class white goods that are not to be dressed, but only mangled and calendered, though desired to have an improved feel, a little senegalin is dissolved in the damping water.

Good quality linings, to have a soft finish, are dressed with the following preparation—For 200 parts of dressing: potato starch 7½ parts, senegalin 6, Marseilles soap ¾, Turkey-red oil 2, glycerine 1, and Japan wax $\frac{2}{5}$th part. The mixture is boiled for ten minutes and applied to both sides of the goods, which are then dried, cooled, damped, put through the finish breaker, and then passed through a very hot calender 3 times. The more open the fabric, the smaller the amount of senegalin in proportion to the potato and wheaten starch; and for low qualities no senegalin at all is used, the purpose of dressing being not so much to impart feel and suppleness as to make them appear stronger, without of course being brittle. For such low grades the dressing has the following composition per 280 parts: potato starch 20 parts, wheaten starch 9, common salt ½, Marseilles soap ½, Turkey-red oil 1½, and Japan wax $\frac{2}{5}$th part. The dressing is applied as described above.

JACONNET LININGS.

For 200 parts of dressing: senegalin 5 parts, wheaten starch 12½ parts, the proportion being correspondingly reduced in the case of more closely woven fabric. The goods are dressed on both sides, dried, damped, and hot calendered twice on a friction calender.

Moleskin, kalmuck, corset drill, and similar fabrics are dressed with senegalin alone or, to increase the effect, with an addition of a little starch, syrup, or sulphate of magnesia. Similarly, bed tickings are dressed with a solution of senegalin (7° to 8° B.) containing 25 to 30 parts of a mixture of 90 per cent. of sulphate of magnesia and 10 per cent. of chemically pure sal ammoniac. If starch be used, 5 to 6 parts of senegalin and 9 to 10 of potato starch (or a mixture of this and wheaten starch in equal proportions), are taken to 200 parts of dressing, according to the finish desired.

For better coloured goods, such as bedding, clothings, shirtings, etc., the following proportions are taken: senegalin 18 to 20 parts, sulphate of magnesia mixture (see above) 25 to 30, starch syrup 20 to 25 parts. The senegalin is boiled first, the salts and syrup being added, and the whole boiled for a short time and diluted to the desired strength. The above proportions may be varied according to the purpose in view, but the relative proportions of senegalin to sulphate of magnesia should not be less than 3 : 4. If more magnesia is desired, a little dextrin should be added, and the amount of senegalin or syrup may be reduced accordingly. To give a supple finish, a small quantity of a decoction of Carragheen moss may be added (1 to 1½ parts). Turkey-red oil may also be employed to improve the softness and gloss, especially when the goods are to be calendered or mangled; but in such case the proportion of sulphate of magnesia should not be higher than stated above, so that the density of the dressing does not exceed 8° to 9° B., or it is liable to be smeary. Turkey-red oil cannot mix intimately with the magnesia salt, and grease spots are produced, which often do not show up until the goods have been calendered.

Dressing with Ammonia Water.

The ammonia water recovered as a by-product in gas works, is well adapted for dressing textiles, to which it imparts a soft, full feeling, without any stickiness even when wetted, the dressing being very durable and free from any tendency to dust or split off. Its application is a very simple matter. After making sure that all suspended particles of tar have been removed, which can be effected by pouring the liquid over twigs or straw, or passing it through a filter, it is applied to the damped goods in a washing machine, which is run until thorough impregnation is attained. The goods are then drained in a hydro-extractor and dried, after stretching or stenting, if found necessary. The colours are seldom affected, except in the case of cochineal scarlet, which is changed by ammonia. The reason for the good stiffening properties of ammonia water, which contains chiefly carbonate of ammonia, together with a little cyanide and thiocyanate (sulphocyanide) of ammonia, has not yet been elucidated. The idea of using it for this purpose probably originated in its resemblance, in point of consistence, to vegetable mucilage.

Improving the Compactness and Fineness of Fabrics.

The method adopted for this purpose is based on the treatment of cottons with alkaline lye, followed by souring with dilute sulphuric acid these operations producing favourable modifications in the fabric. Under the microscope the fibres of cotton look like smooth, twisted ribbons, which, when brought into contact with caustic alkalis, twist, and then contract, finally swelling up and becoming almost circular in section. When the lye is afterwards rinsed out and a little sulphuric acid is added, the modification sustained by the fibres is still retained. The process may be explained somewhat as follows:—

The lye causes the flat, tube-like cotton fibres to swell up, and also contract to an almost inappreciable extent, the liquid then penetrating the interior and being neutralised by the acidified water.

In carrying this treatment out in practice, the dried or well-squeezed fabric is passed once or twice through a starching machine or a vat fitted with bowls, and a pair of squeezing rollers, the apparatus being changed with caustic soda lye of 20° to 25° B. strength, and having a temperature of not less than 62° F. The goods are then wound and unwound through a trough of water, rinsed or washed, and entered for about fifteen minutes in a bath of very weak sulphuric acid, after which they are washed, drained in the hydro-extractor, and dried in a cold or warm drying apparatus. By this treatment, vegetable fabrics are rendered more compact and specifically heavier, by contracting both in length and breadth, and are modified in a manner resembling the effect of milling on woollens.

In addition to being made more compact, cottons are also rendered firmer in texture, a cotton thread which, in the untreated condition, would break under a pull of 13 oz., requiring a strain of 23 oz. to break it after treatment with caustic soda. This increased compactness is of great value in the case of tricot, crinkled and pattern fabrics, since the treated goods dye as finely and bright as woollens, the lustre of red and violet dyes on velveteens and calicoes being particularly noticeable.

The dyestuffs penetrate more completely into the fibres of the treated fabrics, and are absorbed in greater quantity and more firmly retained. Patterns can also be produced on plain white fabrics by printing them with caustic soda lye, thickened with pale roasted starch, and steaming the goods after drying. The portions impregnated with the lye shrink and remain smooth, whilst this contraction causes the untreated portions to crinkle and give the effect of a woven pattern.

For this treatment 40 gallons of caustic soda lye (40° B.) are mixed with 16 gallons of soft, river water, or clarified rain water, the temperature of the mixture being 77° F. If hotter, the goods acquire a yellow tinge, and light fabrics or fine yarns may be corroded by the alkali. The goods, in a dry condition, are passed through the trough of a starching machine charged with the lye, and after being squeezed, are wound on hollow rollers so that the lye can penetrate right through the fabric. At the end of about fifteen minutes, the rollers are placed in a frame mounted over a vat of cold water, the goods being unwound and passed through the water at least twice, in order to remove the superfluous alkali for use over again. After about five or six pieces have been passed through the water, it should be drawn off and the vat refilled. This first rinsing is succeeded by a more thorough one, the goods being suspended or swung in running water, after which they are hung over trestles to drain, and entered for about ten minutes (not more than twenty at the outside) in a weak bath of sulphuric acid (1½° B.), and put through a final, thorough washing process by any suitable means. If the washed goods can be drained in the hydro-extractor, so much the better; otherwise they are hung over trestles to drain before being dried. Drying must be carried on in a drying chamber, and a few blocks of wood must be laid, for weighting, in the folds at the bottom. The goods may also be starched in the wet state. The extent to which the density of the fibre is increased depends on the degree of concentration of the lye, no effect at all, however, being produced when the strength of the lye is below 20° B.

When the rinsed-out lye can be collected and used over again, the process is very cheaply applied.

For increasing the compactness of single or twisted linen, or cotton yarns, the soaking liquor is prepared by diluting caustic lye of 20° B. strength 25, or even 30° B. with warm soft water, the yarns being immersed in the bath for fifteen to twenty minutes, and then thrown into water (wringing being difficult owing to the slippery character of the adherent lye) and moved about therein to wash out the lye. The water is thus rendered alkaline, and can be used for other purposes. Rinsing should be continued and, when the water no longer exhibits an alkaline reaction from the presence of the alkali salts, the yarn may be transferred to running water to complete the rinsing. It is next wrung by hand and entered in a sulphuric acid bath from ten to fifteen minutes, being afterwards carefully rinsed, wrung by hand, and hung on rods, wooden blocks being inserted in the bottom folds to prevent excessive contraction. Drying must be effected in the shade, and no warm air must be employed even in the winter. The slower the drying, the more easy the yarn will be to work later. The brilliancy of the colour of twisted, knitting yarns and fast-dyed yarns is considerably increased; and for these the process can be highly recommended.

Paper Pulp as a Filling for Cotton Dressings.

Ground paper pulp may be used in place of the usual filling materials added to cotton dressings, this pulp penetrating and filling up the pores of the fabric. The pulp may be made from rags, wood, straw, etc., in the usual way, and its fineness of texture should increase with the quality of the fabrics for which it is intended.

The treated goods are passed through the calender, to produce a smooth and solid surface, which is easily dyed or printed. These operations can be performed at once without any further preparation being required, so that the production of certain goods, such as curtains, can be cheapened considerably by this method.

The resulting fabrics are far more solid, soft, and durable than such as have been filled with China clay or the like. They can also be made waterproof by adding substances that repel water to the dressing; and they are specially suitable for bookbinding purposes.

A similar treatment is that employing cellulose, which is recommended by Hartmann for filling or closing up light cotton and linen fabrics. The goods so treated can be sewn, and have the appearance of closely woven stuffs. They may be used for wrapping woollen cloth, emery cloth, light linings, interior linings for clothing, druggists' plasters, cases for dolls, etc. The operation is performed as follows:—

The vegetable fibre is divided as finely as possible in a paper-stock machine, and intimately mixed with suspended potato starch by means of a special stirring apparatus, without any preliminary felting. The mass is then raised to boiling point. The fabric is impregnated in a machine comprising a number of metal rollers running at different velocities. As soon as the loaded fabric has passed through the rollers, which are subjected to heavy pressure, the uniform distribution of the tiny fibres on the fabric is completed by a quick-running, indiarubber roller, which also forces the mass into the meshes of the fabric. The goods are slowly dried in a warm room, not on rollers, and are treated or dressed in accordance with the purpose to which they are to be put. In drying, the tiny fibres, surrounded by starch, unite so intimately with the threads of the fabric that they cannot dust off or drop out like mineral fillings always do; and the dressing can only be removed by repeated soakings and washings.

Parchmenting Cotton.

The thoroughly cleansed cotton is soaked for twenty-four hours in a mixture of 1 part of glycerine and 2 parts of water, the temperature of the mixture being 63½° F. The cotton is then pressed between glass rollers, and washed until the washings no longer give an acid reaction with litmus paper. When dry, the treated cotton exhibits certain of the properties of wool, but has to be put through a felting process before undergoing further treatment. Fabrics made from this cotton resemble woollens; and the cotton may also be advantageously used in making union fabrics, being cheaper and more durable than linen.

CHAPTER XIII

DRESSINGS FOR LINENS

For Well-Bleached Linens.

Twenty-two lb. of wheaten starch, 11 lb. of potato starch, 15½ lb. of Utrecht white, and 2¼ lb. of pale glue, are boiled by steam heat with sufficient water to produce 80 cubic feet of finished dressing.

For Fine Holland.

Best wheaten starch 22 lb., potato starch 5½ lb., Vienna white 2½ lb., Marseilles soap 1½ lb., stearine 1½ lb., white wax 3½ oz., and soda crystals 2¾ oz., are boiled by steam, until the mass swells up to 25 cubic feet.

For Table Linen and Damask.

Best wheaten starch 2½ lb., potato starch ½ lb., white glue 5½ oz., stearine 2¾ oz., white wax 5½ oz., soda crystals 9 oz., and Marseilles soap 3½ oz., are boiled with 4½ gallons of water.

Water 3000 parts, potato starch 100, wheaten starch 150, white glue 25, carbonate of magnesia 30, Marseilles soap 10, gum arabic solution 10, white wax 15 parts.

Clarke's Dressing.

Glue 250 parts, dextrin 200, gypsum 250, glycerine 2500, calcium chloride 25,000, spermaceti 250, starch syrup 400, stearine 100, starch 250, caustic soda 10, carbolic acid 5 parts, with the requisite quantity of water.

Ducket and Mercer's Dressing.

Iron sulphate 1 part, zinc sulphate ½, fish glue ½, Marseilles soap 1, spermaceti ½, dissolved in boiling water and treated with ultramarine ½ part, of soda ½. Into this mixture are introduced: paraffin 4 parts, tallow 2 parts, the whole being thickened with 80 parts of flour and 320 parts of water.

RAWSON AND HARTLEY'S DRESSING.

Sago 40 parts, flour 10, paraffin (or white wax) 1, tallow 2, Marseilles soap 2, boiling water 80 parts.

COULTHURST'S DRESSING.

Starch 10 parts, common salt 28, sulphate of soda 23, alum 28, China clay 50 parts.

China clay 2 parts, common salt 1, wheaten starch 1, rice starch $\frac{1}{5}$th part, water quant. suff.

COOKE'S DRESSING FOR WHITE AND COLOURED COTTONS.

Rice flour 140 parts, wheaten starch 56, wheaten flour 140, sago meal 28, glue 8 parts, water quant. suff.

FLUESSÉ'S DRESSING.

This preparation may be made in either solid or liquid form from the following ingredients: glycerine (20° B.) 100 parts, carbonate of soda 1, gelatine 1, alum $\frac{1}{100}$th, and borax $\frac{1}{100}$th part, these substances being well mixed and transformed into a uniformly fluid mass. Modifications may be introduced by employing gelatine, fatty soaps, stearine, gum arabic, or gum tragacanth in different proportions with varying quantities of soda, alum, or borax. To impart an agreeable scent to the mass, a solution is prepared of 1 part each of oil of peppermint and lavender oil, and 2 parts of camphor in 40 parts of alcohol; and sufficient of this to make 1 per cent. of the dressing, is added to the mass.

THOMSON'S SIZING MIXTURE.

For light dressing Thompson takes 125 parts of wheaten flour, 7½ of tallow, and 5 of Marseilles soap, the flour being stirred up with water and left to ferment, whilst the tallow and soap are boiled separately and added to the fermented flour.

M'KEAN AND GABBOT'S DRESSINGS.

Linseed oil 3 parts, hide scraps 3, alum ½, water 140, China clay 110 parts.

Wheaten flour 50 parts, sago meal 40, water 300, China clay 200 parts.

Alum 1 part, glue 2½, hide scraps 5, water 96, wheaten flour 25, sago meal 20, China clay 100, linseed mucilage 7, water 90 parts.

CRASSE'S DRESSING.

Flour 125 parts, tallow ½, paraffin 1 to 2, potash ½, water quant. suff.

CHALIMIN'S DRESSING.

Starch 16 parts, wheaten flour 16, potato starch 12, zinc sulphate 1½, copper sulphate ⅛th, water 300, white wax ½ part, water quant. suff.

This mass will give a loading effect of up to 25 per cent. without the aid of mineral substances.

CALVERT AND LOWE'S DRESSING.

Water 30 parts, dextrin 8½, Glauber salt 8½, linseed mucilage 2¼ parts, water quant. suff.

FOR MEDIUM FINISH.

Wheaten flour 24½ parts, tallow 4½, paraffin ¼, hard Marseilles soap 2½, soft soap ½, China clay 11 parts. The wheaten flour is stirred up with water and left to ferment, the other materials being then added after having been melted in a separate pan.

FOR HEAVY FINISH.

Wheaten flour 28 parts, China clay 67, tallow 12, magnesium chloride 7½, zinc chloride 6 parts. The flour, water, and zinc chloride, are boiled together and incorporated with the other ingredients, which have been boiled separately.

FOR VERY HEAVY FINISH.

Fermented flour (mixed with rice flour) 14 parts, China clay 22, sulphate of magnesia 11, tallow 2½, magnesium chloride 4½, zinc chloride 5 parts.

DAMASK DRESSINGS.

Damask dressing is important because by its means special peculiarities of the goods may be emphasised or masked, with or without any actual "finish."

The dressing is prepared in the following manner: 11 lb. of lead acetate are dissolved in 3¼ gallons of hot water over a fire, 5½ lb. of sifted litharge being then added, and boiled until all is dissolved. On the other hand, 5½ lb. of best glue (previously softened in water containing a little vinegar) are boiled in 3¼ gallons of water and mixed with the first solution, the whole being incorporated by boiling. A starch preparation is then made by mixing 11 lb. of wheaten starch to a paste with water; and this is mixed and boiled with the previous mixture, the whole being stirred until cold. The resulting preparation is applied to the fabric in a starching machine, preferably one provided with two brass rollers, the dressing being given on one side only—*which* is immaterial.

The goods having thus been starched on one side are hung up on racks and dried without heat. They are afterwards put through a padding machine charged with a solution of potash (4° B.) at a temperature of 77° F., by leading them under a roller in the trough; and they are then wound on a hollow roller.

A thorough washing, either by suspension or working in running water, should follow the alkali bath, a still better treatment being to mill the goods for a quarter of an hour with a thin decoction of potato starch, containing a little soap and carbonate of soda. This treatment causes the mass to incorporate and fix on to the fabric in such a manner as to produce (without starching) a finish that cannot be imitated without knowing the process.

For Crash Linens.

(*a*) Potato starch 2½ parts, wheaten starch 1½, China clay 1½, and mineral white 2½ parts, are dissolved in 150 parts of water, the mass being boiled and mixed with 0·4 to 0·5 part of cream softening, which has been dissolved by heat. A thorough boiling renders the preparation ready for use.

(*b*) Two and a half parts of potato starch are dissolved in 150 parts of water, with sufficient crystalline to produce a density of 10° to 15° B. at 86° to 100° F. This preparation will give loading effects up to 20 or 25 per cent., and the feel of the goods may be improved by increasing the amount of starch or China clay.

For Very Glossy Linens.

Water 300 parts, dextrin 40, wheaten starch 40, sulphate of magnesia 15, talc 5, stearine 5, carbonate of soda 1, olive-oil soap 1 part. The method of application is the same as with Bielefeld dressing. In calendering for the first time, the fabric is passed through both rollers, but only through one the second time.

Dressings for Black Cottons.

Water 300 parts, potato starch 15, wheaten starch 20, glue 2½ parts, the following being boiled together and added to the dressing: yellow wax 1 part, tallow 1, palm-oil 1, soda crystals ¾ part.

Logwood decoction 300 parts, potato starch 12½, wheaten flour 5, glue 1, ferrous sulphate ½, copper sulphate ½, iron acetate ½, rosin preparation 5 parts.

Water 220 parts, logwood decoction 240, potato starch 10, wheaten starch 10, wheaten flour 20, glue 2½, bichromate of potash 0·15, rosin preparation 10 parts, the following being boiled together and added to the dressing: yellow wax 1 part, palm-oil 1, tallow 1, carbonate of soda 1 part.

Water 420 parts, potato starch 20, wheaten flour 5, wheaten starch 10, glue 1½, China clay in paste 15, iron pyrolignate 4, copper sulphate 1½, rosin preparation 12, the following being boiled together and added: yellow wax 1 part, palm-oil 1, tallow ½, carbonate of soda ¾ part.

Black Glacé Dressings.

Logwood decoction 350 parts, fleawort 10, palm-oil 5, Marseilles soap 2½, potato starch 10 parts.

Logwood decoction 280 parts, potato starch 12½, yellow wax 1, palm-oil 1½, Marseilles soap 1, rosin preparation 5 parts.

Water 280 parts, logwood decoction 30, potato starch 10, wheaten flour 6, palm-oil 1, yellow wax 1, tallow ½, soda crystals 0·4 (these four boiled together and added): rosin preparation 7 parts.

Black Dressings for Half-Woollens.

Blood from the slaughter-house forms an excellent dressing for woollen, cotton, and half-woollen fabrics, whether black or dark-brown goods. Four gallons of fresh blood mixed with 20 gallons of water at 77° F. and well stirred, the goods being entered, squeezed, and finished by hand, or in the machine.

CHAPTER XIV

YARN DRESSINGS

For Hard-Twist Yarns.

1. For every 2 cwt. of yarn, 2¾ lb. of fleawort seed are boiled with a moderate quantity of water until dissolved to mucilage, 2¼ lb. of Marseilles soap being then dissolved in hot water, and mixed with about 1 lb. of soda crystals and 1½ lb. of palm-oil, or other clarified oil. The mucilage is strained through a cloth and mixed with the soap and oil solution, being well stirred to ensure intimate incorporation, and thinned with sufficient water to enable the yarn to be hand washed in 2½ lb. hanks. The yarn is left in the liquid for a short time and worked about thoroughly, after which it is wrung lightly, and hung up in the air to dry.

Drying should not proceed too quickly, and when completed, the yarn is treated like ordinary hanked silk. In the case of all starched yarns, it is advisable to weight the hanks with rods in drying, since this straightens out the threads and makes them smoother.

2. For high-count yarns: 3½ gallons of Carragheen mucilage are mixed with so much hot water that the mixture can be pressed through a cloth. Then 6½ lb. of potato flour are mixed with a little lukewarm water, and strained into a clean vessel holding about 15 gallons, 12½ gallons of boiling water being poured on to the stirred flour. This water, in the case of twist yarns for example, should have been boiled with a little white wax, stearine, and soap. For yarns that are desired to remain very mild and soft, Marseilles soap and cocoanut-oil, or also clarified palm-oil, is added. The Carragheen mucilage is next stirred in, and the whole is strained into a larger vessel, in which the water is poured, and the yarns are dressed.

For Hemp and Linen Yarns.

Linen yarns, of whatever count, are well known to suffer in quality when used for sewing. This defect can be obviated by dressing, for which purpose 1 part of gum arabic is dissolved in 32 parts of soft water, ¼ part of isinglass being dissolved in 16 of water, and ½ part of parchment glue in 16 of water, the solutions being mixed, ¼ part of potash and 1 part of white wax (both saponified by boiling with water) added, followed by another 100 parts of water. The yarns are dipped 5 or 6 times in the hot liquid, and reeled wet, being passed through a cloth held between the fingers, or a suitable appliance, to remove the superfluous moisture. This treatment is repeated, and the yarns are then rinsed and passed between a cloth soaked in a solution of: gum arabic ½ part, white wax 1, isinglass ½, parchment glue ½ part, in 16 parts of water, a little alcohol being added for use. The yarns treated in this way have a silky appearance. With black or coloured yarns the potash and wax are omitted, the dressing being applied cold, and the yarn dried in the shade.

Hoffmann's Method of Sizing and Dressing Cotton Yarns.

Flour or starch is stirred to a milky liquid in lukewarm water, the flour, for some purposes, being allowed to ferment or treated with known solvents to remove the gluten. Through this liquid the yarn is passed, by hand or in a machine, and is freed from superfluous liquid by squeezing, wringing, or centrifugalising. The threads, which still stick together, are separated by brushing, beating, or rubbing, and the yarn is transferred to a box where steam is admitted to gelatinise the starch in the threads, the yarn being finally dried.

This method is applicable to sizing and dressing yarn in the hank, though in the former case, the treatment is modified by sizing the yarn in one machine throughout, whilst in the other case, the various operations are performed in several machines, if the latter are used at all.

Dressing for Sewing Twist.

For coloured threads: Irish moss 3 parts, gum arabic 2, Japan wax ½, stearine 0·37, and borax 0·13, are boiled together for a quarter of an hour. For white twist: Irish moss 2 parts, tapioca ¾, spermaceti ½, stearine ¼, and borax 0·18 part, are boiled together for twenty minutes. For black thread: Irish moss 3 parts, senegal gum 2½, ceresine ½, borax 0·18, logwood extract 0·18, copper sulphate 0·06 part, are boiled for twenty minutes. In all cases, the Irish moss must be soaked in 90 parts of water overnight, then boiled for an hour, strained, and the other ingredients added. It is preferable to add the borax to the moss before boiling.

Hoelken's Dull Finish for Cotton, Linen, Woollen, and Silk Yarns.

A uniformly dull and hard finish (black or hard finish) is largely used in England for cotton yarns, especially those for half-silk velvets, to which it imparts a good, solid feel, and very even under-surface, and renders superfluous the costly and difficult process of finishing the woven fabric. After many trials to imitate this finish, during which it was found too expensive to treat the yarn singly, the system of dressing the hanks on a lustring machine was tried. In this, the yarn, impregnated with dressing, is worked with a revolving brush, which separates the stuck threads, the hanks being placed in a drying room to dry. Even then, the yarn does not fulfil the essential condition of uniform, hard finish, since the brushes do not distribute the dressings evenly on the threads, and produce a certain gloss which detracts from the appearance of the finished fabrics. The smoothening of the threads by brushing, diminishes the mutual adhesion of the threads in the weave. A steam-heated roller was tried but found unsuitable, the threads sticking together like boards. On the other hand, the retention of the revolving brush was considered essential, in order to separate the threads.

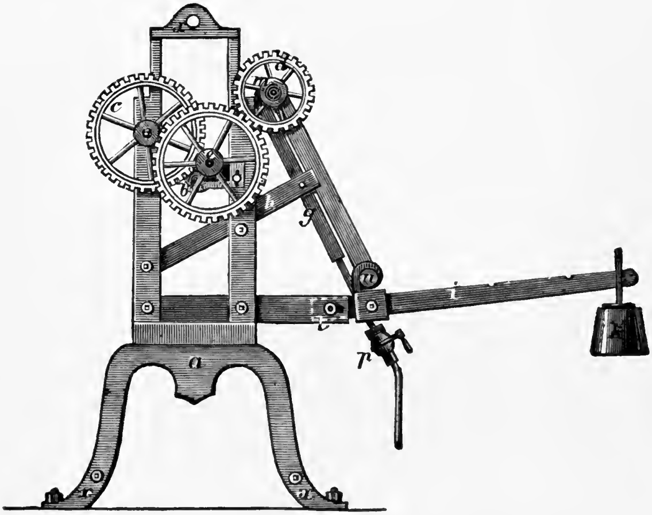


Fig. 31.—Hoelken's finishing machine.

The method finally adopted to get over the difficulties, dispenses with the revolving brush. In the machine used (Figs. 31 and 32) *a a x x* represent the frame, *b*, the driving shaft, with driving wheel, *c d e*, the pinion gearing, *f*, the pinion on the yarn roller *m*, *g* the steam plate, *h r* the steam-plate holder, *i i* levers, *k k* weights for loading the lever *i*, *l* connecting rod for the lever, *m* the upper yarn roller, *n* the under yarn roller, *o* steam inlet, *p* draw-off tap, *h* outlet for condensed water, q^1 q^2 belt pulleys.

The yarn, after being soaked in dressing (containing more or less gluten, according to requirements) and then wrung, is placed, 20 to 23 hanks at a time, on the yarn rollers, *m* and *n*, and pressed, by means of the heavily weighted levers, *i i*, as strongly as the tensile strength of the yarn permits. The rollers are set in rotation by the pinion gearing, the yarn being thereby moved very slowly in front of the steam plate (mounted about midway between the rollers) until completely dried and finished. It is essential that the yarn should not actually touch the steam plate. The entire process takes about four minutes. The hank threads, which are clotted together by the dressing, dry together on the way over the steam plate; but whereas warm yarn rollers are known to cause the threads to stick together like boards, the cold rollers in this machine separate the threads by causing a suspension of the dry process at the moment of contact with the rollers, this cooling effect combined with the powerful bending of the threads, bringing the latter out of their previous position and thus stopping the incipient hardening action of the dressing. The machine is similar to the yarn lustring machine, except that the brush roller has been removed and a drying appliance provided in the shape of the steam plate. This latter is hollow, and made of well-riveted, strong boiler plate and sheet copper, the iron being at the back and the copper in front, the rivets on that side being countersunk in order to present a smooth heating surface.

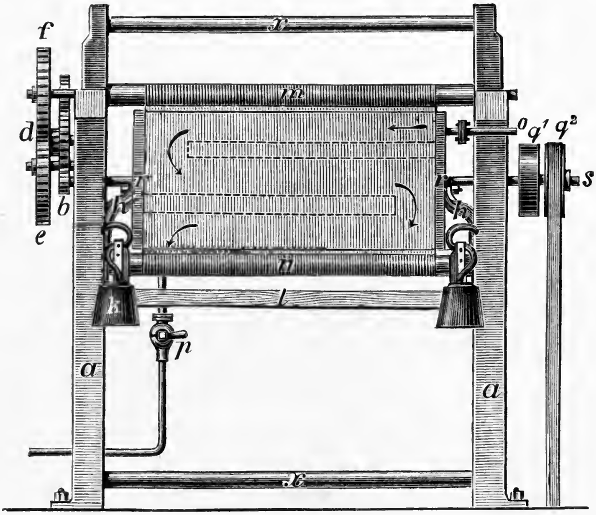


Fig. 32.—Hoelken's finishing machine.

The plate is heated by a current of steam at a pressure of 4 to 5 atmospheres, uniform heating being established by a number of alternating, riveted iron rods inside the plate, to direct the passage of the outflowing steam. The plate is inclined, to enable the disengaged heat to pass through the yarn as completely as possible in its upward course. The rollers are of brass and detachable; and are loaded with the yarn in a separate frame. The gearing is selected so as to move the yarn rollers and yarn very slowly over the plate, this being essential. In addition to cotton yarns, the method can also be applied to woollen, linen, and silk yarns. Any desired hard or soft finish can be given to the yarn, even of the most delicate shades of colour, thus enabling an excellent material to be produced, not only for velvets, but also for half-woollens and ribbons.

Baerle and Sponnagel's Crystal Size Dressing.

The method of applying crystal size dressing to cotton or linen yarns and fabrics (grey goods), which are neither bleached nor finished, but are to be heavily loaded, is as follows :—

The well-fermented wheaten flour (or rice meal) pap, or mixed starch and water, is placed in a wooden or lead-lined vat and slightly coloured with analine blue, whilst best China clay is boiled to a thick pap, with steam and water, in a second vessel fitted with stirrers, tallow, crystal size, and zinc chloride being added during the process. The stirrers are kept running after boiling is completed, and when the mass has cooled, the contents of the two vessels are run together and re-boiled, with stirring. When the mixture has become homogeneous, it is run into the dressing trough, which is heated by steam. The yarns or piece goods issuing from the trough are freed from superfluous dressing by squeezing them between cloth-covered iron rollers, and are then passed over metal drying rollers faced with tin. The yarns are ready for weaving, but piece goods are stored awhile in a damp place, in order to increase in weight.

If the work has to be interrupted, the steam is turned off, and a lump of tallow is thrown into the dressing trough, a coating being thus formed that prevents the dressing from drying to a hard crust.

Horse Chestnut Starch for Dressing.

This starch is pure white, and when heated with water, furnishes a thickening ingredient of greater transparency than that from wheaten or potato starch, but is attended with the drawback that it soon becomes thin. Experiment has shown, however, that this starch is unsuitable as a medium for printing colours, either for hand or machine printing, the product lacking the requisite consistency, failing to give a sharp impression, and showing a tendency to run and become thin, especially in the case of acetate of alumina. On the other hand, good results were obtained in dressing fabric with a mixture of 40 to 50 parts of the starch and 1000 of water; and the starch is adapted to replace wheaten or potato starch for dressing-printed calicoes and bleached cottons, the feel of the goods being softened, and there being no tendency to change during storage, such as is sometimes observed.

CHAPTER XV

LAUNDRY GLAZES

It has long been the practice to provide laundered articles, such as shirts, collars, cuffs, etc., with a stiff, glossy finish, partly due to the application of certain glazey dressings and partly to the treatment employed. Below, are several recipes for these dressings, with instructions regarding the special treatment.

STARCH GLAZE.

A preparation is sold, which, when added to laundry starch, makes the articles a brilliant white as well as producing a high gloss. A tablet of this preparation is taken to every 2 lb. of starch, with which it is boiled for a couple or three minutes. If unboiled starch be used, it is sufficient to add a hot solution of the preparation to the starch, and lightly rub the mixture over the articles with a rag, just before ironing. Analysis of the preparation in question has shown the same to consist of paraffin wax and stearine, the average proportion of the former being 60·11 per cent. so that the composition may be assumed to be approximately 60 per cent. of paraffin wax and 40 per cent. of stearine. The melting point was determined as 45° C. Trials made with a synthetic mixture in the above proportions (3 : 2) gave results identical in appearance and applicability with the original specimens; and the use of the preparation can be recommended.

ZWICK'S STARCH GLAZE.

Melt together 2¼ lb. of wax and the same weight of stearine, add a few drops of some perfuming oil, followed by ½ lb. of 10 per cent. soda lye, heating the mixture until it becomes thin, and diluting it with 4½ gallons of hot water and 2 cwt. of half-moistened starch, drying the whole in the usual manner.

LAUNDRY GLAZE.

This preparation, also intended to produce a glaze on laundry articles, is prepared in the following manner: 50 parts of gum tragacanth are placed in a vessel with 2000 parts of hot water, and kept hot, without boiling. The gum dissolves gradually, solution being complete in two to three days, during which time the mass is stirred several times, but otherwise left covered up. The solution is strained through muslin and left to stand in a tightly corked bottle, to be added to the starch before ironing.

Liquid Starch Glaze.

Borax 1 part, spermaceti 1, gum arabic 1, glycerine 2½, water 21½, scented spirit quant. suff. Three teaspoonfuls of this preparation are taken to ½ lb. of starch.

Vienna Laundry Glaze.

Debreczin lathering soap or medicinal soap 4 oz., scraped on the outside and shredded, are boiled in 20 oz. of water until dissolved. When the solution is cooled down, ½ oz. of permanent white is added, together with an equal weight of asbestos and the white of two eggs, the whole being beaten up until thoroughly mixed and frothing. The mass must be kept covered up, a little being taken out in a basin as required, and brushed over the shirt fronts, collars, or cuffs, before ironing. When the preparation is dry, the articles are gone over with a warm (not hot) iron, the point of which is raised a little, and are then finished in the usual way. Under this treatment the articles do not soften, the glaze does not crack off in patches, and does not disappear or turn yellow. The articles should be ironed on a solid support, preferably a marble slab, covered with thin flannel and a double layer of shirting.

Dietrich's Laundry Glaze.

Potash 15 parts, stearine acid 50, glycerine 20, spirit 100, water 800 parts.

The stearic acid is melted in a porcelain dish over a gentle fire, the potash being meanwhile dissolved in about 150 parts of the water in a bottle, and the solution filtered through blotting-paper if not perfectly clear, after which the glycerine is added.

A thin stream of the mixture is stirred into the molten stearic acid, the whole being then taken off the fire and the remainder of the water added hot. After stirring the mixture until cold, the spirit is added. The glaze is kept in a small, wide-neck bottle, fitted with a cork, through which projects a wire terminating at the lower end in a loop holding a small piece of sponge.

Laundry Glaze.

The simplest, cheapest, and most reliable laundry glaze is prepared by boiling in 4000 parts of water, 6 parts of stearine, 100 parts of tallow (best), 3 of spermaceti, and 2 to 3 of gelatine, adding thereto 15 parts of wheaten starch dissolved in 150 parts of water. After heating the mass to boiling for a few minutes, a quantity of unboiled starch (30 parts dissolved in 300 of water) is added. Where a steam jacketed copper pan is available for boiling the starch, this method is preferable, the uniform heating on all sides facilitating solution. The well-dried laundry articles are rubbed over with this preparation, which is applied by hand in the case of shirts, only a portion of which requires glazing, whilst smaller articles, such as collars and cuffs, are best starched in a machine. The best machine for this purpose is the wringer, since it not only forces the starch into the pores of the fabric, but also distributes it evenly. When driven by steam, the maximum output is obtained from the machine. The starched articles are laid on the ironing board, which is covered with woollen cloth, flannel, and mull, and are ironed dry at first. This leaves them dull, and the parts to be glazed are wiped over with a wet sponge and are then gone over evenly with firm but elastic pressure, with an "English" iron, the pressure being gradually increased by the ironer bending over and concentrating her weight on the iron, under which treatment a brilliant, pure-white glaze is produced in a few seconds. If a patch or strip has not been touched by the iron, and has therefore remained dull, it is damped again in the same way, and ironed anew, the glaze then developing to the same extent as the rest, without showing any boundary marks.

Another method is to rub the articles over well with a coarse linen cloth on both sides, and ironed with an ordinary flat iron. The ironing-board cover should not be too soft, a layer of wadding, covered with linen, being sufficient.

Collars and cuffs are ironed first on the wrong side with a very hot iron, and then on the face, being laid aside whilst still rather limp. When the iron has cooled down a little, the articles are taken up again and re-ironed, the face being damped with a linen rag and then gone over quickly under heavy pressure, chiefly concentrated on the point of the iron, this method producing a uniform gloss, after which the seams or edges are marked out by the sides or back edge of the iron. Collars are finished by drawing them sharply under the iron; and both these and cuffs are rounded by bending them into circular form and inserting them, to cool down, in a glass of suitable size.

In dealing with shirts, the arms are ironed first, and then the shoulders, the back being folded down the middle, and ironed on both sides, after which the shirt is opened and the rest ironed all over, except the "front." Unskilled workers prefer to draw the shirt over the ironing board. The next step is the neckband, the back of which does not require starching. If the band be smooth, the shirt is again spread out on the board, and the front is wiped over with a damp cloth till free from folds, and gone over with a moderately hot iron, the face being ironed first, and then the inside, the face being then damped again, and ironed in the same way as collars. Should any starch stick to the iron, it may be removed by rubbing the latter over with a linen rag (three thicknesses) containing a small lump of white wax, stearine, or paraffin wax, a final rubbing of the iron on a piece of linen cleaning it completely and making it perfectly smooth.

Dressing Preparation for Starching.

Water 318 parts, fine wheaten starch 24·29, flour 9·07, magnesia 4·54, white curd soap 2·72, spermaceti 2·27, Japan wax 2·27, soda crystals 0·907, ultramarine 0·227 part.

The ultramarine is dissolved in the water, the soap, spermaceti, and wax being then melted, and incorporated with the soda crystals by continued stirring. The starch and magnesia are next mixed with the water, taking care to avoid lumpiness, and the soap-magnesia mixture being added, the whole is boiled until homogeneous, and finally strained through a fine sieve.

CHAPTER XVI

YARN SIZING

WASHED yarns, whether dyed or not, require stiffening; this treatment being the more essential in proportion as the fabric is more closely woven and the yarns themselves are finer in count. For this purpose, sizing preparations are used, the warp yarns to be sized being either dipped in the preparation, or else brushed over with the same after having been placed in position in the loom and stretched, a moderately stiff brush being used. In selecting and compounding the sizing preparation, regard must be had to the purpose in view, adhesive ingredients being requisite in order to strengthen the yarn, whilst at the same time, the materials chosen must be such as will not injure the threads or the colours with which the latter are dyed. The best sizing preparation for wool is clear glue of medium quality, boiled and mixed with dissolved starch. On the other hand, only weak decoctions of cabinetmaker's glue can be used, and it is not advisable to employ starch solution by itself, owing to its liability to turn sour and then injure the dye.

In addition to glue, gelatine, and so forth, successful use is made of fermented flour paste, or such as has been mixed with glycerine to prevent fermentation.

In sizing woollen warps, the yarn is placed in the vat charged with the diluted sizing preparation, and left to soak, after which the end of the yarn is grasped and the yarn gradually drawn through the closed hand, in order to express as much as possible of the liquid. The yarn should be dried slowly in a stretched condition.

In the preparation of these sizes, it has long been the practice to take advantage of the known property of starch of forming vegetable mucilage when dissolved in certain salts. Here again, however, it is important to exclude any substance that might subsequently affect the yarn or fabric injuriously. There is no objection to the use of alkalis and dilute acids, or the ferments of malt, especially when the two former are completely neutralised; but on the other hand, the chlorine compounds of calcium and magnesium are generally objectionable, because of their tendency to liberate hydrochloric acid under the influence of heat, the result being that the yarns fall to pieces like tinder when the fabric is afterwards gassed. The fabrics are also rendered hygroscopic by these salts, and liable to become damp and mouldy in stock.

The simplest, cheapest, and most reliable method of dissolving starch is by boiling it in a pressure pan with high-pressure steam. The method is convenient, and by regulating the steam pressure and the duration of boiling, one is able to obtain any desired degree of solubility of the starch, without having to add to the decoction any salts or other chemicals that would prove objectionable during the storage or subsequent treatment of the finished fabrics. This steam-boiling process is decidedly the most rational method of dissolving starch; and the products, when mixed with the usual soaps and fatty substances, will fulfil completely all practical requirements, both in respect of economy and technical features.

Wheaten Flour Sizing.

Caustic alkalis are used for dissolving the gluten in the flour, whereas in the usual method the gluten is partially destroyed or rendered soluble by subjecting the flour to fermentation.

1. Water 66 gallons, wheaten flour 11 lb., and caustic soda solution (39° B. sp. gr. 1·340) 1 fluid oz., are mixed together thoroughly in the cold, and then raised gradually to boiling in a suitable vessel, preferably by means of a current of steam, the whole being kept on the boil for half an hour with continued stirring, and then strained through a copper sieve with about 200 meshes to the inch.

2. This preparation, which is also intended to load the threads, consists of the following ingredients: Water 80 gallons, wheaten flour 240 lb., caustic soda lye (39° B.) 1 pint, and Glauber salt 198 lb. The flour and water are first mixed well together, and then the soda lye is added, the mixture being boiled for three hours with constant stirring. The Glauber salt is next dissolved in the mixture, and the whole is diluted to the desired consistence and treated with the necessary preservative agents.

3. Back's Recipe:—Boiled peas are boiled with poplar buds, and treated to an addition of carbolic acid.

4. Heald's Recipe:—Boiling water 22 gallons, liquorice juice 10½ oz., gum solution 20 oz., copper sulphate 20 oz., starch 70 grains, laundry blue 3½ oz., cherry-laurel water 1 pint; boiled for half a minute. Heald also prepares a mixture of water, flour, and magnesium-chloride solution, boiling the mixture with a small addition of tallow.

5. Makean and Grenoll's Recipe:—Flour and starch, dilute sulphuric or hydrochloric acid, and a little dissolved alum.

6. Lightford's Recipe:—Tungstate of soda (potash or ammonia), starch and flour.

7. Gilbert's Recipe:—Decoction of Brazil wood, tapioca, fig juice, Carragheen moss, rubber solution, and mulberry juice.

8. Kean and Gebot's Recipe:—An adhesive extract is prepared from 180 parts of water, 5 of glue, and 10 of hide scraps, by boiling them together for twenty-four hours by steam, sufficient alum for the preservation of the animal substances being then added, and the resulting liquid mixed with a mucilaginous extract prepared by boiling 7 parts of linseed and 100 of water for ten hours, followed by the addition of 25 parts of sago meal stirred up with 50 of water. For use, the preparation is warmed to 149° F., after the addition of a little tallow and linseed-oil.

9. White's Recipe:—Soft soap 1 part, tallow 2, soda 2, wheaten flour 240 parts.

Sizes.

1. For Woollen and Worsted Warps:—Protamol 12 parts, stirred up well in cold water and warmed to 86° to 140° F., 3 parts of dextrin and 1 of tallow being added, the mixture boiled for fifteen minutes, then mixed with 200 parts of water and again boiled. The product is rather thick for use, and may be diluted with water as required.

2. For Woollen Warps:—Protamol 20 parts, water 1000 parts.
For Worsted Warps:—Protamol 30 parts, water 1000 parts.

The protamol is stirred with the cold water and boiled for five minutes by steam.

3. For Medium Worsted Warps:—Protamol 15 parts, water 1500 parts.

4. For Closely Woven Worsted Yarn:—Protamol 20 to 25 parts, water 1500 parts.

5. For Woollen Warps:—Protamol 20 to 25 parts, animal glue 2 to 2½, water 1500 parts.

The water is boiled with injected steam, the ingredients being added by degrees and the whole boiled half an hour. To prevent the size dusting off in very closely woven fabrics, and to improve the softness of the warps, various additions may be used, the best result being obtained by adding 10 per cent. (based on the amount of protamol) of 60 per cent. sulphonated castor-oil (Turkey-red oil) after the size is boiled.

Loading dressings for mode fabrics, light semi-worsted and worsted mode fabrics, will require less water. For special dressings, instructions are issued by the makers.

Sizes for Unbleached Cotton Warps.

1. For Sizing Yarns Nos. 16 to 32 :—Water 500 parts, potato flour 50, vegetable glue 15, China clay 15, glycerine wax 10, zinc sulphate 0·07 part.

2. To increase the weight of Yarn 50 per cent :—Water 500 parts, potato flour 65, roasted starch 35, vegetable glue 15, sulphate of magnesia 20, China clay 25, zinc sulphate 0·11 part.

3. For Yarns No. 30 to 44 :—Water 500 parts, potato flour 40, vegetable glue 15, glycerine wax 15, glycerine 3, sizing soap 5, yellow wax 1, zinc sulphate 0·05 part.

The boiling vat is preferably made of pine or fir, and fitted with a draw-off tap in or near the bottom. It should be mounted high enough to enable a wooden or metal bucket to be placed under this tap. A copper-steam coil affords the best method of boiling, a receiver or steam-trap being provided to collect the water of condensation.

The water is measured out and the starch weighed, the latter being placed in a second vat along with enough water to enable it to swell up or become liquid. When this condition is reached, the starch solution is strained through a wire-gauze sieve or through a zinc vessel with perforated bottom, and added to the water, the mixture being kept stirred with mechanical stirrers, since the operation is too difficult to perform by hand, when the quantity is large and the mass thick. After the starch solution has been run in, the solutions of China clay and sulphate of magnesia are added, both of them being preferably stirred up with water and passed through a sieve, whilst the China clay should be in a finely ground state. Steam is next turned on, the stirrers set in operation, and the temperature raised to 154° F. whereupon the hot solutions of vegetable glue, glycerine wax, and softening are added, the fats, oils, and soap solutions being run in only after the mass has been sufficiently boiled. Finally, an antiseptic solution is added, either zinc sulphate, zinc chloride, salicylic acid, or alum. The fats, which saponify with the alkalis, dissolve in the mass, whereas wax and paraffin are insaponifiable, and can only be retained in a state of fine division in the mass. The formation of lumps in the mass indicates imperfect stirring in the boiling process; and such lumps must be taken out and forced through a sieve.

When dextrin is added, this should be dissolved in warm water; and albumin must also be dissolved in water at 122° F., and not added to the mass until the latter has cooled down to that temperature. To facilitate the distribution of wax (which is an excellent sizing agent) in the mass, this substance must be melted over a fire and poured hot into the mixture, by degrees, with constant stirring.

The sizing soap is made by melting equal parts of tallow and soft soap together until a homogeneous mass is produced. This soap mixes well with flour and starch, and is added after the other ingredients of the size have been boiled to a finish.

English Size for Heavy Loading.

Flour 616 lb., starch 740 lb., China clay 1480 lb., sulphate of magnesia 740 lb., zinc-chloride solution 22 gallons.

Machine Size for Dyed-Cotton Yarns.

(*a*) Water 500 parts, wheaten flour 15, potato flour 20, vegetable glue 10, glycerine wax 8, Turkey-red oil 2, wax ½, zinc sulphate 0·04 part.

(*b*) Water 500 parts, wheaten flour 15, potato starch 15, glycerine wax 15, glaze 10, Marseilles soap 1, zinc sulphate 0·045 part.

The glaze is made by dissolving 10 parts of bleached palm-oil, 4 of beeswax, and 4 of spermaceti, in boiling water, in a copper pan over a fire, the whole being then well mixed.

Warp Size.

Prime leather glue 10 parts, dextrin 7, glycerine 3, salicylic acid 0·1, water 80 parts.

The glue is softened in thrice its own weight of water for twenty-four hours, then melted in a jacketed pan and mixed with the dextrin and salicylic acid that have been dissolved in the rest of the water, the glycerine being also added. Decoctions of Carragheen moss and other vegetable mucilages are used in place of glue, one recipe of this type consisting in boiling 1 part of Carragheen moss with 25 of water for several hours by direct steam in a vessel fitted with a perforated false bottom, 1 per cent. of ammonia soda being added if necessary. The resulting solution is drawn off from below, and its adhesive power is fortified by the addition of a little soaked glue or, in the case of dark yarns, soda-rosin soap prepared by dissolving 4 parts of pale rosin in 3 of caustic soda lye (20° B.), and diluting with 20 parts of water.

Size Powder.

According to Beck, this may be prepared by making a solution of glue and treating this with a solidifying agent, such as soda, alum, or other saline adjunct, the solid mass being powdered and finally mixed with alum and powdered soap.

Potato Starch Size.

A simple method of preparing soluble starch for size dressings is to stir up 10 parts of potato starch with 70 parts of water in a wooden vat, fitted with a steam coil and stirring apparatus, 200 parts of finely ground malt being added and the whole kept stirred until the mass has become thinly fluid.

Preparations containing soluble starch are superior to gelatinised starch in that the dissociation of the starch is more complete, so that more highly concentrated masses can be produced, without lessening their distributive power on the material to be sized. As a preservative, 1 to 2 per cent. of zinc chloride solution, sp. gr. 1·5, is added.

Potato Flour Size.

According to Moeller-Holtkamp, an excellent preparation of potato starch, that will penetrate into the threads of yarn, may be obtained by treating the starch with solutions of calcium peroxide, sodium bicarbonate, soda, aluminium hydroxide, etc. It is important that the starch should not be completely dissolved, but only attain an intermediate condition between swelling up and solution. The product is fairly thin and pale, almost transparent, saturates the threads inside out, adheres to them with unusual firmness so as not to dust off, and also smoothens the yarn, thus fulfilling all the conditions required of a good size. The preparation is carried out at a temperature of about 122° to 140° F.

Carragheen Size.

This is prepared by suffusing 1 part of Carragheen moss with 64 parts of water, and leaving it to swell up for twelve hours, whereupon twice the above quantity of water is added, the whole being boiled for one and a half hours and strained through a cloth. The product is added to ordinary starch size in the proportion of 25 per cent.

Glycerine in Yarn Size.

The application of glycerine prevents the size from developing a disagreeable smell; and the weaver may work with open windows in dry weather without risk of the warp becoming brittle. Glycerine also prevents the warps from becoming mouldy, or attacked by ferments which make the fabric spotty. The following is a good recipe: dextrin 11 parts, glycerine (28° B.) 26, sulphate of alumina 2·4, water 26 parts. When a little albumin or allied substance is used for thickening, the presence of glycerine prevents the precipitation of coal-tar dyes in dyeing, and indeed, forms the best means of keeping the dyes in solution. In the case of materials soluble in water, sizing preparations, dressing preparations, dyes, and mordants, an addition of 3 parts of glycerine to every 40 parts of the liquid ; and it is not essential for the dyeing, printing, and finishing processes that the glycerine should be perfectly colourless, this being only necessary for sensitive colours such as ultramarine. The glycerine generally used is of 26° to 28° B. strength, and free from acid or alkali, 30° B. glycerine being rarely employed.

Machine Size for Strong Linen Yarns.

Water 500 parts, and wheaten starch 10 parts, are boiled together, the cooled liquid being left to turn sour. Before use, it is warmed up to 86° F., 3 parts of glycerine wax, and 1 of sizing soap being added per 100 parts of water.

Machine Size for Light Linen Yarns.

Water 500 parts, wheaten starch 10 parts, white glycerine (28° B.) 5, sizing glaze 5, alum 0·8 part. The sizing glaze is made by dissolving 1000 parts of wax in 1000 parts of glycerine (20° B.) over a fire, and adding 500 parts of stearine and 125 of turpentine.

Machine Size for Woollen Yarns.

Gelatine 100 parts dissolved in a minimum of water and mixed with dextrin 70 parts, glycerine (20° B.) 20, sulphate of magnesia 20, and zinc sulphate 10 parts, previously boiled together.

Glycerine Size for Dyed-Cotton Yarns (No. 40 to 50).

The glycerine size is prepared from three mixtures, each mixture entailing much care. On no account may glycerine containing lime be used for dyed cotton yarns.

Mixture No. 1 :—Glycerine, white and free from lime (28° B. density) 1000 parts, white dextrin free from chlorine 500, sulphate of alumina 100, water 9000 parts.

The water is heated to boiling, and the glycerine is added slowly, boiling being continued thereafter for five minutes. The sulphate of alumina is dissolved in water and stirred into the first solution.

Mixture No. 2 :—Mixture No. 1 150 parts, and glue 250 parts, dissolved in 3000 parts of water and added to mixture No. 1.

Mixture No. 3 :—Water 100,000 parts, starch 4000, mixture 1 and 2 10,000, Turkey-red oil 500 parts, boiled from twenty-five to fifty minutes (these limits not being exceeded) and then mixed with the previous solutions. The product is stored in glass carboys.

Of this preparation, 5½ oz., mixed with 7 oz of glue previously dissolved in ½ gallon of water, will suffice to size 1000 yards of fine yarns.

MACHINE SIZES FOR JUTE YARNS.

1. Water 1000 parts, magnesium chloride 3, sulphate of soda 4 parts.
2. Water 100 parts, flour 6, glycerine wax 4 parts.
3. Water 100 parts, water-glass 5 parts.
4. Water 100 parts, flour 12, sizing soap 2 parts.
5. Water 100 parts, starch 5, glue 2 parts.
6. Water 100 parts, flour 7, vegetable glue 3 parts.

SIZE FOR HAND OR HANK SIZING DYED-COTTON YARNS (No. 12 to 24).

Water 100 parts, wheaten starch 6, glycerine soap 1, sulphate of magnesia 1 part.

FOR DYED COTTON YARNS (No. 26 to 36).

Water 100 parts, wheaten starch 6, sulphate of magnesia 1·6, sizing glaze 0·3, palm softening 1, dextrin 1·5, borax of alum 1·1 part.

FOR WOOLLEN WARPS.

Gelatine glue 100 parts (dissolved in a minimum of water), dextrin 70, glycerine 20, sulphate of magnesia 20, zinc sulphate 20 parts.

SIZE FOR COTTON.

A solution is prepared of ¾ part of copper sulphate in 140 parts of water, heated to 129° F. in a copper pan; and on the other hand, 17 parts of potato starch are stirred up with 28 of water at 91° F., the mixture being poured into a copper pan and the whole boiled for half an hour, being kept stirred with a wooden spatula. The copper sulphate prevents the development of mould and fermentation. The size should be used fresh, only one day's supply being made at a time.

MANDOT'S GLYCERINE SIZE.

To prepare this size, 500 parts of white soluble dextrin, 1200 of glycerine (28° B.), and 100 of sulphate of alumina are taken to 3000 parts of river water. The water is heated to boiling, and the glycerine is added by degrees. After continuing to boil for a few minutes longer, the liquid is taken off the fire, for the purpose of dissolving the sulphate of alumina and mixing the same with the glycerine. When cold, the product is bottled for storage. A mixture of 5 oz. of this preparation and 8½ oz. of glue dissolved in 3 quarts of water, will be sufficient for 1000 yards of muslin, woven in the upper storeys of the works.

Size for Cotton Yarn.

Twenty-five parts of potato starch are boiled in 100 parts of water, after which are added in succession: oxalic acid 0·13 part, tallow 0·5, lard 0·25, soda 0·1 (or Marseilles soap 0·2) part, the whole being boiled from five to six minutes. If 5 to 10 parts of kaolin be added for loading, the oxalic acid is increasəd to 0·25 part.

Size for Linen Yarn in the Hank.

(*a*) Ten parts of wheaten or potato starch are stirred up in cold water and passed through a fine hair sieve, after which 1 part of cream softening is added, and the mixture is boiled to ensure thorough incorporation. The mass is then ready for use.

(*b*) Ten parts of potato flour are stirred up well with about 20 of water, 3 parts of crystalline being added, and the whole boiled, with constant stirring, until it becomes viscous and gummy when tested with the stirrer. Hot water is then added to reduce the density to 10° to 18° B., the size being used at a temperature of 73° to 86° F.

(*c*) Ten parts of potato flour are mixed with the requisite quantity of water, 5 parts of vegetable glue, and 1½ of cream softening, the whole being boiled up and used for sizing.

(*d*) One gallon of dressing oil is added to 100 lb. of potato starch, the mixture being boiled and used for sizing. This preparation makes the threads loose and smooth, and does not dust out in the loom, being very intimately combined with the fibres and therefore not protruding from the surface.

Morin's Size.

Four parts of Iceland moss are boiled for half an hour in 24 parts of water. When cold, the decoction sets to a jelly. On the other hand, ½ part of wheaten or rice flour is softened in 3 parts of water, and heated, with constant stirring, until the mass becomes a thick pap, the two products being mixed together whilst hot, and well stirred, furnishing about 25 parts of size of the right consistence for use. In a few days, a watery liquid will separate out, but this does not militate against its application, all that is necessary being to stir the mass up again, to restore its original appearance. If the grey colour of the size is objected to, the moss should be softened in water for thirty-six hours, well kneaded, boiled for half an hour 3 or 4 times, and then treated further as above.

Size for Woollen Warps.

Gelatine glue (dissolved in a minimum of water) 100 parts, dextrin 70, glycerine 20, sulphate of magnesia 20, zinc sulphate 20 parts.

Size.

Ten parts of potato starch are suspended in 40 of cold water, 5 parts of lye (36° B.) being diluted with 40 of water and mixed in with the starch, which swells up to a thick, viscous pap. The alkali is then neutralised with 3½ parts of commercial sulphuric acid diluted with 20 parts of water, and the whole is finally thinned down with water to an extent depending on the yarn. The lye and acid must be added very slowly, in order to obtain a good, viscous mass, about one hour and a quarter being taken for the lye and three quarters of an hour for the acid. If necessary, a solution of glue or dextrin may be incorporated as well.

Loaded Size.

(*a*) Water 90 parts and potato starch 30 parts are boiled with caustic soda (36° B.) 0·15 part, 12½ parts of Glauber salt being dissolved in the hot mass, and the whole thinned down to the requisite consistence with water.

(*b*) Fifty parts of potato starch are boiled with the necessary amount of water, 50 parts of magnesium chloride, and ½ part of sulphuric acid, for an hour, and finally neutralised with limewater.

Potato Flour Size.

Instead of following the usual practice of mixing large quantities of wheaten flour with water, and leaving the mass to stand until it has lost its thickening power, this preparation may be made in small troughs and used in the sizing machine while still hot. The trough or vessel in which the potato flour is mixed should be lined with brass; and the mass being used at once retains its stiffening properties completely. Yarn stiffened in this way is said to be far superior to that treated with wheaten flour.

Potato starch 5 parts, Leio gum ½ part, and water 50 parts, are boiled for an hour over an open fire, and will suffice for a mixture containing 500 parts of water. The object in view is said to be fully attainable when only Leio gum is used in admixture with the starch.

WATER-GLASS SIZE.

Solid potash (or soda) water-glass is dissolved in boiling water in a clean copper or iron pan, and the solution is diluted with sufficient water and Eau de Javel to destroy the brown colour and make the liquid limpid. During the addition of the alkali, the liquid must be stirred quickly. Sulphuric acid, diluted with 8 volumes of water, is then added, slowly and carefully, in sufficient quantity to neutralise all the free alkali present, the mixture being stirred until flakes of silica begin to separate and float in the liquid. When the amount of free alkali is small, no acid is required.

The resulting solution is poured into a copper or iron pan and is concentrated to the desired strength by rapid boiling. When cold, it is stored in glass bottles. If it should be necessary to dilute the liquid with distilled water, for sizing any particular kind of yarn, this may be done in the copper or iron sizing trough. Talc or soap can be added in the trough as in the case of flour sizes.

SIZE FOR JUTE WARPS.

A composition made from potato starch and good leather glue is recommended for sizing jute warps. The glue is first soaked in water, and then boiled until fully dissolved. The starch is dissolved in cold water, and stirred into the glue until boiling point is reached. Approximately equal weights of the two ingredients are taken, the glue being in excess, if anything. Enough water is taken to give the necessary consistence. Rosin must not be used, or the warps will tend to stick to the sizing drum.

VOGT'S RECIPE FOR SIZE.

Water 150 parts, potato starch 14 parts, small quantities of carbonate of soda, glue, and copper sulphate. The glue may be replaced by roasted flour; and tallow, rosin, and other resins may be added.

BONE SIZE.

This size is prepared by boiling the carcases of dead animals under high pressure, and consists of a solution of glue, contaminated by flesh extractives. The process, in which bone fat is also recovered, can be adopted, with advantage, by knackers.

HAUBOLD'S YARN-SIZING MACHINE.

This machine consists of a wooden vat, with four cast-iron feet, a steam coil being provided for warming the size. The superfluous size is drawn off through a valve in the bottom of the vat. Above the apparatus is mounted a copper roller, driven by a cord from the main shaft; and two hooks are also provided, one of which is retarded by a weight, whilst the other is mounted in two bearings on a shaft, and can be rotated and stopped by means of a fast and loose pulley, the belt being thrown on to the latter by a treadle fork. When the yarn has been sufficiently sized in the machine, it is transferred, by means of two sticks, to the two hooks aforesaid, and is wrung by rotating the movable one. The yarn is afterwards brushed in a machine consisting of iron frames connected by iron traverses. In the frames are mounted two copper cylinders and two rotary brushes, the latter consisting of three detachable brushes set in wood. The yarn is hung on the copper rollers by raising the latter out of their bearings by means of swing levers; and the hanks are weighted by loaded copper guide rollers attached below, the bearings of these rollers being adjustable, to take hanks of different lengths. To take off the yarn, the load on the lower guide roller is released by pressing on a treadle, thus setting free the roller and enabling the yarn to be taken out with ease.

The machine is constructed to brush one or both sides. The yarn is dried by means of reels, on which it is wound, and transferred to a small, hot air-chamber, the temperature of which can be raised as desired, the reels being rotated by shafting, driven by the steam-engine.

Methods of Recovering Size, Oil, Salts, Acids, and Other Substances from Yarns and Fabrics.

The fats, sizes, mineral salts, and acids, glue, etc., with which textile materials, in the raw, spun, and woven condition, are impregnated in the various stages of working, are claimed to be recoverable by the process now to be described.

The liquids resulting from the scouring of sized-worsted yarns, and dyed and undyed fabrics, contain adhesive substances preventing the decomposition of the liquids by acids. Even when the decomposition is at all feasible, the oil does not separate properly from the rest of the liquid, so that the extraction is not economical; the residual liquids still remain unutilised. Also lost are the rinsing waters from yarns and fabrics that have been cleansed from particles of straw, burrs, and other foreign substances by chemical means, the said cleansing being effected either with mineral acids, salts, magnesium chloride, or with aluminium chloride or alkali silicate. The process now under consideration consists:

1. In extracting the adhesives from the fabric before scouring the latter, in order to recover said adhesives and enable the oil to be separated from the spent scouring liquor by treating the latter with acids.

2. In recovering, without the expense of neutralising, the acids

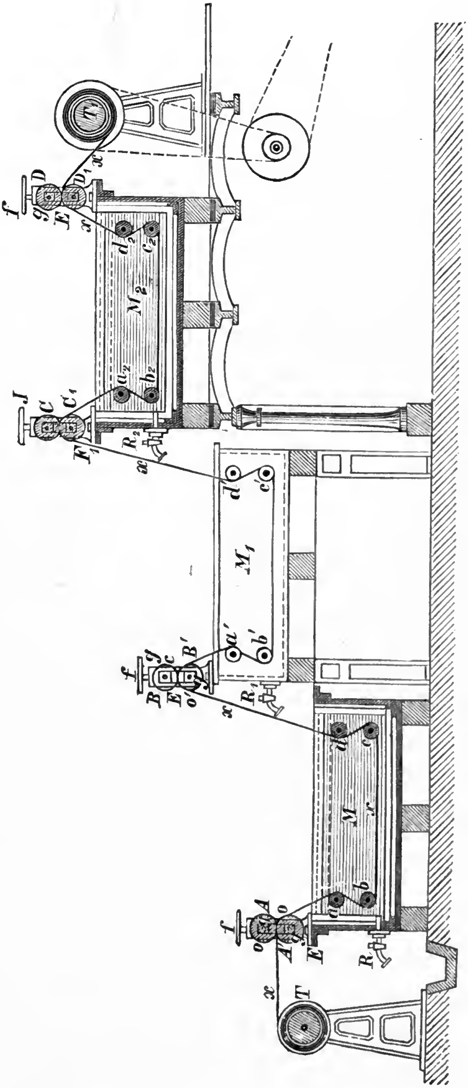


FIG. 33.—Apparatus for recovering size, etc. (C. Charbonneux, Rheims).

from the woollen yarns and fabrics treated therewith for the purpose of removing straw.

Extracting the Adhesives from the Fabric.

The fabric, coming from the loom, is passed through several tanks filled with water at a temperature depending on the character and quality of the adhesives present in the fabric. The latter is thus subjected to a systematic washing.

These tanks are shown in vertical section in Fig. 33, and as a plan in Fig. 34. Three tanks, M, M_1, M_2, are assumed to be used, though the number may be larger or smaller, according to the character of the adhesive substances. The fabric x, wound on the roller T, is first passed through the feed rollers A A^1, the journals, O, of which are mounted in the standards, E, secured to the tank. The relative position of these rollers can be adjusted by the hand-wheel screws, f, an elastic support being afforded by a rubber plate, g, under the bearing of the lower roller. The fabric, x, issuing from the rollers, is immersed in the water in tank M, being led in front of the guide roller, a, then behind the two rollers, b and c, and in front of the roller, d. It then passes between a pair of squeezing rollers, B B^1, the bearings of which are mounted on the tank M_1, and after traversing the water in this tank, goes through another pair of rollers C and C_1, into the third tank, and thence through the rollers D D_1, being finally wound on the cylinder T_1.

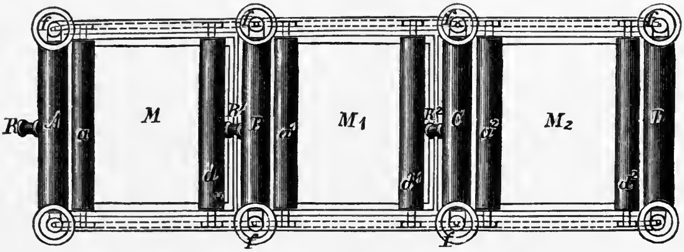


Fig. 34.—Apparatus for recovering size, etc. (C. Charbonneux, Rheims).

In commencing the process the three tanks are filled with warm water, the temperature of which is kept at 140° F. In a short time the water in the lowest tank will have taken up a considerable quantity of adhesives, whereupon the tank is emptied through the tap R, and is then filled with the water drawn off from the tank M_1 through the tap R_1, this tank in turn being filled with the water hitherto in the tank M_3, through the tap R_2. Thus the water from tank M, is collected for treatment, whilst tank M_2, is filled with fresh water.

If the water charged with adhesive substances, from tank M, contains any small quantities of oil or fat from the fabric, it can be freed therefrom by treatment with carbon disulphide, petroleum spirit or ether, which solvents are lighter than the greasy water and partially carry the fat upward to the surface and partially dissolve it. The rest of the water is run off and concentrated, thus recovering the sizing ingredients, glue, etc. After the fabric has left the apparatus it is scoured, and the resulting liquor is free from adhesives, so that in the acid treatment, the decomposition proceeds without difficulty, and the oil is readily separated from the remainder of the liquid.

To separate the acids and salts used in freeing textile materials from straw, etc., the treated fabric is put through a systematic washing process similar to that just described, the washings containing sulphuric acid, hydrochloric acid, nitric acid, aluminium chloride, magnesium chloride, and silicates of potash and soda. These acids and salts are recovered, for use over again, by concentrating the liquor from the tank *M*.

The fabric, thus freed from acids and salts, is washed repeatedly with water in the usual manner, so that all traces of acids and salts are eliminated. In the case of wool that has been freed from straw, etc., previous to weaving, it is sufficient to treat the same in a separate vessel, with water, the latter being cold for acids and warm for the salts, especially the alkali silicates which are only sparingly soluble in cold water. The fabric is next dried in a hydro-extractor, and the drainage water is concentrated in the way already mentioned.

In the case of merino worsteds, a systematic washing, as described, will furnish a saturated spent liquor. The previous separation of the water from the fats can be dispensed with, since these fats will collect as a scum on the surface during concentration, the underlying liquid becoming fully clarified.

Eliminating Dressings with Diastafor.

Diastafor, a malt preparation, possesses a high solvent power for starch, and is used in the following manner to eliminate dressings from fabrics. The fabric or sized yarn is damped and treated with a solution of diastafor (about 2 per cent. strength) for half an hour, at 140° to 158° F., at the end of which time all the starch will have passed into solution. The addition of alkali to the diastafor solution must be strictly avoided. When the starch has been dissolved, the dressing can be removed by rinsing.

CHAPTER XVII

FINISHING WOOLLEN GOODS

In finishing woollen goods, the finisher works with essentially different means from those used for cottons and linens. His work is, above all, just as dependent on the kind of washing, dyeing, and drying processes used as on the nature of the wool used in spinning, and proceeds concurrently with these operations, being occasionally interrupted and being influenced in one direction or the other by their success or failure. The number and exceeding variety of woollen fabrics are, if possible, greater, and fluctuate more from one season to another, than is the case with cottons or linens. Nevertheless, the differences thus produced in the finishing processes are not very great; and it will therefore be sufficient here to give merely a general indication of the direction to pursue, taking as example a piece of dyed cloth of medium quality, taken from the loom and dried.

In the first place, defective wefts, thick threads, broken ends, etc., are mended with a nopping tool, and knots removed from the cloth. Each piece is then provided with a number and a sewn-in mark, and is scoured in a washing machine, in which it is treated with warm soap and soda solution, and perhaps with fuller's earth, to cleanse the fabric from the glue in the size, the oil from the wool-softening process, and from other impurities. Next, follows a thorough washing in clean water, draining in the hydro-extractor, and drying on drums, air-drying machines, or stenters. The dried goods are placed in a milling machine, which is charged with moderately hot water, dissolved soap, stale urine, and fuller's earth, which are allowed to act until the threads are sufficiently felted, the texture thickened, and the fabric has shrunk to the desired breadth. After washing, which is best performed in a full-width washing machine, the cloth is placed, in the damp state, in a raising gig, in order to disentangle the felted nap, which is brushed after drying, and shorn off in the shearing machine. After another damping, the final raising is effected, this being followed by the shearing process proper, in a longitudinal machine and then in a transverse shearing machine. For dull finish, all that is now required is a passage through pressure rollers, followed by steaming to fix the mild lustre imparted by pressing, and to prevent the goods from shrinking in the event of their afterwards getting wet, as well as to retain the nap in its final position. Dyeing is the next stage, the goods being moved throughout in the same direction as the nap is brushed; and this is succeeded by a good washing with fuller's earth, brushing the nap with dulled raising cards or the brushing machine. After drying, the pieces are lightly shorn on the transverse shearing machine, steamed, damped, and made up in the form in which they will be put on the market. In this state they are finished off in the hot press, smooth pieces of millboard being inserted between the several layers of material, and the pieces themselves piled one above another in the hydraulic or spindle press, with intervening thin boards and warm iron plates, in order to produce a smooth surface, according to the duration of pressing. The gloss imparted depends on the extent of the pressure and the temperature of the iron plates, this object being achieved more satisfactorily in this type of press than in the roller press, which does not produce such a high lustre.

In finishing worsted goods, milling is omitted (except in certain piece-dyed goods), in order to preclude all tendency to felting, the raising process being also dispensed with for the most part. Piece-dyed worsted suitings, for instance, are scoured in the machine with water, curd soap, and a little soda, drained in the hydro-extractor, stented and dried, then nopped and gassed. It is only in rare cases that the goods are raised with dulled cards; but on the other hand, they are preferably transferred, in a damp state, to the brushing machine, raised and shorn, and then put in the press. To fix the relative position of threads in the fabric and preserve the lustre, the pieces are steamed, or passed through water at a temperature of 176° F., either in the carbonising machine or the crabbing machine. After washing with fuller's earth comes dyeing, followed by washing, drying at a moderate temperature, gassing, shearing, steaming, and, in the event of a desire to improve the feel of light goods, treatment (on one side) with glue in the sizing machine. Finally, a cold pressing in the spindle press and warm pressing between rollers completes the finishing process.

Worsted Cheviots form an example of worsteds that, contrary to the rule, are milled; and they also illustrate the manner in which the wool finisher may, with certain articles, have to alternately employ phases of the two chief types of finishing process. These goods are required to possess a mild feel, decided lustre, and a close, somewhat smoothly shorn surface. The pieces coming from the loom are nopped, and then scoured with a weakly alkaline liquor. With piece-dyed goods, the next stage is carbonising, followed by a short milling with soap and water, and washing in lukewarm water containing a little ammonia, this being succeeded by washing with fuller's earth. Fine piece-dyed Cheviots are occasionally packed and boiled for a short time, or treated on the gassing machine before dyeing. After the dyeing process, the goods are again scoured with fuller's earth, drained in the hydro-extractor, lightly raised, like goods that have been dyed in the wool, wound up damp on the steaming roller, and steamed thereon for eight minutes, to be then dried at a moderate temperature, either in the open or in a hot-air machine.

The rough nap is topped on the longitudinal shearing machine, and the goods are again nopped, and warm pressed in the hydraulic or plate press. The second warm pressing is succeeded by a light steaming, cooling, and cold pressing.

The finishing of half-woollen goods is very similar to that of worsted and, if the goods are to be piece dyed, is divided into two main phases, separated by the dyeing process. The finishing begins with gassing, the pieces being then treated in the crabbing machine, alternately with soft soap and hot water. This treatment removes the oil, size, and other impurities adhering to the rough fabric. At the same time the wool fibres, as is the case with worsteds, lose their property of curling and felting. After crabbing, the goods are steamed for ten minutes in the steaming machine, and treated with warm water in the padding machine. This completes the first stage of finishing, operations being resumed, after dyeing and rinsing, by a second steaming, gassing, and warm water treatment in the padding machine. Inferior grades of half-woollens are dressed with glue solution in the same machine. After drying in the stenter, the sized or unsized goods are lustred in a suitably warmed hydraulic press.

Hitherto, woollen fabrics have been lustred by one of two methods. In the one, a perforated steaming plate is used, the goods being pressed more or less tightly by means of a screw. The fabric is laid on the plate in regular folds so that a piece of cloth occupies a thickness of about 4 inches. Backing material is laid under and over the cloth, and several plates are then laid one on the other and pressed together, after which steam is admitted, and traverses the various layers of the cloth, the length of the steaming depending on the degree of gloss desired.

In the alternative method the cloth is wound evenly on a perforated cylinder, into which steam is admitted, the cloth being left until the requisite gloss is attained.

Since neither of these methods can be carried on continuously, another has recently been invented, in which the cloth is impregnated with superheated steam, and pressed against a strong, polished plate, also maintained at a temperature above the boiling point of water, the cloth being passed between two rollers subjected to pressure. One of these rollers is perforated with fine holes for the passage of steam, and is covered with cloth, whilst the other is polished and is heated by means of admitted superheated steam. While the cloth is passing between the rollers, steam is also admitted into the perforated roller under pressure, and by this means the purpose in view can be accomplished in a continuous manner.

Silk Finish for Wool.

To give wool the lustre and feel of silk, it is entered at 158° F. in a bath containing 1½ to 3 volumes of hydrochloric acid per 1000 parts of water. A milk of bleaching powder (½ to 1 lb. of bleaching powder to every 5 lb. of yarn) is added, and the yarn is worked about in the bath for three quarters of an hour at the above temperature, after which it is rinsed, a little soda being added, if desired, to neutralise the acid. For light colours, the bleaching powder (1 lb. per 5 lb. of yarn) should be in the state of a clear solution. Dyeing is best performed in a soap bath, acidified with sulphuric acid; but the wool may also be dyed first in an acid bath, then soaped and scoured.

Looke's Dressing for Worsteds.

Starch 10 parts, sago meal 10, rice meal 7½, blue 3, water 240 parts.

Dressing for Flannels and Woollens.

Dextrin 30 parts, dissolved in 30 parts of water and mixed with 5 parts of starch syrup (42° B.), followed by adding 6 parts of starch stirred up in a solution of 5 parts of sulphate of magnesia in 50 parts of water, 4 parts of 40 per cent. dressing oil (sulphonated castor-oil) being finally added.

Dressing for Heavy Trouserings.

Bone glue 20 parts, wool fat 2, soap 10, starch syrup (42° B.) 20, glycerine 2, water 125 parts.

The soap and wool fat are boiled with 80 parts of water until completely dissolved, the starch syrup and glycerine being added, followed by the glue, which has previously been soaked for twenty-four hours in the remainder of the water, and brought into solution by heat. The ingredients are well mixed together and boiled for twenty minutes.

Dressing for Inferior Woollens.

Mix 3½ oz. of caustic soda (28° B.) in 11 gallons of water, then add 11 to 13 lb. of potato flour and boil for half an hour. Next, dissolve 7 to 14 oz. of monopol soap in hot water and add to the mass, stirring it up and applying to the fabric at 122° to 140° F. If any loading be desired, 1 to 2 pints of sulphate of magnesia solution (20° B.) or magnesium-chloride solution may be added.

PROTAMOL DRESSING FOR WOOL.

Protamol 20 to 30 parts, Turkey-red oil 2 to 3, water 970 to 980 parts.

DRESSING FOR WORSTEDS, CHEVIOTS, AND HALF-WOOLLENS.

Water 50 parts, sago meal 3½, dissolved glue 5, and glycerine 1½ parts, boiled together for an hour and applied at 122° to 140° F.

BACK DRESSING FOR WORSTEDS.

To 11 gallons of water add 2 to 5 pints of glue solution, prepared by soaking glue for twenty-four hours with 12 to 15 times its weight of water, and then boiling it in a jacketed pan or water-bath. To take away the disagreeable smell of the glue, add about 1½ oz. of salicylic acid.

FINISHING WOOLLENS BY THE ELECTRIC CURRENT.

Attempts have been made to finish woollen fabrics with the aid of the electric current; and in one instance, the experiments were carried out with flannels and light dress fabrics, which had been found to lose excessively in weight under the raising process. A wooden steaming apparatus was used, which was fitted with adjustable wooden rollers on both sides, outside the frame and near the bottom, so that while the front roller was unwinding the full width material, the back roller took it up, and *vice versa.* The fabric was guided by two straight bars of iron, secured front and back to the top crosspieces of the machine and thus bounding an area of the same width as the latter. Both bars were mounted on insulators, and there was no metallic connection of any kind between the two rollers. On connecting the one bar with the anode and the other with the cathode of a Schuckert dynamo, it is evident that the current could not pass unless the cloth stretched between the bars allowed. This, however, it would do so long as it remained dry—as might, of course, be assumed in view of the non-conductivity of wool. Even when the fabric, after milling, had been wetted and drained in the hydro-extractor, the current passed was merely a feeble one; but on passing the fabric through dilute sulphuric acid, the current passed and remained constant so long as the fabric was kept wet. By winding the cloth repeatedly from one roller to the other, all parts of the fabric were gradually subjected to the influence of the current. This treatment produced a decided nap on both sides of the material, an incipient grain being developed on the fabric being neutralised and gently brushed toward the front end on a frame, without any previous treatment in the raising gig. This nap undoubtedly results from the electrical action; and this granted, it follows that the current has a loosening influence on the wool threads, and disentangles the wool hairs out of the fabric in which they are intertwined with others in the threads.

CHAPTER XVIII

FINISHING SILK FABRICS

Silk yarns and (though to a far smaller extent) the fabrics woven therefrom, are dressed; and this applies not only to dyed and raw silk yarn—sold under various names, as sewing silk, embroidery silk, galloon silk, etc., but also many semi-manufactured products employed by the silk (ribbon) weaver are put through a dressing process which serves, to some extent, as a preparation for the subsequent finish of the woven fabric. To restore to silk yarn the lustre it has lost in the various stages of the dyeing process, the yarn is put through a reviving process, in which various chemicals are used according if the yarn is to become scroopy or soft. A soft, and at the same time scroopy, finish is produced, for example on black-dyed yarn, by means of an emulsion of olive-oil, water, and soda or potash, acidified with citric acid. For scoured silk, 1 to 2 per cent. of olive-oil, based on the weight of the yarn, is taken; for "soluble" yarn, 5 to 15 per cent., and for fringe silk, 5 to 20 per cent. of olive-oil. Furthermore, the amount of oil varies according to the origin of the silk and the purpose for which it is required, *e.g.* for warp or weft, and for twill, taffeta, or other fabric. The oil is stirred to an emulsion with twice its weight of water and with soda solution of 65° strength, 20 to 25 per cent. of citric acid being added when the production of scroop is in question; and the mixture is cooled to 95° F. The silk is worked about quickly in this bath, and is then wrung and dried. The citric acid may be replaced by 10 to 12 per cent. acetic acid, 9 per cent. hydrochloric acid, or dilute sulphuric acid (1 : 1000), a small percentage of cabinetmaker's glue or gelatine being sometimes added to improve the feel. When the silk is for watered fabrics, it is worked about quickly in sulphonated olive-oil extensively diluted with water, and is dried without being wrung, this treatment rendering it soft. Another way is to treat it for half an hour in a bath of warm soap (25 to 30 per cent. of white soap) at 86° F. or—and this is particularly recommended for sewing silk—it is worked about for half an hour in water containing fuller's earth in suspension. In the latter case, it is afterwards immersed in lead acetate solution—to increase the weight—dried, and impregnated with olive-oil (without acid). This loading with lead soap, however, cannot be too highly deprecated from the hygienic standpoint.

The mechanical portion of the process of finishing silk yarns consists first in stretching the threads, the damp hanks being suspended from a peg, and a rod inserted in the bottom loop, to which rod several downward thrusts are given, whereby the threads are forced into a parallel position and the yarn is stretched 2 to 3 per cent. To perform this work mechanically, several machines have been devised. If, in addition to the vertical thrusts, the rod be given a horizontal twist, right and left, the threads in the hank rub together and are rendered glossy. This operation is of special importance in the manufacture of sewing and cordonnet silks. In the lustring machine the yarn is glossed by friction on metal rollers, accompanied by the action of steam in a closed chamber, a very high glaze being produced.

Fabrics of pure silk require no dressing, and are finished simply by warm pressing, mangling, or slight calendering, with or without friction. Lighter fabrics are treated on one side with a dressing composed of readily soluble substances, such as glue, gelatine, dextrin, tragacanth and gum arabic, rosin- and other soaps, alcoholic solutions of resins, paraffin, wax, and the like. In most cases, the dressing is applied to the back of the fabric only, the fabric being either stretched on a frame and sponged over with dressing on the back, or else dressed on the under side in a starching machine, then dried on a cylinder machine and put through an ordinary calender, or, when an embossed effect is to be produced, through a calender fitted with deeply engraved iron rollers. Half-silk goods containing more or less cotton, are dressed on one or both sides, since they often lack stiffness, hardness, and the desired scroop.

Whatever the dressing used, it should be applied with great care, and from one side, generally the back. The mass must not penetrate right through the fabric; and it should be applied, lightly and evenly, by sponging, the fabric being stretched on a frame.

Various dressings are used, such as: rice water, gum solutions, ox gall, sugar solution, isinglass, gelatine, poppy oil, and tragacanth. Moreover, in order to produce a special lustre, the fabric is often treated with solutions of metallic salts, such as copper sulphate, lead sulphate, or bismuth sulphate, followed by exposure to sulphuretted hydrogen gas. Basic lead acetate, employed in the same way, is said to improve the lustre and depth of black silk considerably.

Of other dressings, dissolved resins, such as amber, copal, and pale rosin in alcohol, wood spirit, etc., are recommended. Rosin soaps, prepared by boiling rosin with soda solution, produce a more lasting finish than gum, and are frequently referred to as waterproof dressings, because they do not spot under the action of drops of water.

Single Dressing for Silk.

The preparation consists of: gelatine 225 parts, water 20,000, paraffin 1500, white wax 450, castor-oil 1100, and soap 900 parts.

Full Dressing for Silk.

Size 55 lb., water 22 gallons, thick tragacanth mucilage 1 pint, soap 1 pint, cocoanut-oil 1 pint.

If the goods have a greasy lustre when calendered, they must be steamed.

Kaeppelin's Dressing.

Rice 10,000 parts, water 50,000 parts, the mixture being passed through a sieve and treated to an addition of 58 parts of white cabinetmaker's glue. Albumin and dextrin may also be used.

Jandin and Duval's Dressing.

This consists in boiling the silk with dissolved soap, taking care not to exceed boiling point. This dressing is particularly used for raw silk.

Ramsbotten's Dressing.

Ramsbotten proposes to use a very weak alcoholic solution of shellac, which stiffens and glazes the silk; but this treatment is not greatly to be recommended, as the shellac makes the threads too stiff and brittle. It has also been proposed to employ solutions of gum arabic or tragacanth, either alone or with stannous chloride, collodium, and amyl alcohol.

Pastor's Dressing.

Tragacanth is gradually dissolved in soft water, a little glue being added, the solution well beaten and brought to the consistence of syrup with porter and brandy.

Knape's Dressing.

The warp yarn is sized with gelatine solution, the weft being reeled dry, rinsed, and a damp sponge is placed in the shuttle, the thread running through this sponge in weaving. The fabric coming from the loom is dipped in gelatine solution, partially dried, beaten well between the hands, and then stretched on a frame.

Dressing for Taffeta, Foulard, etc.

The dressing is prepared from: water 1000 parts, gum arabic 25, stannous chloride 1 part, the gum being soaked in cold water for twenty-four hours. When dissolved, the stannous chloride is added, the object of this being to produce a certain scroopy effect. The silk is dressed, either with a sponge or in the machine, and is then put in the press.

For printing black or blue silks, or similar articles with dark background, the dressing should not be applied too thickly, or it will make the colours appear lighter in shade. In this case, the following preparation may be used: rice 200 parts, water 1000, white gelatine 12 parts. The rice is boiled with the water, the gelatine added, and the whole forced through a sieve. Many finishers prefer calendering to pressing; and the silk may also be stretched on a frame and dried in the air.

Amber Dressing.

Impregnation with amber is practised to impart elasticity, elegance, and durability to silk fabrics.

The finest, transparent amber is finely powdered and dissolved, as completely as possible, in chloroform (2 parts of solvent to 1 of amber). After being separated from the undissolved amber, the solution is sponged or brushed over the fabric, which is then dried in a drying chamber, the evaporated chloroform being recovered. The fabric is next rolled between heated iron rollers as often as necessary, which treatment renders it particularly soft, elastic, and of elegant appearance.

Finishing Half-Silk Satins.

The finishing of these fabrics is closely connected with the dyeing process, the dyer being frequently required to deliver the goods in a finished state. The following general summary of the process may be given, but the practical performance of the operation cannot be learned from recipes:—

The finishing process is divided into the stages of gassing, gumming, calendering, breaking, and pressing.

Gassing, which is also performed to some extent before dyeing, is employed in order to cleanse the fabric from fluff and loosely adhering impurities, and must be carried out in a gassing machine, the goods being passed over a slotted gas burner, whilst the opposite face of the fabric is kept cool by contact with a hollow roller, generally in connection with a water-pipe.

The gumming is usually done with tragacanth, containing a little glue, and a trace of dressing oil. The glue should be perfectly inodorous, so that the fabric may not afterwards exhibit a bad smell —almost invariably due to glue.

The added ingredients vary according as the feel of the goods is to be hard or soft, glue and oil also improving the gloss of the under side. The mass is boiled, or dissolved, in a jacketed pan, and applied when cold. The fabric is drawn, face downward, over an oilcloth pad, opposite to which is mounted a doctor (usually a glass rod supported on wood), the dressing being laid on the fabric with a ladle, and the doctor lowered into more or less firm contact with the pad, according to the amount of dressing to be left on the fabric. The same machine is provided with a large, tinned drying cylinder, over which the goods pass on their way to the wooden beaming roller.

Care is necessary to see that the dressing does not penetrate right through the fabric, this result being effected by maintaining the consistence of the dressing and the tension of the fabric.

The ensuing calendering which is intended to improve the gloss of the fabric and especially of the cotton, is performed in a very heavy machine and under very powerful pressure. The calender consists essentially of two to four heavy iron and paper rollers, mounted alternately; and the goods are put through according to requirements, though it should not be forgotten that each operation makes them harder and thinner.

Breaking is to impart the desired feel to the fabric that has been rendered stiff and hard by the preceding operations. The breaking machine consists essentially of a roller carrying a number of longitudinal blunt spiral blades. The goods are drawn over the quickly rotating roller under light and regular tension that is supervised by an attendant. Though the operation seems an easy one, it entails great skill on the part of the attendant, who stands facing the machine and allows the fabric to pass between his hands. He must be able to judge the feel quickly, and alter the tension on one or both sides of the machine, so as to make the fabric harder or softer as required.

Pressing is effected in a heavy hydraulic press, under very powerful pressure. With this object, the fabric is piled up between press boards, and is generally left in the press all night, four to six hours being the minimum. In getting the goods ready for the press, they are simply folded, zigzag, between the press boards, the edges of the latter producing the folds in the fabric.

The amount of gloss produced can be regulated at will, and the goods leave the press in a finished condition, having then merely to be stitched together at the edges, and packed.

Half-silk fabrics are dressed in the ordinary starching machine, which can be arranged for starching one or both sides of the material. In single starching, 8000 parts of water are taken to 800 of stiffening, 50 of gum, 25 of soap, and 5 of wax, the two latter being dissolved in 200 parts of water, the dissolved gum added slowly, and the whole poured into the pan already containing the dissolved stiffening. The mixture is well stirred and suitably boiled, and is applied in the usual manner, using drying cylinders and steaming apparatus. Finally, the goods are pressed in steam presses with steam-heated press plates.

For starching both sides, glue size is used, *e.g.* 15 parts of size are dissolved in hot water, to which solution is slowly added one of ½ part of gum tragacanth and ½ part of soap, together with ½ part of cocoanut-oil, the whole being boiled up, and applied hot in a steam-heated trough.

CHAPTER XIX

WATERPROOF DRESSINGS

In the present work, the waterproofing of fabrics can only be dealt with in connection with such processes as leave the appearance of the goods unaltered, and do not require the use of any other devices than those usually employed in dressing and finishing.

All processes in which the fabric is treated with a coating that changes its character are outside our present scope, which is restricted to waterproofing by immersion in dissolved metallic salts that readily decompose and leave a precipitate to the fibres, or by means of soaps and solutions of metallic oxides.

This class of waterproofing yields fabrics that are unchanged in external appearance, and in their permeability to air and corporeal exhalations; and it is therefore admirably adapted for waterproofing articles of clothing and such goods as covers, tents, flexible piping, etc. In many of the processes the impregnating agent is the same, but the methods of application differ; and it must be remembered that very careful treatment alone will furnish products of a character that will satisfy all requirements, any slight negligence resulting in defects that will be difficult, if not impossible, to rectify.

The fabric should be closely woven and exhibit a minimum of pores, since the latter also have to be filled with the waterproofing substance, in order to satisfy the requirements of the consumer. Hence, for waterproof articles other than clothing, very close fabrics must be chosen, on the one hand because the degree of waterproofing will be greater, and on the other because the consumptiom of impregnating material will be less, so that the weight will not be unduly increased, whilst the work will be more cheaply performed.

Alexanderson's Recipe.

The method consists in impregnating the fabric with a solution of some basic (aluminium) salt, prepared by treating an aluminium salt with an equivalent quantity of a hydrate or carbonate of an alkali or alkaline earth, if necessary, in presence of tartaric or citric acid. The fabric is carefully washed in this preparation, and then dried quickly.

Recipe of Arieny-Flouy, Bayol, and Laurens.

The method is said to furnish an elastic, soft, and waterproof fabric, which does not lose its waterproof character even after repeated washings.

About 1000 parts of water, 100 of crystallised alum, 140 of carbonate of lime or chalk, and 1½ parts of gum sandarach, previously dissolved in alcohol, are placed in a large vessel and left to settle, the clear liquid being drawn off into a separate vessel, where it is heated to 140° to 158° F. by steam. The fabric is entered, worked, milled, and, when fully impregnated, dried. The addition of the carbonate of lime to the alum produces a so-called neutral alum: $K_2SO_4 . Al_23SO_4 . Al_2O_6H_6$, which is really a basic alum. When the solution of this basic alum is heated to 104° to 122° F., it deposits an insoluble mass (artificial alunite, insoluble alum: $K_2SO_4 . Al_43SO_4 . 2Al_2O_6H_6$), leaving ordinary alum in solution. In the present instance, this insoluble precipitate is thrown down on the fibre by boiling with steam.

The object of adding gum sandarach is merely to fix the basic precipitate.

Balard's Recipe.

Lead acetate 30 parts, and sulphate of alumina 30 parts, are each dissolved separately in 500 parts of water, the two solutions being mixed and the resulting liquid (acetate of alumina) used for impregnating the fabric, after the precipitate has been removed. The fabric is soaked and milled, then taken out and allowed to dry in the air. In drying, the acetate of alumina decomposes and liberates acetic acid, which can be detected by the smell. At the same time, basic acetate of alumina is formed, which imparts to the fabric the property of repelling water, just as though it were impregnated with fat. The process is very simple, and the treated fabrics can be dyed, the acetate of alumina acting as a mordant. The wearing capacity of the fabric is but slightly affected. According to Heinzerling, acetate of lime should be used instead of the lead salt, 48 parts being taken to 34 of sulphate of alumina. The decomposition produces sulphate of lime and acetate of alumina, the former, which is insoluble, being separated from the dissolved acetate of alumina by subsidence and decantation.

Chevallot and Girre's Recipe.

In this process, use is made of the oxides of aluminium antimony, tin, lead, and zinc, which form soluble compounds with acids and alkalis. Mutual decomposition of the oxides occurs, insoluble hydroxides being precipitated. Thus, for instance, a solution of aluminate of potash, treated with a solution of sulphate of alumina, gives a precipitate of aluminium hydroxide (hydrate of alumina), whilst if zinc acetate be used in place of the sulphate of alumina, a mixture of zinc and aluminium hydroxides is thrown down, Another group of mordants comprises the insoluble silicates, formed by double decomposition between the alkali silicates and metallic salts. If soap be mixed with the said alkali salts, decomposition does not occur; and it is upon this and the subsequent formation of insoluble compounds that the process is based.

Two baths are used: the first consists, for instance, of a solution of soap with aluminate of potash or water-glass; the second, or reaction bath being prepared with salts that form insoluble compounds with the constituents of the first bath, *e.g.*, acetate of alumina. In order to produce a precipitate that will waterproof fabrics, there must be present, to each 1000 parts of water, at least 9 parts of fatty acid and 6 parts of silica, apart from the salts requisite for precipitation. To obtain this result, the first bath may be compounded, for example, of 15 parts of Marseilles soap, containing at least 60 per cent. of fatty acids, and 1000 parts of water. When the soap is dissolved, sufficient alkali silicate is added to bring the silica content of the bath up to at least 6 parts, reckoned as anhydrous silica. The second bath consists of solutions of salts of aluminium, antimony, tin, lead, and zinc, including acetate of alumina, and determines the amount of alkali salt, *e.g.*, aluminate of potash, that must also be included in the first bath, in order to precipitate the hydroxides. It should be borne in mind that the most suitable proportions of the precipitate have been found to be: hydroxides 60 per cent. and silicates 40 per cent. Consequently, either the adjuncts to the first bath must be determined from the composition of the second bath, or *vice versâ*. In practice the second bath is made twice or three times as strong as is theoretically necessary, in order to ensure success and enable the bath to be used for a longer time. The mechanical treatment and method of preparing the baths are as follow:—

The fabric is worked about in the first bath, and then in the second, until thoroughly impregnated, and is then squeezed between rollers and washed in water at 122° to 140° F., to eliminate the decomposition-products that have not become fixed on the fibre. In addition to being waterproof, the treated fabric is said to take any kind of dye well, the hydroxides on the fibre also acting as excellent mordants. The fabric is waterproof but not airproof.

FELTON'S RECIPE.

The waterproofing of cotton and linen fabrics is effected with zinc or cadmium chloride, or sulphate, in conjunction with ammonia.

The solution used contains about 3 parts of crystallised zinc sulphate or stannous chloride (sp. gr. 1·48), and 2 parts of ammonia (sp. gr. 0·875). The fabric—paper may also be treated—is placed in a lead-lined tank, provided with a system of rollers enabling the material to be run through at a velocity of 25 to 30 yds. per minute, according to the thickness of the fabric to be saturated with the waterproofing medium. On leaving this bath, the fabric, etc., is fed between cylinders, the pressure of which expels all superfluous liquid, and also hardens the material to some extent. The process terminates in hanging up the material to dry in a chamber at about 109° F.

Kappelin's Recipe.

A solution of dextrin or starch is used, with an addition of zinc sulphate, rosin soap, and borax, the padded fabric being then passed through a solution of alum. Another similar dressing consists of—starch paste or dextrin (also glue) 3 parts, acetate of alumina 10, and glycerine 1 part.

Sorel's Recipe.

The fabric is washed, to remove dressing, and soaked in soap and water containing a little stearine or wax, melted by heat. It is then entered in a solution of alum, zinc sulphate, or lead acetate, which forms an insoluble soap; after which it is dried and warmed sufficiently to melt the soap in question. After this dressing with insoluble soap (stearate or oleate of alumina, lead or zinc), the goods are dressed with a preparation of the said ingredients, in order to increase their impermeability, and are passed through water to remove the tendency to stick; or they may be strewn with a finely powdered mixture of stearic acid and clay, or powdered talc.

Waterproof Dressing for Linens and Cottons.

Casein 40 parts stirred up in water 300 parts, 1 part of dry-slaked lime being added by degrees. At the same time 20 parts of neutral soap are dissolved in 240 parts of water, the solution being mixed with the former one. After the fabric has been steeped in the mixture and wrung, it is entered in a solution of acetate of alumina, at 122° to 140° F., to render the casein insoluble, the goods being then dipped for an instant into nearly boiling water and dried.

Muratori and Landry's Method of Waterproofing Felt, Woollens, and Half-Woollens.

Woollen or half-woollen felts and fabrics treated by this method, are said to be improved in texture, durability, felting-power, and weight, besides attaining a high degree of impermeability. These properties are imparted by treatment in a solution of 100 parts of potash alum, 100 of animal or vegetable glue, 5 of tannin, and 2 parts of silicate of soda. The solution is prepared in three different operations:—

(1) One hundred parts of potash alum are dissolved in an equal weight of boiling water. (2) The above amount of glue, preferably animal glue, is allowed to soak in a vessel full of cold water, until it has absorbed twice its own weight of the latter. The surplus water being poured off, the glue is dissolved by boiling; and into this boiling solution are strewn the 5 parts of tannin and 2 parts of silicate of soda. (3) The two solutions are united, and boiled, with constant stirring until completely incorporated, which done they are left to cool, the mass becoming gelatinous.

The proofing bath is prepared by boiling 1 part of the above mass in 10 to 12 parts of water for three hours, and replacing the water lost by evaporation. The solution is then cooled down to 176° F., the felt or fabric being then entered for half an hour. When thoroughly impregnated, the goods are spread horizontally on a table for six hours to allow the liquid to drain off. The spreading must be performed at the ordinary temperature, and in such a manner that the goods are uniformly charged with liquid in all parts. The drainings are collected for use over again.

Drying is effected out of doors in the sun, or in a drying room, at a temperature not exceeding 122° F., the goods being kept in a horizontal position throughout, to maintain uniform distribution of the liquid.

The treated fabric is afterwards dressed or calendered between rollers heated to 122° F. When the prescribed treatment is carried out after dyeing, it serves the purpose of fixing the dye completely. In the case of delicate colours, it is advisable to use very pale glue and perfectly pure alum.

Jacquelain's Process of Waterproofing Linens, Cottons, Woollens, and Silks.

To waterproof linen, cotton, woollen, and silk fabrics, without affecting their penetrability by air, softness of texture, and the colour, Jacquelain dissolves 3 parts of alum in 100 of water in a wooden vat, mixing this solution with another containing 3 parts of lead acetate in 300 of water. The solution drawn off from the precipitated lead sulphate, consists of acetate of alumina and the surplus alum. The fabrics and articles of clothing to be proofed are immersed in this liquid for several hours, lightly shaken, and dried; after which they are brushed and ironed to restore their pristine appearance.

Jacquelain was of opinion that the process would be efficacious only to a certain extent and with thick materials; but Balard obtained more successful results, finding that lighter cloths, and even alpaca, when prepared by this process, will hold water on its upper surface for weeks, without the under side even becoming wet, and that the water will evaporate without penetrating through. He also found that when cloth or articles of clothing, treated in the same way, are left for thirty-eight hours in water, they will be just as impermeable as before, when dried.

It is quite as justifiable to assume that the alumina compounds to which the waterproof character is due, will not separate from the fabric any more than those employed as mordants in dyeing, and that the treated articles of clothing will remain waterproof as long as they are fit for use at all. Even, however, should they gradually lose their waterproof character in wear, all that is necessary for its restoration is to treat the fabric afresh with acetate of alumina.

Acetate of potash and an excess of alum in the Jacquelain solution, mixed with acetate of alumina, have no effect, this being apparently produced solely by the acetate of alumina, which is probably transformed into the described insoluble acetate, by evaporation of acetic acid, the smell of which can be detected for several days. The acetate of alumina could, however, be prepared in a cheaper manner, viz. by decomposing sulphate of alumina by acetate of lime, or perhaps by dissolving aluminium hydroxide in vinegar. Moreover, contrary to the advice of Jacquelain, the liquid should not be thrown away after being used 2 or 3 times, but employed until nearly all the acetate of alumina has been absorbed.

Fabrics treated with acetate of alumina are greatly improved in feel, and are warmer to wear than ordinary fabrics, the air seeming to adhere more strongly to their surface, a circumstance that is probably at the bottom of their resistance to water. In foggy weather, too, the moisture does not condense on them so much; and even when wetted by rain, they retain a smaller quantity of water, especially if shaken, than ordinary fabrics. Since the combined action of water and air is the chief cause of the depreciation of the fabric, the quicker rate of drying ensures longer life.

Alum solution may also be precipitated with carbonate of soda, and the alumina jelly dissolved in an excess of distilled wood vinegar. The process is suitable for smooth and milled woollens, for cottons, and for linen and hempen fabrics. To fix the mordant and improve the suppleness of the fabric, the proofed and dried goods are treated with oleic acid, the excess of this acid being afterwards removed by boiling the fabric in a dilute solution of soda.

Treating the fabric with a solution of sodium oleate gives an unfavourable result, inasmuch as the mordant can be separated from the dried fabric by rubbing and beating. Attempts to fix the alumina with water-glass and borax have also failed, better results, however, being obtained with phosphoric acid, whilst benzoic and succinic acids proved more favourable, and butyric and valerianic acids best of all. Butyrate of alumina would undoubtedly make the best waterproofing substance for fabrics, were it not that the objectionable smell precludes its use entirely.

Ferric acetate behaves like acetate of alumina, and may replace the latter in all cases where a light colour is not essential. Chromium acetate also, prepared by precipitating chrome alum with lead acetate, has given the same result.

Baswitz's Recipe.

The fabric is impregnated with a solution of vegetable parchment —parchment-paper waste, dissolved in ammoniacal copper oxide— the ammoniacal vapours being removed by an exhaust and absorbed, in a scrubber, by sulphuric acid. To eliminate the copper hydroxide, the parchmented fabric is treated with a suitable acid, the excess of which is got rid of by treatment with ammonia and washing. A solution of sulphate of ammonia and acetate of alumina is also recommended for this purpose, monobasic sulphate of alumina and ammonia—a fireproof substance—being left in the fabric, whilst copper acetate passes into solution.

Doering's Recipe.

The fabrics to be proofed are treated with fatty acid compounds of metallic oxides, being first padded with acetate of alumina, dried, and entered in a soap bath. The alumina mordant loses part of its acetic acid in drying, and becomes insoluble, even though—as is generally the case—it still contains a large amount of sulphate of alumina. If the mordant be prepared from equal parts, by weight, of sulphate of alumina and lead acetate, the liquid separated from the precipitated lead sulphate will contain a variable excess of sulphate of alumina. There is no object in completely precipitating the sulphuric acid with lead acetate, since the sulphate is decomposed by the soap just as well as the acetate. The mordant need contain only sufficient acetate to fix the alumina salts by the formation of basic compounds, for which purpose equal weights of the alumina salt and the lead acetate will suffice. There is also no object in buying commercial acetate of alumina. The case is quite different, however, when the production of woollens that are water- but not air-proof is in question; for, as subsequent soaping cannot be practised, the acetate of alumina has to do the work alone. In drying, each fibre becomes surrounded by a chain of microscopic air bubbles, which adhere with unusual tenacity to the fabric and form a water-repelling stratum. In this case, the presence of any other salt than acetate of alumina is directly harmful. In separating the dissolved acetate of alumina from the precipitated lead sulphate, this latter retains a considerable quantity of the former, to extract which it is repeatedly suffused with water, stirred up, and left to settle. For the subsequent treatment with soap, it is highly important that there should not be any surplus of free acid in the fabric. Now, commercial acetate of alumina always contains free sulphuric acid, with the result that the mordant contains free acetic acid (this evaporating in the drying process). Hence the mordant must be treated with soda, from 1 to 8 parts per 100 being required for mordants of 9° B., if the addition be pushed to the limit beyond which a permanent precipitate of basic salt would be thrown down. This uncertainty is a defect due to the variable composition of commercial acetate of alumina, and is excluded when crystallised alum is used, though the latter is dearer. The behaviour of acetate of alumina at high temperatures is well known; but it is advisable not to produce such temperatures by a direct inflow of steam, an immediate deposition of basic salt being caused at the point of inlet, though it redissolves on cooling. In preparing the soap bath, it is important to remember that an aqueous solution of soap is capable of taking up fats, resins, and mineral oils that have been melted with wax, and even rubber solution, so that not merely an emulsion, but a true solution is formed. The wax consists of Japan wax, and the rubber solution is a strained 10 per cent. solution of best Para rubber in oil of turpentine or camphor-oil. The following quantities are required per sq. yd. of fabric: tallow soap 1 oz., Japan wax $\frac{7}{8}$th oz., Para rubber in solution 22 grains, good boiled oil 15 grains, dissolved to make 1 pint of liquid. The Japan wax is melted and mixed with the rubber solution and boiled oil, $\frac{1}{2}$ lb. of a hot-saturated solution of liver of sulphur being added for every lb. of rubber taken. When all has been mixed, and a smell of sulphuretted hydrogen is apparent, the mass is put into the boiling soap solution, which is then ready for use. This treatment fills the pores of the fabric well, since in proportion as the soap is decomposed by the alumina, the adjuncts are thrown down as well and adhere to the fibre. The degree of waterproofing attainable is equal to a pressure of 12-inches gauge, whereas the fatty acid compound of alumina produces only a slight effect by itself. The liver of sulphur is easily melted, and deposits very finely divided sulphur under the action of atmospheric carbonic acid, its action on salts of alumina being powerful and well known. If a piece of fabric, impregnated with acetate of alumina and dried, be padded with a weak solution of liver of sulphur, the fabric at once becomes transparent, a sign that the aluminium hydroxide has been precipitated. Hence it has a loosening effect on the dried alumina mordant.

Muzmann and Krakowieser's Recipe.

Dissolve 50 parts of gelatine, and 50 of tallow soap in boiling water, adding 75 of alum, making the whole up to 1900 parts with water, and cooling down to 50° F. The fabric is immersed in this solution until soaked right through, after which it is taken out, dried, washed, re-dried, and finished on the calender. In this process the soap is partially decomposed by the alum, either free fatty acid being liberated, or an acid fatty-acid compound formed. The gelatine forms an insoluble compound with the alum. The free fatty acid, or the acid fatty-acid compound, is suspended in the liquid, and is, for the most part, thrown down on the fibre along with the gelatine and alum.

Bled and Dujardin's Recipe.

The fabric is dipped in a solution containing: zinc sulphate 10 parts, sannous chloride 10, calcined magnesia 2, Carragheen moss 10, mallow root 4, linseed 2, gum arabic 1, and stearine 4 parts, in 1000 parts of water, and is then mordanted in a bath of acetate of soda.

Braff's Recipe.

Seventy parts of alum are dissolved in 2000 of water, and 15 parts of lead acetate in 500 of water, the two solutions being mixed and filtered.

Hermann Cohrs' Recipe.

According to this recipe, fabrics and articles of clothing are waterproofed without, so it is claimed, affecting the colour, softness, or permeability of the material, to any appreciable extent. The preparation consists of a mixture of 5000 parts of hot water, 200 of alum, 175 of water-glass, and 300 of white vaseline, the mixture being thoroughly stirred and applied with a brush to the front of the article to be treated. The latter are spread on a long table, and after being suitably heated are coated with the preparation, and exposed for ten to fifteen minutes to a dry heat of about 158° F., being then ready for use.

Various Waterproofing Recipes.

(*a*) Lead acetate and alum in equal quantities, dissolved by stirring in hot water, the mixture being poured into a vessel containing hot water. The fabric is soaked in this liquid, and then dried without wringing.

(*b*) Seventeen parts of isinglass are boiled in water until dissolved, and in the meantime 35 parts of alum are dissolved in 1000 of water, and 10 parts of soap in 500 of water. The solutions are strained separately through a coarse cloth, and mixed. The liquid is heated for use, and is brushed on to the inner side of the articles of clothing to be proofed. This treatment makes the fabric waterproof, but not airproof.

CHAPTER XX

FIREPROOF DRESSINGS

The very high inflammability of certain light fabrics and materials has frequently been the cause of very grave accidents, and many attempts have therefore been made to impregnate these materials in such a manner as to guard against the danger successfully.

Special attention is merited by the endeavours that have been made for some time past, especially by English manufacturers, to introduce preparations for impregnating fabrics so as to make them uninflammable. In view of the too frequent recurrence of regrettable accidents, caused by the readiness with which lightly woven dress materials ignite when brought into accidental contact with a flame, a welcome must be accorded to the attempts on the part of the manufacturing industry to provide these materials with dressings that preclude the risk of ignition.

With regard to the means adopted, it may be premised that no known substance is able to preserve combustible bodies from destruction by charring under the protracted influence of fire. Many salts, however, have the property of temporarily protecting from destruction the substances which they are impregnated, and of rendering these substances uninflammable on contact with flame—a result that is so far satisfactory, inasmuch as a body that is merely glowing is less dangerous than one in actual ignition. The most satisfactory experiments in this connection were those performed by Gay-Lussac, who found generally that salts which leave behind an unfused, earthy residue when heated, and also those which do not fuse except at a very high temperature, cannot accord such a degree of protection as is imparted by salts that fuse at a relatively low temperature, and thereby cover the surface of the combustible material with a glassy coating, *e.g.* borax. Volatile salts, such as sulphate of ammonia and sal ammoniac, are also efficacious, their vapours mingling with those liberated by the heated fabric or other material and lessening their inflammability. The most efficient were found to be those salts which combine the two properties, such as the borate and phosphate of ammonia, either alone or in conjunction with sal ammoniac. The solutions used must be concentrated, and the fabric, etc., thoroughly impregnated therewith. One of the best known substances for preventing inflammability is alum, although it belongs to the inferior substances of Gay-Lussac's classification, since it leaves an unfused, earthy residue behind when heated. Nevertheless, a fabric that has been passed through a solution of alum and then dried, will only char on heating, on which account alum is often used for dressing white curtains and other white fabrics. Even the addition of a small quantity of alum in starching the goods is sufficient to render them incombustible, inasmuch as they will only glow and char when attacked by fire, but will not burn with a flame. Before using the solution for coloured fabrics, a trial should be made, because alum acts on many dyes and alters their colour. The effect will be much greater if acetic acid or sulphuric acid be used along with the alum. In the case of linen and cotton fabrics, such as are used for bed and window curtains, a solution of neutral tartrate of potash will also suffice, the same applying to solutions of common salt, ferrous sulphate, sulphate of lime, and various other salts.

According to Woehler, a solution of neutral tartrate of ammonia is able to dissolve a large quantity of lead sulphate, at a temperature of 176° F.; and fabrics impregnated with this hot solution can only be ignited with difficulty. If, however, they are exposed to a high temperature for some time, the whole of the organic substance will be consumed to ash, asphyxiating fumes being given off.

Masson recently recommended calcium chloride for fireproofing fabrics. Owing, however, to the ease with which this salt is decomposed, he employed the double salt of calcium chloride and acetate of lime which can be obtained in the form of crystals by dissolving equal weights of the component salts and allowing the solution to evaporate slowly. The crystals may be dissolved in water, though care is necessary, since the double salt readily undergoes partial decomposition by water. The object is most easily achieved by employing warm ammonia as the solvent. The fabric to be proofed is saturated with the solution and then dried.

When proofed articles are washed, the water extracts the protecting salts, and they must therefore be impregnated afresh after each washing. Doebereiner, in criticising the various means employed for preventing inflammability in fabrics, made favourable mention of tungstate of soda as giving excellent results and possessing the valuable advantage of not affecting sensitive dyes.

B. Hoff's Recipe.

The vanadic acid salts recommended by Hoff are claimed to be superior to alum or borax, since (like tungstates) they do not injure the colour, nor do they produce white streaks on the surface of the material.

Fersmann and Oppenheim's Recipe.

A 20 per cent. solution of tungstate of soda is recommended for fireproofing fabrics, a cheaper alternative being a mixture of tungstate and phosphate of soda, a 28° Tw. solution of the former being treated with 3 per cent. of the latter salt. In this mixture no sparingly soluble bitungstate of soda—which crystallises out and thus weakens the solution—is formed, as is the case with the neutral salt.

From another source it is gathered that tungstate of soda is well adapted for impregnating articles that are to be washed. A 20 per cent. solution of this salt is used lukewarm, the washed articles being simply dipped in the solution, well wrung, and ironed. For starched articles, the tungstate solution may be used in preparing the starch. Tungstate of soda is soft and of tallowy consistence—properties which greatly facilitate ironing. As stated above, it is desirable to add a little phosphate of soda, in order to prevent the formation of the sparingly soluble bitungstate.

Since the tungstate melts only at red heat, and does not decompose at high temperatures, the fabrics impregnated with this salt can be ironed with a hotter iron than if treated with any other fireproofing preparation. On the other hand, tungstate of soda has the drawback, in comparison with sulphate of ammonia, of being much dearer.

The addition of phosphate of soda makes the tungstate rather more fusible, and therefore improves it as a fireproofing agent. Like sulphate of ammonia, tungstate of soda is suitable for use with the finest and lightest fabrics, and does not produce any change in the most sensitive colours.

Fleck's Recipe.

Fleck uses sulphate of ammonia—which had been already recommended—the solution ranging in strength from 9 to 20 per cent., and the concentration increasing with the lightness and inflammability of the material. A 9 per cent. solution (1 part of sulphate of ammonia to 8 parts of water) is well adapted for thin linen or cotton fabrics, laces, muslin, or tarlatan, whilst a 10 per cent. solution will fireproof coarser fabrics, such as sailcloth, sacking, etc.

Gleichmar's Recipe.

Sal ammoniac 40 parts, borax 10, and common salt 5 parts, are dissolved in 300 parts of hot water. The fabric is soaked for an hour in the boiling hot solution, then lightly squeezed, and hung up to dry. For impregnating white ball dresses, 30 parts of starch are boiled with 500 of water, and into this preparation is stirred a solution of 60 parts of sal ammoniac, 15 of borax, and 8 of common salt, in 500 parts of hot water. The method of application is the same as just described.

Gimenez and Grigogen's Recipe.

Oak bark is extracted with brine, and the resulting solution is mixed with zinc sulphate, sal ammoniac, and fish glue, the whole being heated, filtered when cold, and used for impregnating the fabric.

J. A. Martin's Fireproof Dressing.

(*a*) For Light Fabrics:—8 parts of pure sulphate of ammonia, 2½ of pure carbonate of ammonia, 3 of boric acid, 2 of pure borax, and 2 of starch (or 0·4 part of dextrin or gelatine) are dissolved in 100 parts of water, the fabric being entered at 100° F. and fully soaked, after which it is lightly wrung, and dried in the air. The proportions of starch, dextrin, or gelatine can be modified according to the degree of stiffness desired.

Another recipe:—Sulphate of ammonia 5 parts, boric acid 3, borax 2, and water 100 parts. The liquid is used at 212° F.

(*b*) For Coarse Fabrics, Ropes, etc.:—Sal ammoniac 15 parts, boric acid 6, borax 3, water 100 parts. The fabric is dipped for fifteen to twenty minutes in the boiling hot solution, lightly wrung, and dried.

Nicoll's Fireproof Dressings.

(*a*) Alum 6 parts, borax 2, tungstate of soda 1, dextrin 1 part in soap and water. The dextrin is intended to make the salts stick better to the fabric.

(*b*) Sulphate of ammonia 4 parts, carbonate of ammonia 1¼, boric acid 1½, borax ¾, starch 1, water 50 parts. The solution is heated to boiling point before the fabric is immersed.

(*c*) Boric acid 2½ parts, sal ammoniac 7½, potash felspar 2½, gelatine ¾, starch paste 25, water 50 parts. The mixture is applied to the fabric with a brush.

Patera's Fireproof Dressing.

Three parts of borax and 1½ of sulphate of magnesia are dissolved in 20 parts of warm water. The fabric is immersed until well soaked, and is then squeezed, wrung, rolled up in a cloth, and ironed. Starch may also be added to the solution.

Eisner's Method of Fireproofing Fabrics.

Dry, white commercial sulphate of alumina is dissolved in water so as to obtain a saturated solution without heat, this solution being then treated to an addition of a cold-saturated solution of phosphate of ammonia, so long as a white precipitate of phosphate of alumina is formed. Sal ammoniac, either in sticks or as a saturated solution, is next added until that precipitate is completely redissolved, and a clear liquid is obtained. Trial strips of linen and muslin, steeped in this preparation for twenty-four hours and then dried, charred at the edges when exposed to direct contact with flame, but did not ignite, so that the method is adapted to prevent combustible substance from taking fire.

Hottin's Recipe.

A solution of phosphate of lime is supersaturated with ammonia, filtered, decolorised with bone black, and concentrated by evaporation for an hour, after which it is treated with 5 per cent. of gelatinous silica, further concentrated to a crystalline mass, dried, and powdered. This mass is mixed with a solution of 35 per cent. of gum and 35 per cent. of starch solution, and used for impregnation.

Intyrn's Recipe.

This composition for rendering combustible substances incombustible, consists of sulphoricinate of ammonia, borax, sal ammoniac, alum, tungstate of soda, and silicate of soda.

Fielding's Recipe.

Eighty parts of alum are dissolved in water, 16 parts of lead acetate being added, and the liquid decanted from the resulting precipitate of lead oxide. In this solution the fabric is immersed for a short time, and is then transferred to a solution containing 32 parts of glue, 16 of fish glue, and 8 parts of gum arabic, in water.

Thouret's Fireproof Dressing.

This preparation consists of a solution of: phosphate of ammonia 3 parts, sal ammoniac 2, sulphate of ammonia 1, and a little potassium chloride, in 45 parts of water.

Washable fabrics are treated in the liquid in the usual manner, and though rendered somewhat stiffer and harder than otherwise, the difference is so slight that even the finest cloths do not suffer in value or appearance.

Sulliot and David's Recipe.

This method is for fireproofing fabrics of all kinds, especially theatrical curtains, decorations, etc., that require to be rendered uninflammable, by impregnating or coating them with a solution of various salts of a suitable character. All borates, phosphates, silicates, and bases that are soluble in water, or even such as are insoluble, *e.g.* biborate of lime, form salts with sugar, glucose, or molasses (which is a mixture of the two), these salts (saccharoborate of lime, soda, potash, magnesia, alumina, or ammonia) protecting fabrics from combustion, owing to their non-crystalline character. The borates are either insoluble, *e.g.* borate of lime, or else insufficiently soluble in cold water (*e.g.* borate of soda) to be used for impregnation, on which account, and by reason of their tendency to effloresce and fall off, they are not used. When mixed with sugar, glucose, or molasses, however, the crystallisation of these borates is prevented, and the capacity of the sugar, etc., for absorbing large quantities of the dissolved salts enable these latter to be used for the fireproofing of fabrics, the fibres of which are penetrated by the mixture and retain same permanently. Solutions of this kind, of 10° B. strength, are used cold, and coarse materials are treated with an excess of solution.

The essential feature of the method consists in the addition of sugar, glucose, or molasses to the solutions of the aforesaid salts, which undoubtedly possess the property of incombustibility.

CHAPTER XXI

SPECIAL FINISHING PROCESSES

IMPARTING A SILKY APPEARANCE TO VEGETABLE FIBRES.

1. THE method proposed by Gedge is intended to bleach the crude vegetable fibres and, by a process of animalisation, not only to increase their affinity for dyestuffs, but also to impart an external resemblance to silk. The bleaching consists in successive treatment with caustic soda, hydrochloric acid, and bleaching powder; the animalising in impregnating with sugar solution, followed by drying, and treatment with a mixture of nitrous acid and sulphuric acid, which converts the sugar into nitrosaccharose and the cellulose into dinitrocellulose. The idea of using nitrosaccharose is not a new one, having been formerly recommended by Bonneville, the latter also adopting the more rational course of applying nitrated sugar to the fibre. Whether the direct nitration of the textile material, previously mordanted with sugar, and the inclusion of cellulose into the nitration process, is practicable and advisable, is a matter for consideration; at all events, the method proposed by Kullmann for the production of nitrocellulose in order to fix basic dyestuffs has not yet been worked. The nitrated fibres are rinsed, dipped in boiling soap solution, and washed. Although they are claimed to absorb dyestuffs of themselves, the animalised fibres are mordanted with tannin, fixed with tartar emetic, which salt, in the event of the vegetable fibres being mixed with silk, would cede to the latter a certain amount of antimony, thus lessening the porous and attractive properties of the product. The antimony really serves merely to fix the tannin, and does not leave the fibre in dyeing. The impregnated fibre is then carded—either alone, or mixed with silk or waste silk. For this purpose it is dressed with a preparation consisting of water, olive-oil soap, glycerine, and wax, boiled to a thick dressing, and applied in the usual way.

The method serves to load silk or woollen yarns and fabrics, with an alkaline silk or wool solution, and improve its defects. Mixtures of alkaline solutions of silk and wool, or of silk and feathers, etc., may also be used for coating other textile fibres.

2. According to Holsemann, a solution of silk or wool fibre in alkalis is prepared, and when of the desired concentration (depending on the character of the fibre to be treated), the previously damped material (crude fibre, yarn, or fabric) is immersed in the silk or wool solution for some time, and then dried.

Silk or wool fibre, or down, is dissolved in caustic soda and used for soaking the fabric, which is then entered in a bath of sulphuric acid, followed by careful rinsing. The fabrics treated in this way may be bleached or dyed.

The bath of silk or wool solution may be used either cold or hot, according to the character of the fibres. The process does not require any special auxiliary assistance, such as the use of an electric current, a vacuum, etc., the result being complete without, and indeed so good that the fabric can be bleached and dyed without losing the acquired silky or woolly character. Yarns and fabrics treated with silk solution are finished by hot pressing, beating, stretching, etc., in just the same manner as employed for developing the lustre and scroop of silk. The silk and wool solutions may be prepared in the known manner, the properties of the fibre to be treated being, however, borne in mind. A particular feature about the process is that it enables inferior, dull silk to be considerably improved by the aid of dissolved silk of better quality and lustre. By suitably repeating the treatment, the weight of silk (tussah silk especially) can be increased, by depositing silk on silk, and thereby cheaply replacing the troublesome processes employed for loading silk, particularly silk for weaving. The deposit of silk produced by the process adheres with remarkable tenacity to all fibres.

As regards wool solution, this also is prepared in a manner corresponding with the properties of the fibres to be treated. The deposit thrown down on the fibres gives the latter the exact appearance of wool, and the treatment in the prescribed baths makes the vegetable fibres curly. Cocoanut fibre and waste from jute, flax, hemp, etc., treated by this process, find their sphere of application increased by the acquired resemblance to animal fibre. Flax and cotton fibres, yarns, and fabrics are made to resemble carded wool, whilst China grass and hackled flax become like worsted. Very remarkable effects are obtained by impregnating the vegetable fibres first with silk solution and then with wool solution or *vice versâ*, especially when the treatment is applied for a suitable length of time. These effects may be compared, on the one hand, to strewing a silken surface with velvety particles, and, on the other, to the decoration of a velvet surface, with specks of silky lustre. By selecting a suitable solvent, the solutions of silk and wool may be used in a mixed condition.

3. Mueller's Recipe:—To obtain a silky lustre, 1 part of silk

waste is dissolved in 6 to 8 parts of hydrochloric acid (25° *B.*) or in an ammoniacal solution of copper, nickel, etc. After a brisk boiling, the liquid is clarified, and filtered through quartz sand, and then diluted until a slight cloudiness is observed, whereupon it is ready for use.

4. Silk Solution and Simili Silk :—The process consists more particularly in the combined use of acetic acid, heat, and pressure, with the important condition that the weight of the acid and the extent of the heat and pressure may be varied. The method described below is said to have answered well in practice.

Equal weights of silk and acetic acid are taken, the silk being dissolved in a closed vessel under a pressure of 10 to 12 atmospheres, by steam heat. By increasing the proportion of the solvent to 2, 3, 4, or more times the weight of the silk, the steam pressure may be reduced to about 6 atmospheres. The resulting solution may be used to smoothen textile fibres, and for the finishing of fabrics in such a manner as to enable them to absorb brilliant dyes; it will also act as a varnish for a great variety of substances such as wood, rubber, leather, guttapercha, resinous substances, and metals of all kinds.

Hemp, jute, China grass, flax, etc., are among the substances said to be capable of treatment by this process; and the application of the solution to these fibres is performed in the following manner :—

Flax, previously bleached in the usual way, is treated in a bath of caustic potash or soda (sp. gr. 1·03) for about two hours at 212° F., whereby the extraneous constituents are eliminated from the cellulose, chief among them being the resinous bodies enveloping the fibres.

The flax, after repeated rinsings in clean water, is boiled in a bath of soft soap for half an hour, then washed in clean water, rinsed, and dried. It is now pure cellulose, and may be treated like cotton.

It is sufficient to dip the cellulose for four to five minutes in a mixture of nitric acid and sulphuric acid, which converts the cellulose into pyroxylin, this being then washed in clean water until the washings no longer show any trace of acid. The nitrated fibres are dried at the lowest possible temperature, and then reduced without destroying the nitrogenous material. The cellulose is placed in a hermetically closed vessel, the air in which is exhausted until the pressure does not exceed 10 mm. of mercury gauge. The cellulose is then transferred to a bath of bisulphate of soda, or other substance that liberates sulphur dioxide when treated with an acid, for which purpose phosphoric acid is recommended. In order to reduce the nitrocellulose, the sulphur dioxide must be allowed to act in the nascent state on the nitrocellulose, which latter has previously been dried in vacuo. After this treatment the fibres are placed in an autoclave, where they are disposed so that no two fibres are in contact, or the silk will not be deposited uniformly all round them. The vessel is charged with the solution of silk (sp. gr. 1·28) already described, and, being closed, steam is admitted through the false bottom or spiral pipe, until the temperature has risen to 374° F. The material is left for at least fourteen hours in the silk solution, during which time a powerful current of dynamic electricity is passed, until the examination of a test sample shows that there is no more silk left in solution. The electric current causes the silk to deposit on the vegetable fibres, and the latter are then capable of absorbing coal-tar dyes.

Silvering and Gilding Silk.

The silk is soaked in a 5 per cent. solution of potassium iodide, dried, and transferred to an artificially lighted room, from which daylight is excluded, where it is steeped with a 5 per cent. solution of silver nitrate containing a few drops of nitric acid, the silk being taken out after a few minutes, and pressed between blotting-paper. The silk has now acquired a yellow tinge, due to the formation of silver iodide. It is next exposed to daylight, care being taken that the exposure is complete all over; and in a few minutes is immersed in a 2 per cent. solution of ferrous sulphate containing a little sulphuric acid, whereupon a grey coloration appears, due to the deposition of metallic silver on the silk. After washing in clean water and drying, the silk is burnished with a hard smooth object, preferably glass, which develops a metallic lustre. The existing film of silver is, however, too thin, especially when intended to be gilt, and must be strengthened by the following operations. The silk being finished as above, but not dried, is immersed in a dilute aqueous solution of potassium iodide, containing a little tincture of iodide and a few drops of silver nitrate solution. This bath converts the silver into silver iodide again; and by re-entering the silk into the silver bath and then in the ferrous sulphate solution, the deposit is considerably strengthened. This silver deposit is transposed into gold, by immersing the silk in a very weak bath of gold chloride, the high affinity of chlorine for silver soon resulting in the formation of silver chloride, whilst metallic gold is deposited on the silk. The silver chloride is dissolved in a solution of hyposulphite of soda, leaving the pure gold behind on the fibre. When dry, the metallic lustre of gold can be developed by burnishing, provided the deposit be sufficiently thick; whereas, if the film be too thin for this purpose, the colour produced will range from green to purple, according to the amount of gold present.

Sachs' Printing Process.

This process is one whereby fabrics and materials, whether plaited, knitted, embroidered, crocheted, or made in any other way, or any non-metallic articles, can be prepared either for being printed, or as a medium for printing fabrics or other materials, or for the preparation of matrices for printing and other purposes.

The ordinary printing process entails the preparation of printing cylinders or surfaces, which are either engraved with the design to be printed, or electro'd from leaden matrices produced by pressure.

The process now to be described is a direct one, inasmuch as the article to be reproduced by printing is rendered suitable for application either as a printing medium itself, or employed for the production of printing cylinders by casting or pressure. For direct use, the fabric or material must be prepared in such a manner as to convert it into a printing medium, and this can be accomplished in two ways: by electroplating, or by chemical means.

For the electro process, the fabric, etc., is treated, wholly or partially and on one or both sides, with a layer composed of one or more metals. The article is rendered electrically conductive by coating it with graphite or other substance, and is then placed in one or more electroplating baths, wherein the fabric is coated with a film of metal.

The chemical process is carried on in the following manner:—

The fabric is impregnated by dipping in a suitable solution, *e.g.* lead acetate or other well-known substance, and is then treated with an acid (*e.g.* sulphurous or sulphuric acid) and a salt (*e.g.* hyposulphite of soda), this fixing the metallic substance. Good results can be obtained, without any metallic substance, by using chrome gelatine or similar bodies, and also with rubber solutions or compositions, or by putting the fabric through a process of tanning.

The article may also be coated, without any preliminary treatment, with a paint or varnish (*e.g.* white lead ground in oil, shellac varnish, etc.). It is sometimes preferred to coat the fabric with gelatine, and then treat it with tannic acid, chromic acid, or other suitable acid. The fabric is coated with chrome gelatine and albumin, and is exposed to the light under any convenient fabric, so that a photographic image of the pattern of the latter is obtained, the exposed portions being thereby rendered more or less insoluble. By washing out the soluble portions, a facsimile of the original pattern is obtained, and can be prepared for use as a printing medium by either the above electro or chemical process. The facsimile may also be used for reproducing the original by photographic printing. By the electro process, the design may be reproduced full size, reduced or enlarged. The printing surfaces produced in this way can be inked by means of rollers, brushes, etc., and the impression transferred in any suitable way. For example, when a prepared, closely woven fabric is used as printing surface, the impression is transferred to the fabric to be printed, by bringing the same in contact with the pattern on the printing surface.

If, on the other hand, a prepared, open fabric be used as the printing medium, this can be either supplied with colour (inked) as described, and the pattern transferred by pressure to the fabric that is to be printed, or else the colour is passed through the interstices of the pattern, so that a negative impression is produced on the fabric to be printed. The prepared fabrics, etc., to be used as printing media, are arranged either on cylinders or plates, or else on endless bands, so as to be adapted to print fabrics, etc., on one or both sides, or several pieces at a time. These arrangements are illustrated in Figs. 35 to 37.

Fig. 35 shows an apparatus for printing a fabric on both sides, and adapted for use with one or several colours.

A is the printing plate or medium of open fabric, and mounted as an endless band on the rollers *B* and *B′*, which can be rotated together or separately. *C* is the backing roller, made wholly or in part of elastic material, and *D* is the fabric to be printed, this being fed to the apparatus in any convenient manner. Colour is applied to the outer surface of the printing medium *A* from a duct *E*, and this colour is transferred to the material *D*, on coming in contact with *A* between the rollers *B* and *C*. Another colour is supplied to the roller *B* from a second duct *F*, and this colour is forced through the interstices of *A* on to the fabric *D*, which is thus printed in two colours at the one operation. If the fabric is to be printed on both sides, *C* is either transformed into a printing cylinder, or into a guide roller, carrying a second printing medium. The printing medium, which may be of the same kind as the lower one, receives colour from the duct *G* or similar appliance. If the printing surface *A* is not of open material, the colour duct *F* is omitted.

An apparatus for printing a number of pieces of fabric *D* simultaneously is shown in Fig. 36. Here, *A* is the printing cylinder, *C* are the backing rollers, and *E* the colour ducts. For printing a fabric with several colours, use may be made of the apparatus shown in Fig. 37, in which the ducts *E* are charged with different colours, and the inking rollers *E′* are provided with recesses *a a*, so that their contact with *A* is interrupted at intervals, thus leaving blank spaces on the printing roller for the reception of colour from one or other of the remaining ink rollers at the predetermined time.

Designs or portions of same may also be cut out and attached to the surface of the printing roller; and these then receive the colour to be printed, in the same manner.

If different colours are to be printed on small articles, the colour ducts must be arranged on a flat surface, the printing surfaces being then brought in contact with them and then with the fabric to be printed, the latter being placed either in direct or indirect contact with the printing surface or surfaces. The colour can be transferred from the ducts to the printing rollers, either direct, or by the intermediary of other rollers. If various patterns are to be produced, either in one or more colours, on a smooth or any other fabric, the latter may be printed with mordants and then dyed; or resists may be printed on dyed or printed fabrics.

Fig. 35.

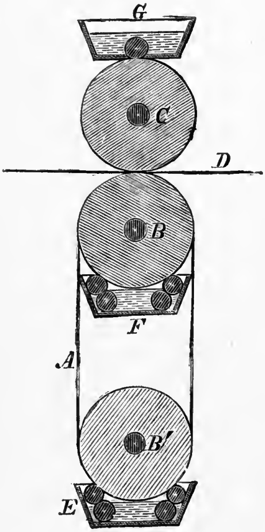


Fig. 36.

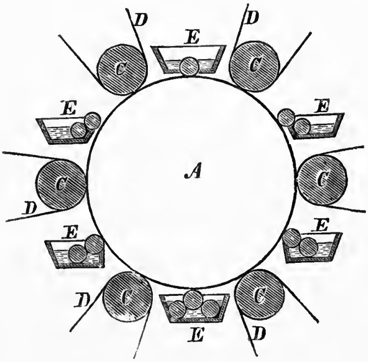
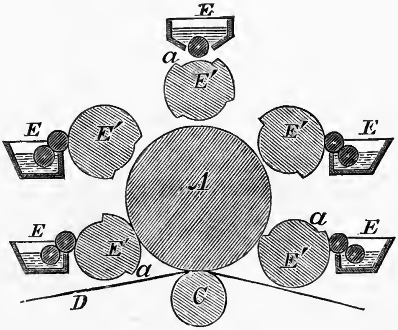


Fig. 37.



Figs. 35, 36, and 37.—Sachs' apparatus for printing fabrics.

Openworked fabrics can be printed in considerable number at one time, by stretching them in frames or clips, with the printing pattern above or below, or one above and another below, the colour being forced through the whole either by the aid of a vacuum (on the side remote from the colour duct) or pneumatic pressure. The fabrics to be printed may also be either in the cold or warmed state. Direct impressions or castings may be taken, by the electro or other process, for printing or other purposes. For instance, the prepared fabric or material is applied to a cylinder, and a hollow plaster-casting or rubber impression is taken, the inside of the casting bearing the form of the fabric on the cylinder. An electro of the interior of the plaster cast will furnish a cylinder suitable for printing.

Flexible Mother-of-Pearl Design on Various Fabrics.

The following method gives a flexible nacreous finish that sparkles brilliantly, stretches in any direction, is devoid of any roughness, and will not detach from the fabric even when vigorously rubbed.

A thin sheet of rubber, of the same size as the design, is laid on an elastic backing and covered with a copper stencil perforated with the design. Over the stencil is laid the fabric to which the mother-of-pearl is to be attached. On passing a hot iron over the fabric, the heat melts the rubber under the stencil, and the joint pressure of the iron and elastic backing forces the adhesive through the stencil, so that the design is reproduced in rubber on the fabric. Powdered mother-of-pearl is then strewn over the fabric and pressed down smooth with the hot iron, such as does not adhere being removed by a soft brush. This done, an extremely fine crepe fabric, damped with gum water, is laid over the mother-of-pearl design and, when dry, is attached to the ground fabric by suitably embroidering it on the tambour machine, with a design appropriate to that of the mother-of-pearl.

The mother-of-pearl dust is held firmly by the adhesive, and is protected from crumbling by the overlying crepe which, being of very fine texture, does not appreciably lessen the sheen of the mother-of-pearl.

Metal Lustre Finishes.

1. Tomson and Irving boil fabrics and yarns, previous to dyeing, in a solution of a copper, lead, zinc, or silver salt, and then enter them in a bath of hyposulphite of soda, potash, or ammonia. The process is particularly adapted for woollen and half-woollen yarns and fabrics. To dye 4½ lb. of fabric or yarn black or brown, the material is boiled for half an hour in a bath of 4¼ oz. of copper sulphate, 2¼ oz. of cream of tartar, and 44 gallons of water, followed by washing it in water and dyeing in the usual manner, 3¼ lb. of Campeachy wood and 1 lb. of fustic being preferred for black. After washing, drying, and redrying, the goods are placed for ten to fifteen hours in a bath of 44 gallons of water and 2¼ oz. of copper sulphate (dissolved in 18 oz. of ammonia), at a temperature of 150° to 176° F. The goods are then washed and dipped for ten to fifteen minutes in a bath contain-

ing 1½ fluid oz. of alkali hyposulphite (40° B.), after which they are washed again and finished in the usual way. Grey, lavender, or similar colours may be obtained with a salt of lead, zinc, or silver. Lead acetate is the best lead salt for the purpose; and of this 18 oz. dissolved in 44 gallons of water, will suffice to treat 4½ lb. of material, which is boiled therein for half an hour, washed, dyed as usual, treated with alkali hyposulphite, washed, and finished as usual. Zinc sulphate, used in the same proportions and same way, is the most suitable zinc salt. When silver is used, the material is first entered in the aforesaid copper bath, washed, dried, and treated for ten to fifteen minutes in a bath of 44 gallons of water (at 122° to 140° F.), containing not more than ¾ oz. of silver nitrate. Treatment in the alkali hyposulphite bath, followed by washing and finishing, completes the process.

To impart a metallic lustre to cotton fabrics, a metallic oxide is incorporated with the fibre by passing the goods through a dyeing and washing machine, provided with two vats charged with a solution of lead acetate, copper acetate, or silver nitrate. Treatment with an alkaline liquor then decomposes the metallic salts and precipitates a deposit in the fibres of the material, which is afterwards placed in a closed receptacle into which steam is introduced along with coal gas or sulphuretted hydrogen, and finally dried and calendered. A very fine metal finish can be produced by passing the fabric through a solution of stannous chloride, followed by steaming and calendering.

Adolf's Chrome-Glue Dressing.

The fabric is coated on one side with a layer of chrome glue, and is then exposed to the action of actinic light rays. By this means the fabric can be dyed with wool dyes and printed in colour, like wool, by animalising the fibre wholly, or in part, and exposing it to light. A subsequent washing removes all the chrome glue that has not been exposed and has therefore remained soluble. The apparatus for carrying out this process consists of a glass cylinder, *A* (Fig. 38), on the outside of which (on the wall *b*) is attached the transparent negative or openwork design (with the image outward). The cylinder runs on eight rollers, *f*, four at each end. In the centre, *C*, of the cylinder is arranged the source of actinic light, which light traverses the cylinder walls uniformly in all parts, and acts on the

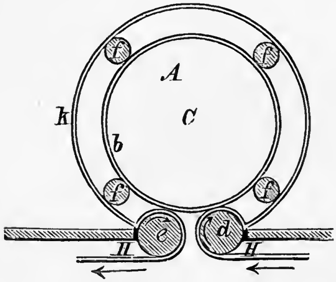


Fig. 38.—Exposure apparatus for chrome-glue dressing.

sensitised or printed material. The latter passes over the roller, *d* (from the room in which no actinic light is admitted), in the direction marked by the arrows, and is led round the cylinder, *A*, which rotates at the same velocity, being then passed over the roller, *e*, into the room again. The admission of actinic light is prevented by the walls *H H*, and the light from inside the cylinder is excluded from the space between this latter and the sheet-metal casing *k*, by a thin but opaque material which travels with, and serves as a backing for, the fabric.

Applying Spangles to Fabrics.

By the aid of metallic spangles and small crystals, very fine effects, resembling the sparkle of diamonds, can be produced on textiles. The metals (preferably gold and silver) may be coloured in different ways and stamped in pieces of suitable size, this also applying to the other—crystalline or gelatinous—substances used. If the gelatinous particles do not adhere of themselves to the fabric, they are intimately mixed with finely powdered gum arabic and strewn over the surface of the fabric as the same passes over a roller or rollers, exposure to a jet of steam then softening the gelatine or gum, and causing the particles to adhere to the fabric, on which they are then fixed by a passage over a drying cylinder. Instead of strewing the particles of metal, etc., indiscriminately over the fabric, designs can be produced by the use of paper stencils.

Colour Photography on Woven Fabrics.

Bleached, woollen, or silk fabrics are soaked in a solution of 12 parts of bichromate of potash and 6 of sulphuric acid in 100 parts of water, and are then dried in a rather dark room. On being afterwards exposed to direct sunlight for about ten to twenty minutes, the fabric turns pale brown. Potassium cyanide gives a medium blue colour. Patterns or designs can be reproduced in colour on fabrics, by exposing the latter (after treatment on the lines sketched above) under thick black paper in which the pattern, etc., has been cut out so as to allow the light to pass through on to the fabric. If desired, this paper negative may be supported on glass, etc. After sufficient exposure, the fabric is taken from under the negative and washed, to prevent subsequent darkening of the unexposed portions.

It has been discovered by Gruene that ferrocyanide compounds will give the best chamois blue, green, and grey shades, whilst browns, violet, black, olive, etc., can be produced with chromates. For blue, the fabric is impregnated with a solution of 60 parts of ferrocyanide of potash, 80 of tartaric acid, and 24 parts of pink salt. A pale to medium blue is obtained on exposure to sunlight, according to the strength of the solution. For green, a solution containing 60 parts of ferrocyanide of potash, 40 of sulphuric acid, and 40 of sal ammoniac is used.

Chamois is obtained by passing the blue-printed material through a bath of caustic alkali, the blue being discharged and replaced by ferric oxide.

Grey and mode colours are obtained by treating the above chamois in dye baths of gall nuts, logwood, etc. If silken fabrics impregnated with copper chromate be exposed to direct sunlight, brown shades are obtained, which can be transformed into a variety of greys, violets, blacks, and browns by means of different baths of dye.

The same result is furnished by chromate of alumina, except that the colours are far purer and brighter than those from copper chromate.

In all cases it has been found that the presence of moisture in the fabric is specially advantageous and essential to the brilliancy of the pattern, and the rapid development of same on exposure.

Gold and Silver Designs Applied by Heat.

According to Kurrer, gold and silver designs, vignettes, etc., may be produced on fabrics by the aid of heat. A mixture of powdered mastic and albumin, in equal parts, is strewn through a hair sieve over the portions to be silvered or gilt, and leaf metal is cut into pieces of suitable size and applied to the coated places. The brass or copper pattern, on which the desired figuring is engraved in relief, is then moderately heated over a coal fire and laid on the coated places, the heat melting the powder and causing the leaf metal to adhere to the fabric. The remainder of the metal can then be brushed off with a feather. Very fine silver or gilt designs, such as flowers, arabesques, architectural decorations, etc., can be produced in this way.

A similar process is employed by Depoully, except that bronze powders are used, these being mixed with adhesive preparations.

Imitating Embroidery and Lace.

According to the French Patent of Guillaume frères, open fabrics are printed over with a white, opaque mass, which imparts the appearance of embroidery or lace. The impression can be given by means of wood blocks or printing cylinders, the colour employed being prepared from: dry albumin 2 parts, lukewarm water 2, dextrin syrup 2, and zinc white 5 parts. These proportions may be modified, and the zinc white replaced by clay, chalk, or magnesia, whilst casein, guttapercha, or rubber solution may be used in place of the albumin.

Silvering and Gilding Silks.

F. Fonrobert uses gold and silver powder, prepared by grinding leaf metal in gum water, and then washing away the gum. The silk is mordanted with boiling stannous chloride solution, then rinsed and entered in boiling water containing the metal powder in suspension. Finally, the fabric is rinsed and dried. The silk appears to be covered with a fine film of gold or silver, which can be burnished.

Velvet Effect.

A large variety of velvet effects, both simple, shaded, and iridescent, can be produced on plain fabrics by means of wool croppings. For this purpose the fabric is stretched over a long wooden table, by means of rollers at the ends. A short distance above the table are arranged two boxes, divided into as many compartments as there are colours in the design, and these compartments are filled with wool croppings of predetermined colour. The hopper-shaped boxes are closed at the bottom by fine wire gauze or canvas, to ensure uniform distribution of the wool on the fabric. When the fabric is coated with glue or other adhesive, and the boxes are drawn over its surface, the wool drops through the fine perforations and sticks to the adhesive, thus forming a velvety coating.

To obtain a mingling of the various colours, the boxes are raised a few inches above the table. A partial mixing of the colours can be obtained by tilting the boxes at an angle, whilst to keep the various colours well defined, all that is necessary is to extend the partitions under the boxes, all mixing being then precluded. The boxes are moved by cords and rollers, mounted on the ends of the table.

Complex designs can also be produced by similar means, by using wooden frames in which the design is marked out by strips of metal, the spaces being filled with variously coloured wool dust. The bottom of the frame is formed of wire gauze or canvas. On placing the box over the glued fabric and giving it a slight tap, the wool dust will fall through and adhere to the fabric in accordance with the pattern.

Another method is to cover the perforated bottom of the frame with paper, etc., cut in accordance with the design to be reproduced, so that the coloured wool will only fall through the portions left uncovered by the pattern. Other colours may be applied by means of another frame, similarly provided with a different pattern, thus enabling complicated designs to be reproduced in a variety of colours.

Embossed Metal, or Colour Designs on Velvet.

To impress gold, silver, and colour designs on velvet or velveteen in the piece, the goods are immersed in a bath of porter, or sponged over with same on the pile side. The suppleness of the velvet is restored by passing it through a finish breaker and then through a brushing machine, the back being afterwards dressed with size as a support for the adhesive absorbed from the porter by the pile, so that in the subsequent pressing on the hot cylinder, the adhesives in the pile and on the back will stick together. The prepared fabric is rolled and passed under the hot, engraved embossing cylinder, powdered gold, silver, or colour being strewn over the fabric. When cold, the superfluous powder is removed by brushing.

Metallising Clothing Materials.

In addition to waterproofing and fireproofing, attempts have been made to render clothing materials capable of resisting bacteria and destructive insects.

Maricunt proposes to effect this result by the following process of metallisation: The material—linen, flannel, cloth, etc.—is immersed for an hour in a boiling hot bath containing 5 lb. of copper sulphate and 1 lb. of sulphurous acid to 100 gallons of water. When pressed, mangled, and dried, the fabric is said to possess the desired property completely. Materials treated in this way may be washed two or three times before the treatment need be renewed.

Bouillonné Finish.

The undulating appearance known as bouillonné finish can be obtained by means of an embossing machine, or by hand in the same way as dress trimmings, etc., are waved and pleated by folding and stitching. This expensive operation, however, can be replaced by the method introduced by F. Boland & Co., in which the material is laid on a coarse network of metal or otherwise, and then pressed into the meshes of the same by means of blunt studs or pins, either all over or only in places, according to the design required. The fabric is next steamed for five to fifteen minutes, or longer, and then pressed (still in contact with the network) as long and as heavily as circumstances demand. After drying in warm air, the fabric is removed from the net with care. It is found that the portions which have been forced through the meshes will retain their acquired shape, even when the material is stretched and released.

CHAPTER XXII

THE APPLICATION OF DRESSING PREPARATIONS

The dressings compounded in accordance with the instructions given in an earlier chapter are applied to the fabric, in order to produce the effect known as "finish."

In the present work we are concerned merely with the actual methods of applying these dressings, the subsequent operations, detailed below, being outside our present sphere. These operations comprise :—

1. Smoothing the fabric by damping, steaming, calendering, mangling, and pressing, as well as by spreading, stretching, and stenting.
2. Drying, by wringing, squeezing, beating, pressing, and centrifugalising, followed by actual drying in the air, or in drying chambers with a current of heated air.
3. Lustring in the glazing calender, friction calender, and lustring machine.
4. Folding, lapping, winding, and measuring.

The finishing process is based, not merely on the application of the dressings—whether for stiffening, glazing, or loading—but mainly on the subsequent treatment; and in this connection Grothe divides the process into two chief classes: chemico-physical and mechanico-physical finish. The former comprises bleaching, dyeing, and printing, and is chiefly based on the chemical action and influence of suitable substances on the fabric, so that the fibres sustain a superficial chemical alteration.

Mechanico-physical finish, on the other hand, is for the purpose of improving the outward appearance of the goods after the removal of extraneous impurities. This result is attained by the aid of pressure, shock, impact, friction, movement, stretching, the application of tension in combination with warmth, moisture, and steam, both in plain and impregnated fabrics. The modifications employed are extremely varied, according to the character of the fabric and the special purposes in view, and a great variety of machines for carrying out these operations are now available. Pressure, for instance, is applied by presses, calenders, and mangles, a different kind of pressure being produced in each. In the press it is distributed uniformly over a given surface for some time; in the calender the pressure acts for only a moment, and only upon a very narrow portion of the fabric; whilst in the mangle it is repeated on the same places in rapid succession. In this manner the arrangement of the mechanical appliances can be varied extensively, in order to meet the requirements of the different kinds and forms of material and the class of finish desired.

Owing to the changes of fashion, the finish has to be modified, and therefore it would be useless to classify the properties and degrees of the various finishes, or to describe them in detail, each kind of goods having to be treated specially.

Apart from the question how any dressing is to be treated subsequently, the first point is the method of applying it to the fabric. When the industry was in a lower state of development than at present, the application of dressing preparations was naturally effected in a primitive manner, by brushing or immersion, the surplus being removed by wringing, just as is now done to a limited extent in the textile industry.

Such methods were evidently unsuited for working on a large scale, and it became necessary to resort to mechanical appliances, enabling large quantities of fabric to be dressed, with a moderate expenditure of time and labour, in a more uniform manner than is possible by hand.

Without going into the history of these machines, it may be pointed out that the principles on which they are constructed have remained almost unchanged, and that at the present time starching machines are frequently met with in combination with other machines, especially those for drying. The principle is the same in all the machines, viz., that the fabric, instead of being passed through the dressing preparation, is treated therewith in various ways by one or more rollers, brushes, and special brushing appliances, special means being again provided for removing the surplus dressing.

Attempts have also been made to employ centrifugal force in the application of dressings. Thus, Townsend constructed a centrifugal machine provided with a small central perforated cage for the dressing, the centrifugal force expelling the dressing through the perforations in the cage and into the pores of the surrounding fabric, which is afterwards dried, by the admission of hot air, before removal from the machine.

In connection with the application of dressings by machinery, it should be borne in mind that the dressing may be applied to one or both sides of the fabric, and that machines are built for both purposes, the operation being performed in one or two stages. In other machines again, the fabric is immersed in the dressing preparation.

The starching calender is a machine for applying the necessary pressure to force the dressing into the fabric, by means of heavy rollers (bowls) of iron, copper, stone, or wood, according to the character of the dressing and fabric. The weight of the rollers being insufficient of itself, pressure is applied by weighted levers, springs, or screws.

In some of these calenders the dressing is applied by allowing the fabric to pass through the trough, and then squeezing the material between rollers; but this is only suitable where the starching has to be done on both sides. Padding machines are machines in which the dressing is sprayed into the fabric under considerable pressure, and specially heavy dressing is carried out in the double padding machine. Beetles, which are not much used, are machines in which the fabric is wound on a roller, which is rotated on its axis at low speed and is subjected to the action of a number of wood-faced beetles, of wood or iron, which are raised by a shaft and allowed to fall on to the fabric.

It is therefore evident that the application of dressings is not confined to merely distributing them uniformly on the fabric, but extends to forcing them more or less completely into the fibres and interstitial spaces as well. Hence the construction of the starching machine will vary with the result to be produced, arrangements being also made to apply more or less pressure to the rollers under which the fabric is passed.

Dressing Machines.

Formerly, piece goods were dressed by passing them by hand through a trough filled with dressing preparation, yarn being dressed in the hank, wrung by means of a wooden bar, and spread out on a table, where it was brushed, also by hand, to distribute the dressing. Then came the simplest form of starching machine, consisting of a wooden frame, a wooden trough for the starch decoction, and a pair of maple or beech rollers, mounted above, in vertically adjustable bearings, for squeezing, the lower roller being turned by a hand crank and flywheel. The pieces to be starched pass under one or two wooden guide rollers in the starch, and the surplus dressing is forced out by the squeezing rollers, after which it is drawn out of the machine, by hand, and spread out. This type of machine is still used in small works, and its principle has been retained in the larger machines, except those for starching on the back of the fabric only. The hand wheel for driving has been superseded by a belt, operated from the main shafting; the frame is made of cast iron; the number of smooth, horizontal tension rods has been increased, and the feeding of the pieces into the machine has been facilitated by traverses provided with radial grooves, for spreading and smoothing out the fabric. The method of weighting the squeezing rollers has been improved, and the lower roller provided with a pinion that operates a train of gear driving a delivery roller for drawing the fabric out of the machine. The material of the rollers has also been changed from wood to metal—brass, copper, or iron covered with linen, cotton, or rubber. Thus modified, the machine can be used for padding and various other purposes; and the finisher is able to control the amount of dressing left in the goods, by altering the load on the squeezing rollers, and by either passing the goods through the starching trough, or merely between the rollers, the lower of which is then partly immersed in the dressing.

The lower roller may also be engraved, only the upper one being faced; or a medium dressing may be given by passing the goods over a wooden roller, provided with projections and dipping into the starch. For back finishing, the goods are passed between the squeezing rollers, the lower one being engraved, dipping into the starch and provided with a "doctor" (scraper), which scrapes the starch off the surface, leaving only such as is retained in the depressions of the roller to be applied to the goods. With heavy finish, the dressing covers the surface like a film or powder, a circumstance that must be borne in mind when dressing coloured fabrics. When these are of one colour, the dressing may be coloured to correspond; but this is impracticable in the case of printed calicoes, which are partly white and partly coloured. When the goods are dressed on the back only, they cannot be rolled up at once, but must be passed, face downward, over a drying cylinder; but even this method does not entirely prevent the production of a film on the surface, even if a doctor be attached to the upper roller to prevent the dressing exuding through the fabric from coming in contact with the face. Consequently, the use of squeezing rollers must be discontinued for back finish, in the case of this class of goods. The object can be accomplished by means of a device, introduced in the sixties, in which the starch trough is freely suspended, and the goods are drawn along, face downward, underneath, in a stretched, horizontal position, and conveyed to the steam drier. The dressing is delivered on to the back of the fabric through an adjustable, longitudinal slit in the bottom of the trough, the surplus dressing being kept back by means of two doctors, set a short distance apart. Still more satisfactory is an ordinary machine, with two plain, unfaced copper or brass rollers, connected by pinions, so that neither of them slips over the other. Dressing is transferred to the lower roller by contact with a cloth-faced roller dipping half way into the starch trough, and a smaller portion of this dressing is transmitted to the top roller. This roller turns in the same direction as the fabric, which runs over and in contact with it, face upward, so that the dressing is applied to the back. The fabric is held in tension and pressed lightly on the top roller, by means of two vertically adjustable, copper guide rollers (Fig. 39). On its way to the drying machine, the fabric is scraped by a doctor, which removes the surplus dressing and returns it to the trough. This device answers well for stiff dressings, the viscous and constant consistence of which enables them to distribute better over the unengraved metal rollers than is the case with boiled starch paste, which varies in consistence every hour. Other useful appliances for the same purpose are also available. For instance, in one case the upper metal roller revolves in the opposite direction to that of the fabric; and this roller may be engraved. Again, a single metal roller may be used, which dips in the dressing and transfers it to the under side of the fabric direct. This arrangement is found in Hummel's machine for this purpose; and the doctors in this machine are arranged slantwise against the engraved metal roller, instead of vertically underneath the dressed fabric.

The yarn starching machine of Haubold and Merkel consists chiefly of a long, rectangular starch trough, a copper roller mounted above the one side of the trough, and a guide roller, parallel with the other, in the bottom of the trough. Both rollers are easily detachable. The hanks of yarn are slipped over the two rollers and revolve with the movement of the latter, through the starch in the trough, being squeezed by a weighted roller above the copper roller. The dressed yarn, after being taken out of the machine, is again squeezed between a copper roller and a rubber roller, mounted on the back of the trough.

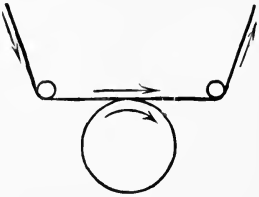
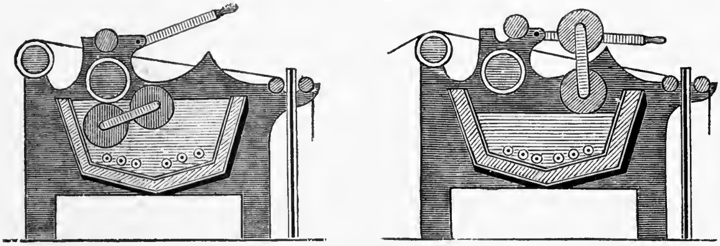


Fig. 39.—Arrangement of rollers in starching machine.

Baerlein's Sizing Machine.

This machine, which is largely used, is equally suitable for wool, worsted, and cotton yarns, of coarse or fine count, and dyed or plain. It will turn out ten times the quantity of yarn that can be treated in a Scottish sizing machine, and is used in combination with air drying, which is preferable to cylinder drying, inasmuch as it gives a tougher, smoother, and rounder thread. Moreover, the yarn is not stretched at all, and thus retains its elasticity, so that inferior yarns handle as well as better qualities sized in other machines. The size is more effectually pressed into the yarn and adheres better, the consumption of size is reduced, and the yarns do not become ropy.

The machine can be used for a variety of purposes, the addition of revolving brushes adapting it for woollen yarns; and it can also be employed for scouring and cleansing woollen and worsted yarns. It is easily managed, and is of simple and very strong construction, there being no risk of explosion or leakage of the steam-pipes, even when the machine has been out of use for some time. The approved method, in rapid sizing machines, of placing all the warp beams at one end, has been retained, all the warps going through the size and drier together, and being beamed at the opposite end in the finished state. For undyed and plain-dyed yarns, the old form of beam frame is used; but for particoloured yarns a "railway" frame is employed, in which the frame of each beam can be moved in and out on rails, and the yarn is passed through a reed and healds before entering the sizing trough.



Figs. 40 and 41.—Baerlein's sizing machine.

The trough is of a new type, and the yarn is squeezed in the size itself. It runs first over and under, then over a wooden roller, and finally over a copper roller, being pressed between this and an overlying iron roller covered with flannel.

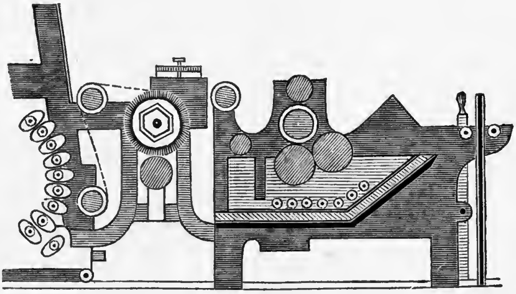


Fig. 42.—Baerlein's sizing machine.

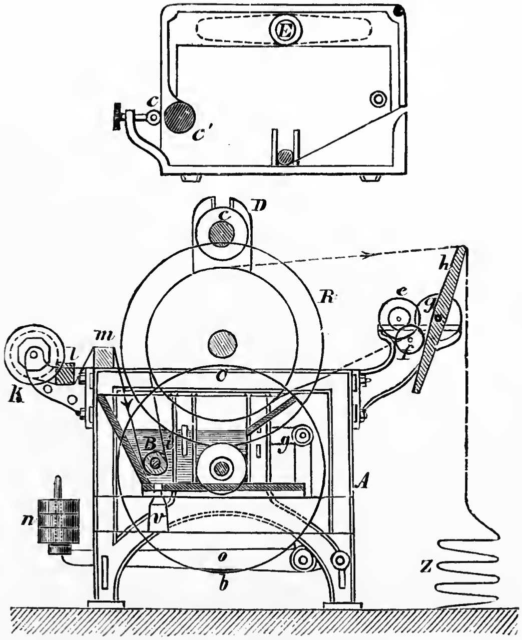
The first are pressed together, and also against the copper roller, by a lever bearing in which they are mounted. The copper roller, being operated by a lateral shaft, drives all the other rollers, so that, unlike other machines, the yarn has not to perform the task of driving the rollers, and therefore there is no stretching of the yarn, such as occurs in ordinary troughs fitted with one immersion roller, a wooden roller, a copper roller, and two squeezing rollers, or in machines in which the wooden roller is replaced by another copper one, the tension being little less in this latter case owing to the smaller diameter of the first copper roller. There is some risk in allowing copper rollers in the starch, because they run very hot, and are very liable to scorch the yarn. The continuous contact of the yarn with the rollers, in passing through the starch, prevents tangling, and the greater length of time the yarn is in the size, coupled with the fact that it is squeezed whilst in that position, naturally leads to improved penetration of the sizing material.

For sizing cotton yarns, perforated pipes are provided for boiling the dressing; but when glue is used, spiral pipes are provided, though both kinds may be used for either purpose. The trough may also be fitted with a patented feed device; it is usually lined with copper, the parts immersed in the liquid being of brass.

For cotton yarns an improved circular brush is used, which runs at high speed, and there is also a special adjustment for setting the yarns accurately against the bristles, to ensure better contact with the fibres. Cleansing brushes are also provided in the trough.

In stopping the machine, the pressure roller is raised by the side lever, and the lever bearing of the two rollers is raised by means of the hand wheel and rack. The wooden roller in contact with the copper one, rolls upward on same, until its centre is rather higher than that of the copper roller, whereupon the first wooden roller swings away, so that the yarn does not come in contact with any of the rollers while it is being taken up by the yarn roller. For woollen and worsted yarns which require boiling, two troughs are provided, the one for boiling the yarn and the other for sizing. These two troughs work as evenly and simply as a single one. The yarn is dried by moving it up and down, over and under rollers in such a manner that the impinging air is compelled to penetrate through it, the damp air being removed without again coming in contact with the yarn. The guide rollers are ribbed, and are easily cleaned, being everywhere accessible, even in the widest machines, the lower one being got at by lifting the overlying board, the middle one from both sides, and the top one by walking along the said board across the machine.

The drying chambers are fitted with hinged side doors. When the yarn is properly beamed, the machine can be run for weeks on end, without having to be stopped to remove tangled threads. The yarn being properly guided over the top guide rollers, it can be easily retained in position without any strong tension, and is therefore not stretched at all, even in drying. The air is heated and fed to the drier by a fan inside the chamber, which fan draws in cold air from outside, past a number of surrounding pipes, heated by steam, and then blows it against the yarn. On each side of the machine are iron steam-chests, fed separately on either side. The cross tubes in these steam-chests are mounted in such a manner, by stuffing boxes and rubber packing, that they can expand and contract freely, always remaining steamtight, and being removable quickly in case of accident. The cross tubes may be of iron or copper as desired. The steam-chests are separated from the outer frame of the machine, so that there are no hot surfaces, apart from the drying chests. A steam-trap is provided at each end of the drying chamber. The whole apparatus is tested to a steam pressure of 4 atmospheres, whereas the actual working pressure does not exceed $\frac{2}{3}$ to 1 atmosphere.



Figs. 43 and 44.—Starching machine.

Starching Machine.

When the fabric is to be starched on both sides, the goods are passed over the tension bars *l*, *m* (Fig. 44), from the roller, *k*, on which they are wound, and enter the starching trough *B*, in which they pass round the dipping roller, *i*, and between the squeezing rollers *C*, *D*, which remove the surplus starch, after which they are drawn out of the machine by the wooden reel *h*, and deposited at *Z*.

If they are only to be starched on the one side, they must not be passed through the trough, but are led direct from the rail *m* between the squeezing rollers and thence to the reel, *h*, as before. In this case the trough must be filled with starch to such a height that the lower roller *C* dips into the mass, and transfers some of this to the fabric in revolving. To facilitate this operation, the lower roller, which is of large diameter, must be made of beech or maple wood, and covered with several layers of calico, the upper roller, *D*, on the other hand, being of brass. To enable the pressure of these rollers on the fabric to be adjusted, a system of levers is provided (*o* and *g*), through which a weight *n* presses on the shaft journals. The reel or board, *h*, lays the fabric in folds, so that the starched and unstarched sides do not come in contact, since that would give rise to patches. Usually, however, the starching machine is close to the drying machine, and the goods pass from one to the other without touching the reel. The cloth beam, *k*, may be either round or octagonal, and is made of wood, like the guide rollers, *i*. The journals and bearings of the latter must be of brass, to prevent rusting. The trough *B* is lined with thin sheet copper, and is provided with a draw-off valve, *v*. Motion is transmitted to the starching roller, *C*, the shaft of which carries an external pinion, gearing with a second pinion attached to a belt pulley, driven from a second motion. A throw-off belt fork is provided. When the machine is used for double starching, both rollers are of brass, whilst for starching embroidered and decorated fabrics, a lower wooden roller, faced with calico, is used, the upper roller being preferably of cast-iron faced with rubber.

Padding Machine.

In finishing light but fine quality printed cottons the task in hand is to make them appear more solid and heavier than they really are. These goods are starched in a padding machine (Fig. 45), so that the printed face comes in contact with the top metal roller, whilst the starch is applied to the back by the calico-faced lower roller.

The machine consists essentially of the cast-iron frames, *A*, and the starching trough, *H*, with the pair of squeezing rollers, *F* and *G*, mounted above the same and loaded heavily by the train of weighted levers, *B*, B_1, *C*, *D*, and *E*.

The fabric passes from the cloth beam, *N* (loosely mounted in the bearing *o*), over the guide rollers, *q* and *r*, into the starch trough, *H*, and round the starching roller, *i*, which is entirely immersed in the trough; and thence between the squeezing rollers, *F* and *G*, where the superfluous starch is forced out. The fabric then passes, either over the guide roller, *b*, on the arm, *U*, and to the folder, *X*, *Y*, where it is laid in folds; or, when it is not to be folded, is wound up on a beam, *M*, which is pressed firmly against the upper squeezing roller, *F*, by a bell-crank lever, L^1, and a weight attached at 4. If the goods are to be starched on one side only, they are led direct from the guide roller, *q*, between the squeezing rollers, of which the lower one, *G*, dips into the starch, and transfers the latter to the back of the goods in revolving.

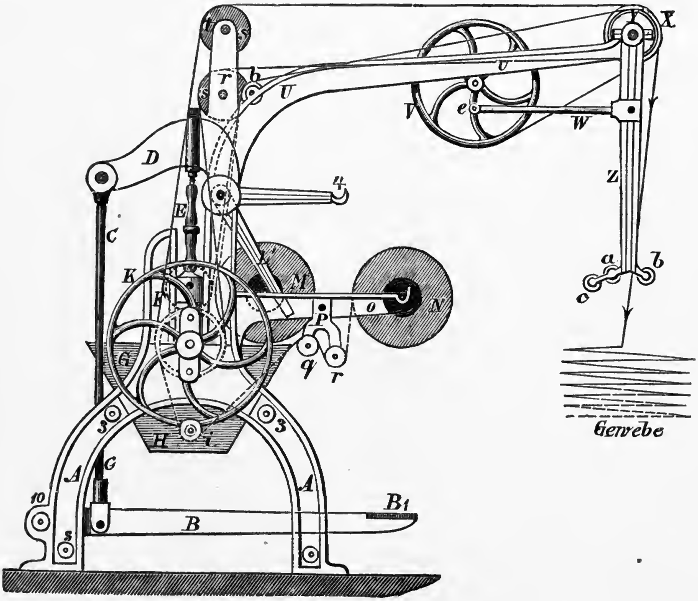


FIG. 45.—Padding machine. (Gewebe = fabric.)

The lower squeezing roller, *G*, is hollow, the walls being 1 inch thick, whilst the upper roller, *F*, is solid, to press the fabric. As a rule, both rollers are faced with calico. The side frames *A* are held together by wrought-iron traverses, 3. The folder is operated by a belt which passes from a belt pulley on the axis of the lower squeezing roller, to the belt pulley, *X*, of the folder shaft, *Y*, over the guide rollers, *s*, *s*, on the arm, *r*. The crank shaft, *e*, receives motion through the pulley, *Y*. The folder shafts, *a*, *b*, have a quick inward motion, to prevent the cloth from stowing.

The Double Padding Machine.

This machine, which is made in various widths, with cast-iron or brass rollers and with or without a folder, is used for washing,

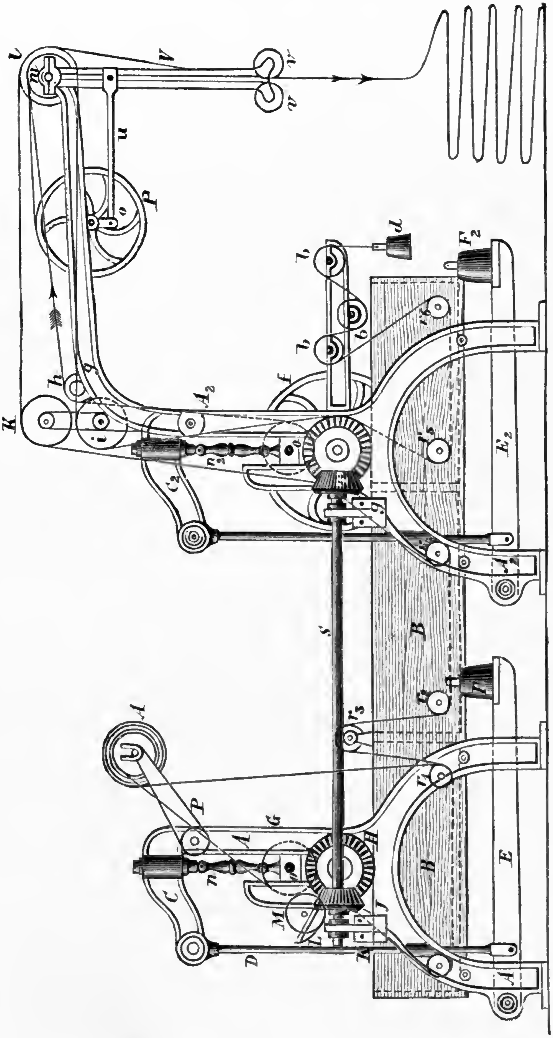


Fig. 46.—Double padding machine.

rinsing, and blueing, as well as starching. For heavy finish, so that the dressing is forced into the threads from both sides of the goods, the latter are passed from *d* over the guide rollers, *i*, into the wooden starch trough, thence by the rollers, r_4, r_5, between the first pair of (cast-iron) squeezing rollers, where the starch is pressed into the goods, and the surplus is removed. After passing over the guide rollers, r_2, r_3, the goods enter the second compartment of the starching trough, and pass over the guide rollers, r_1, to the second pair of squeezing rollers, where they are subjected to a pressure that is greater in proportion as the texture of the fabric is desired to be more prominent when dried. The goods are next wound on a wooden roller, *M*, the journals of which move outward in the bearings, *L*, as the winding proceeds, or else the fabric is led to the folder, *l m v*, where it is deposited in folds. According to the degree of starching desired, the first compartment of the trough is filled with diluted starch dressing, which penetrates right into the fabric, whilst the second and third compartments are charged with a thicker dressing, according to the amount of loading required. For less heavy starching, each of the two combined machines is used singly, the fabric coming over, *i*, from, *d*, and the first pair of squeezing rollers, passes over a guide roller, *h*, to the folder, *l m v v*, to be delivered in folds. In the left half of the machine, on the other hand, the fabric from a beam, *O*, inserted at *P*, enters the

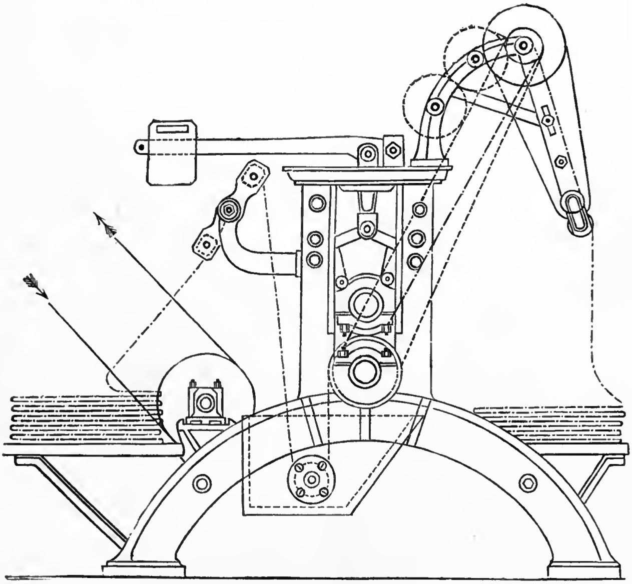


Fig. 47.—Loading machine.

trough and passes round the guide rollers, r_1, r, to between the squeezing rollers, and is then wound on the beam M.

Loading Machine.

Rudolf and Kuehne's loading machine (Fig. 47) consists of an iron frame, in which are mounted two heavy iron rollers, one of which is positively operated, whilst the second rotates with it. Both rollers are pressed firmly together by means of bell-crank and weighted levers. Underneath them is the trough to hold the loading preparation, and in the bottom of the trough is a roller to guide the fabric. One of the squeezing rollers is covered all the way along with jute or other material, to make the pressure elastic, and prevent overpressing the goods. The latter are passed through the loading preparation, which they absorb, and are then strongly squeezed between the rollers, so as to secure uniform impregnation and discharge the surplus dressing into the trough again.

Starching Machine for Heavy Goods.

The machine (Fig. 48) is intended for starching heavy cotton goods on one or both sides, under heavy pressure.

The two squeezing rollers, m, n, are mounted on a solid iron frame, and a starch trough, W, is arranged under the lower roller. This latter, of hard wood (maple or beech), is positively operated, and is covered with strong calico. For fine goods, like starched muslin, etc., the upper roller, n, is of rubber, brass being used for medium fabrics, and it is pressed against the wooden roller by the levers E, F, C, B, and the weights K. The fabric runs from the beam Q, which can be checked at will by the brake R, F, S, over the tension rails, G and P, and over the guide roller, U, in the starch trough W; thence between the squeezing rollers, m, n, and from these to the folder, f, which deposits them in such a manner that, in the case of single-starched goods, the starched and unstarched sides cannot come in mutual contact and cause patchiness. The lower squeezing roller is operated by the wheel, N, and a piston on the shaft K, which shaft carries the driving pulley, L. For single starching, the goods do not pass through the trough, but run direct from the tension rail, O, to the rollers m, n, the starch trough, W, being raised so that the lower portion of the roller, m, dips into the starch, which is carried round by that roller and applied to the back of the fabric.

It is usual to fasten several pieces of fabric together, care being taken that the printed side of each is on the top. It is found advantageous to calender the goods heavily before starching, the printed side being set to face the calender bowl. This treatment presses the threads flat, and at the same time pushes them closer together, so that the starch does not penetrate through to the face of the fabric so easily. The appearance of the finished goods is thereby improved. Drying may be performed either by hanging up the goods or by passing them over steam-heated cylinders; but in the latter case they must not be so heavily starched, and considerable pressure must be applied in squeezing. The machine illustrated in Fig. 49 is the only kind suitable for drying goods that are desired to remain clear and of good appearance. In this machine, which is well adapted to its purpose, the fabric passes from the feed end, *C*, over the guide rollers, as shown in the drawing, and round the drying cylinder, to be then either wound at 10, or led to the folder *O* 8 and 9. The bottom longitudinal traverse, *f*, of the frame *A* is hollow, and conveys the heating steam, on the one hand, to the copper-drying cylinder *E*, and, on the other, drains away the water of condensation into the automatic collector *m*. The machine is driven by a friction-clutch gearing, *q*, *r*, *s*, *t*, *u*, *v*, *w*, *x*, *y*, and h_2 The dried fabric is finally treated in a 3-bowl calender. The dressing is composed of 50 parts of finely ground and bolted rice meal, mixed with twice its own volume of lukewarm water and treated with 1½ parts of concentrated solution of carbonate of soda.

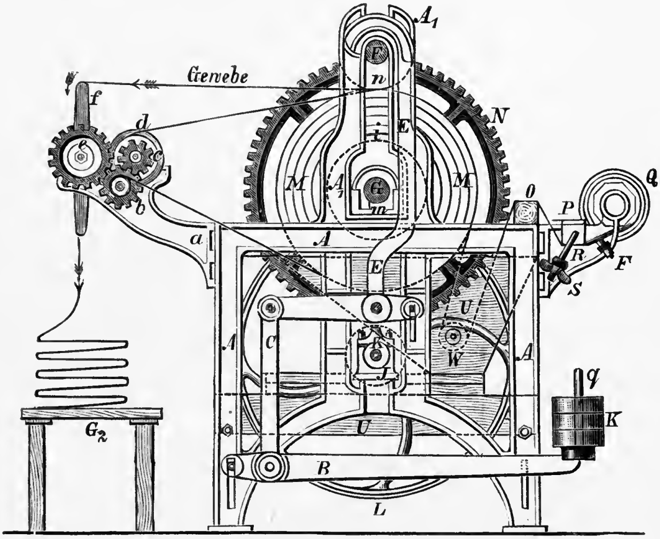


FIG. 48.—Starching machine for heavy goods.

After standing for several days, the liquid is decanted from the deposited meal, the latter been then stirred up with boiling water, containing 1½ parts of carbonate of soda in solution. When the

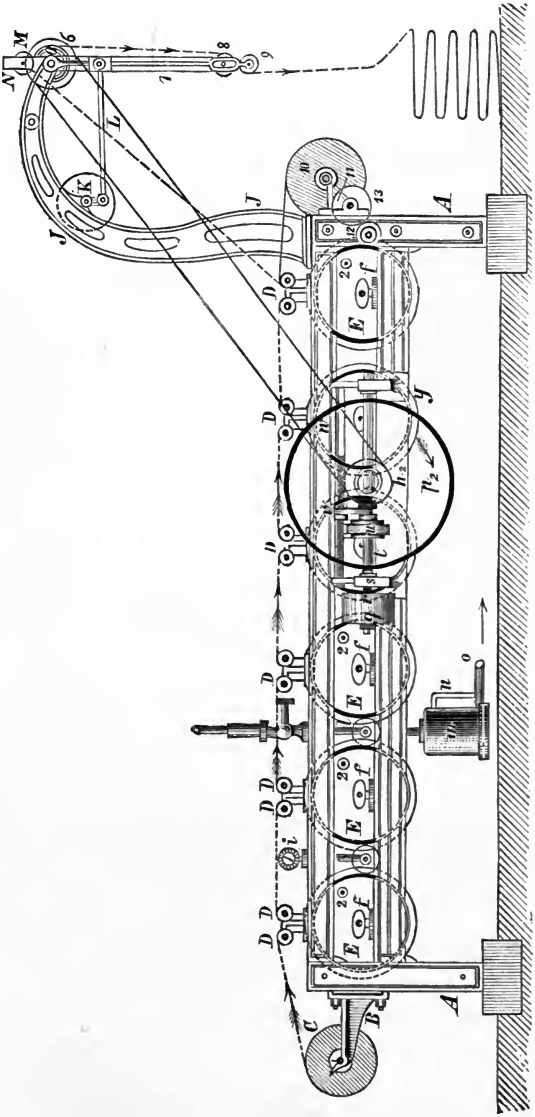


FIG. 49.—Drying machine for single-starched goods. (Gewebe-fabric.)

goods are to be loaded, the dressing is mixed with scalded potato starch, China clay, or other filling and loading ingredients, the whole being boiled for some time and used in a lukewarm condition.

Machine for Back Starching.

The best type of machine for this purpose is illustrated in Fig. 50. It consists primarily of a starch trough, into which a fairly large maple roller dips about half-way in the thin starch dressing, and thus acquires a coating of the latter. The stretched fabric passes, face upward, over this drum, and the thickness of the layer of dressing on the roller is regulated by an adjustable doctor, whilst a second doctor scrapes the surplus dressing off the back of the fabric, after the latter has left the roller, thus preventing the dressing from working through to the face. The back of the fabric is then passed over a quick-running circular brush, which distributes the dressing uniformly; after which the goods travel over the upper guide roller, and direct (face outward) to the first reel of the drying machine, the rods of which are preferably covered with cotton cloth.

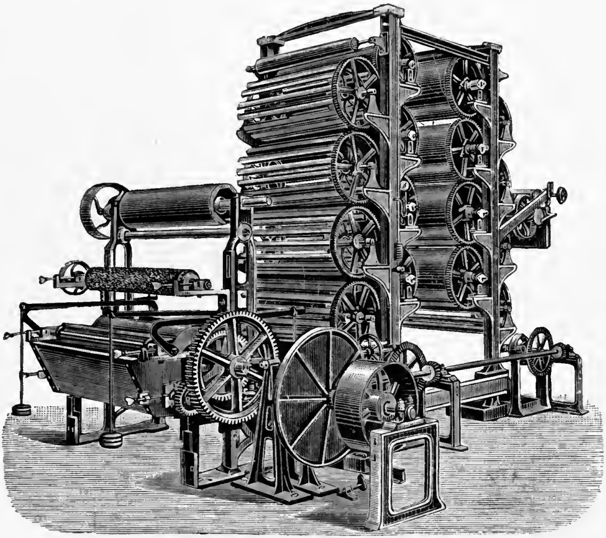


Fig. 50.—Downham & Co's. machine for back-starching goods.

From this first reel the fabric is delivered to the first drying cylinder, so that the face is in contact with the same, and passes thence with the back in contact with the secondary reel, which delivers it so that the face comes in contact with the second drying cylinder, and so on.

The reels are provided for the sole purpose of preventing the starched back of the fabric from coming in contact with the hot metal cylinders since the dressing would stick on these and dirty the fabric.

THE SIZING MACHINE.

This machine, for sizing silk fabrics, consists of a trough containing a felt-covered roller, which takes up the dressing and delivers it to the fabric, which is pressed between this and an upper roller. The pressure on the latter must be only slight. The machine is frequently combined with a drying machine, which may consist of horizontal, steam-heated plates, the fabric being passed over, and at a short distance from these; or drying cylinders may be used. To impart a high lustre, a drying calender with heated cylinders is employed.

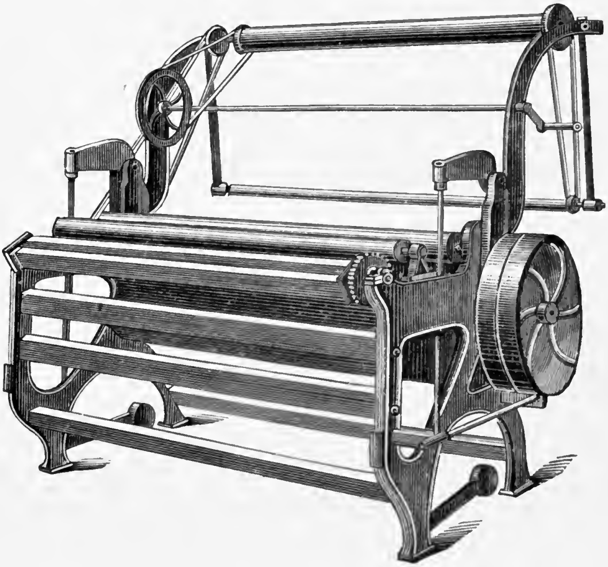


FIG. 51.—Sizing machine.

A 3-roller machine (Fig. 51), made by Gebr. Wanzleben, is also used for the same purpose. One of the rollers is mounted in the trough, and the dressed fabric is passed over a hot box, which may be replaced by a drying machine with 1 to 5 cylinders, 20 to 80 inches in diameter, the fabric being guided in such a manner that the dressed side never comes in contact with the cylinders.

Pneumatic Spraying Apparatus for Liquid Dressings.

Dressings may be applied in an extremely uniform manner by spraying them over the fabric, into which the dressing then penetrates to a merely restricted depth.

The apparatus for this purpose (Fig. 52) consists of a sheet-copper chest *A*, which is filled with dressing through the inlet *D*, and is provided on one or both ends with a gauge *C*, of the type of an ordinary water gauge. The length of the chest is equal to the breadth of the widest fabrics made; but the interior is divided into a series of cells or compartments, a large or smaller number of which can be operated at a time, according to the width of the goods to be treated. The cells are formed by a number of tightly jointed cross partitions, the lower edges of which extend to within about an inch from the bottom of the chest, so that the cells are in communication below, whilst hermetically separated in the upper portion. Each cell is fitted with an air connection, which can be connected with a compressed air main, *R*, by means of rubber piping and a valve, *S*.

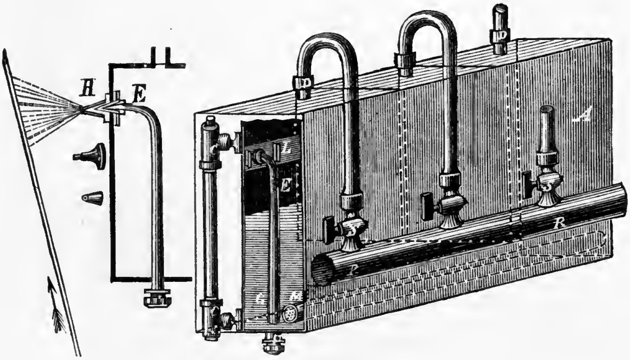


FIG. 52.—Spraying apparatus.

On the other hand, each cell is fitted with a system of nozzles, which convert the issuing liquid into a fine spray and discharge it on to the fabric. The bent pipe *E* extends to the bottom of the chest *A*, where it exhausts through an opening that is easily accessible by means of a screw stopper. At the bottom of the chest, this pipe has an orifice *G*, into which the liquid can penetrate, whilst at the top it opens into the air conduit, which is formed by the rear wall of the chest, two fillets and a pressure rail. The mouth of the pipe *E* is provided with a small internal nozzle, surrounded by a larger one, the inner nozzle being screwed into the mouth of *E*, and the larger one into the wall of the chest *A*.

The inner conical space of the nozzle terminates at the apex in a small slotted orifice, but is otherwise large enough to allow a corresponding free space. In the cover rail of the conduit, and on both sides of the inner nozzle, are slits *L*, through which the compressed air in the chest *A* can find its way into the system of nozzles, and thence into the open air.

The chest *A* is mounted on one side of the dressing machine—over which the fabric is passed, spread out vertically or aslant, by means of rollers—and at a suitable distance from same. One or more air-pumps, *N*, are mounted near the machine, and operated either direct from this or from the shafting; and the compressed air is conveyed through the pipe *O* into the wind chest, where the pressure can be read off on a pressure gauge.

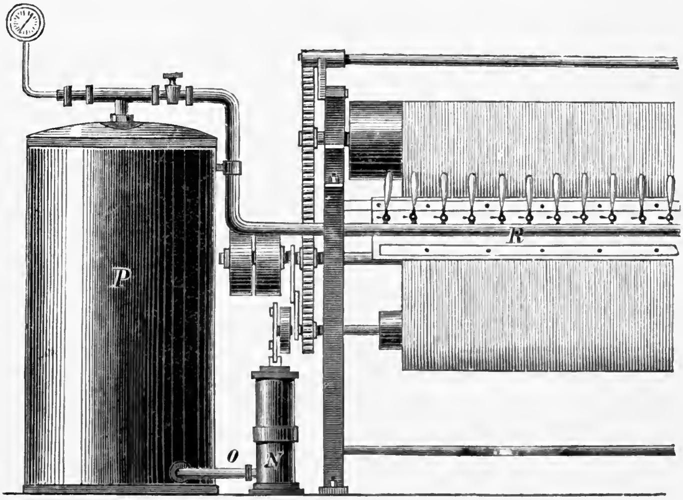


Fig. 53.—Spraying apparatus.

From the wind chest *P*, the air-pipe *R* passes to the chest *A*, and is there provided with as many valves, *S*, as there are cells in the chest.

On opening the number of valves corresponding to the width of the fabric, and starting the air-pump, the valve on the wind chest being also opened, and the dressing preparation fed into *A*, the compressed air begins to act in the opened cells, pressing the dressing on the one hand, so that the latter is forced through the nozzles in a thin stream; whilst, on the other hand, the air itself escapes through the slits, *L*, and nozzle, E, thus spraying the issuing liquid on to the passing fabric, which is thereby damped in a uniform manner.

The extent to which the liquid penetrates into the fabric depends on the air pressure employed, and the speed at which the fabric travels.

The copper pipe, extending all along the bottom of the chest *A*, is common to the whole of the cells, and is connected with a steam-pipe, in order to warm the dressing, and also for cleaning out the pipes and apparatus, or for damping the fabric with steam.

Jahr's Universal Stenter and Drying Machine.

Two systems of drying are combined in a very simple manner in this machine. When required by the nature of the fabric and of the dressing, hot air can be forced under the lowest, and comparatively dry, layer of fabric, and thus compelled to pass through the meshes of the stretched material; whilst at the same time a supply of hot air can be passed along both sides of the fabric by the aid of laterally arranged pipes, and of metal plates arranged between the layers of material.

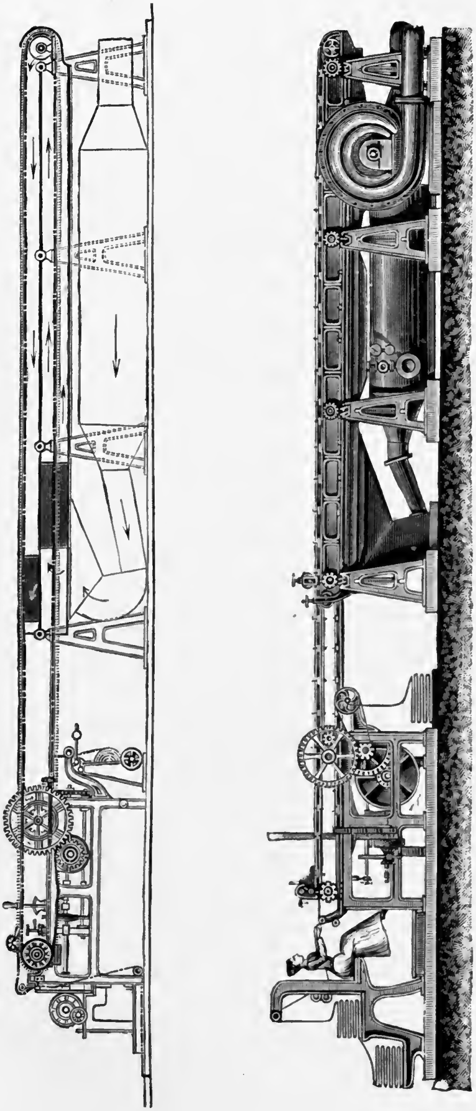
The first-named system of drying is employed for all goods of more or less open texture, such as flannels, Cheviots, light buckskins, and certain dress stuffs, in pure and half-wool, the second system being used in the case of closely woven, milled, or dressed fabrics, such as cloth, suitings, upholstery fabrics, satins, zanellas, shirtings, linings, etc., where it would be difficult to force the warm air through the meshes of the stuff. Moreover, whilst the first method has a favourable influence on loose fabrics, like flannel, since it raises the nap and improves the feel, it would have the opposite effect on close, smooth fabrics.

The drying effect required is obtained by operating the two valves in the lateral connecting pipes.

Owing to this simple and appropriate arrangement, all classes of goods can be stented and dried with advantage on the machine.

The machine consists of two endless chains, to which are attached the stenting hooks or needles for holding the selvedges of the fabric. The chains run in guides that can be adjusted to suit the width of the fabric, by means of right- and left-handed screw spindles and nuts. These chains are driven by a train of pinions, fitted with a friction coupling for variable speed, the fabric being fed from the feed table and over rollers to the chains, where the selvedges are attached automatically to the hooks, etc., by the action of reciprocating or rotary brushes. It is then gradually stretched, by the divergence of the chains, in passing through the first two sections of the machine, and travels thence to the further end of the machine where it turns downward and is released from the chains by a pair of rollers, at a point where the tension is relapsed by the converging chains.

The hook or needle plates are provided with a number of openings or passages, through which warm air is admitted to the selvedges, so that these are dried at the same rate as the rest of the fabric.



FIGS. 54 and 55.—Jahr's universal stenter and drying machine.

The air for drying the wet fabric is forced by a fan through a system of tubes, heated by steam, into a space below the bottom layer of fabric. When the lateral pipes are closed, the air accumulates in this space and penetrates the fabric. After passing through this almost dry layer, the air is still able to take up a further quantity of moisture, and is therefore forced through the upper layer of fabric, which it thereby partially dries. This countercurrent system of drying gives the maximum of effect, and is intensified by opening the valves in the side passages, through which the air ascends from the bottom space into the upper one and thus reaches the inner side of the fabric. It is there compelled by the plates (Fig. 54) to travel along the wet fabric in an opposite direction to that taken by the latter.

The damp air escapes through a lateral opening at the feed end of the machine.

Partial use is made of spent moist and warm air, so that the natural moisture of the fabric is retained whilst on the hooks of the stenter.

Woollens that are dried in this machine do not shrink like those treated in the older types of vertical or horizontal frames, in which the fabric was exposed to the moisture-laden air of the room.

The stenter and drying machine has been greatly improved by the addition of the longitudinal stretching device, for stretching milled flannels, etc. This device is attached in such a manner that the fabric is obliged to pass through it before reaching the stenting chains. It consists of two pairs of copper-faced iron rollers, one of them running at lower speed than the other. The slower pair is driven by a friction coupling, which enables the degree of stretch to be adjusted while the machine is running. If the fabric requires sizing, a trough, adapted to be raised and lowered by pinion or rack gearing, is mounted below the under pair of rollers.

JAHR'S GASSING MACHINE.

This machine enables gas to be used at any desired pressure, the blower mounted on the machine frame drawing in the atmospheric air as well as the gas. In all other machines the intensity of the flame depends on the gas pressure for the time being; and even in this machine the pressure of the compressed air must not exceed that of the gas, or the latter will be forced back into the pipe instead of mixing with the air. The new arrangement also secures other advantages. In passing through the blower, the gas and air which have already commingled in the same pipe are intimately mixed, thus ensuring a considerable saving of gas (up to 50 per cent.). The air is warmed in the brass gassing roller above the flames, thus raising the heating power of the gas, and at the same time cooling the gassing roller. Owing to the suitable construction and good workmanship, the burners give a perfectly uniform flame, the breadth of which can easily be adjusted to the width of the fabric, by means of a close-fitting cover. The flame can also be instantly withdrawn from the fabric. The burner is of very simple construction, and no devices for controlling the pressure and ratio of the mixture are needed, rubber tubes and valves being also superfluous. The gassed fabric passes between two rollers which put out any sparks at once, and from these it is led over guide rollers to the circular brush, which removes all the dust produced in gassing. The fabric is securely guided by three delivery rollers, and is folded in a folder. The velocity of the blower, and consequently the intensity of the flame, is a constant factor, whereas the velocity of the fabric under treatment can be easily regulated by means of a friction coupling. The machine is preferably driven from shafting, or by an engine that replaces the friction coupling.

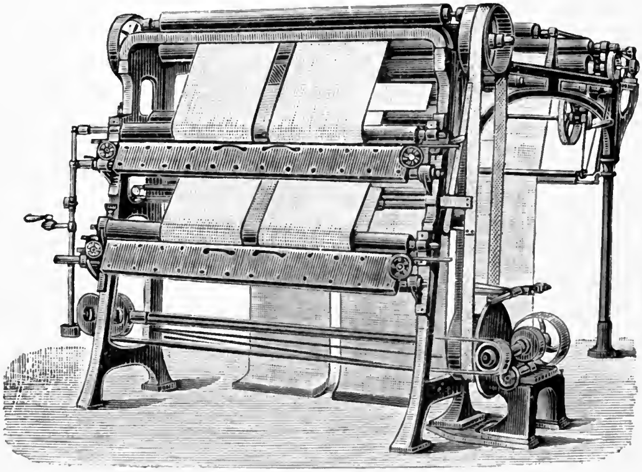


Fig. 56.—Jahr's gassing machine.

Dressing Distributor.

In machine starching the dressing is not distributed over the fabric so evenly as to entirely preclude smearing, which shows up when the fabric is dried. To obviate this drawback, the starched goods are repeatedly spread open in a warm room before going on to the drying frame, and are then pressed and beaten by hand until the dressing is uniformly distributed through the piece, and is partially dried to a sufficient extent. Malleral's machine (Fig. 57) stretches, partly dries, and presses the fabric in the following manner:—

The starched fabric is wound on the beam 23, and passes first between two copper, wooden, or rubber rollers 12 and 3, being then wound up on the roller 14, on which it is pressed by the metal roller 17. The roller 3 is positively operated, and drives the roller 4 as well as the blower 8 while the goods are in motion. When the whole of the piece has been wound on the roller 14, it is reversed so as to return to roller 12. The goods are squeezed by the rollers 16 and 17, which are pressed by the ratchet and pawl gearing 18, 19, through special draw bars and the levers 16′ and 17′ in conjunction with the weight 25. Drying is affected with cold or warm air, forced through the fabric by the fan, or by heating pipes at the bottom of the apparatus. Very fine goods can be folded across the middle and passed through the machine, two or three pieces being laid side by side on the same roller; at the same time, the whole apparatus can be used as a foulard machine, by allowing the roller 3 to run in a dressing trough, the goods then passing direct to the roller 14, where it is pressed for the first time and equalised.

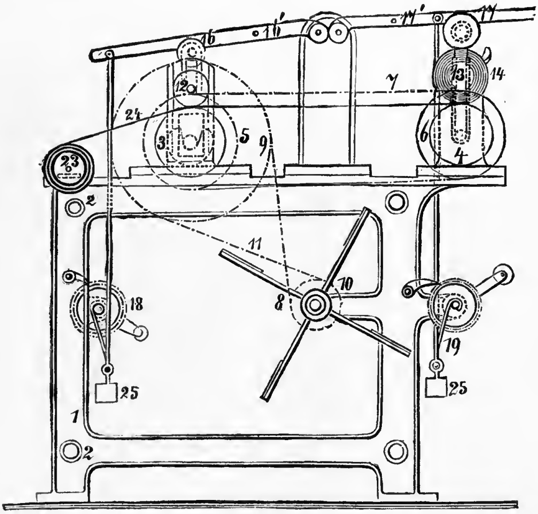


Fig. 57.—Dressing distributor.

Gebauer's Hydraulic Box-Mangle.

This machine, which is intended to replace the old box-mangle, is provided with a bottom bowl in fixed bearings, whilst those of the upper bowl can be moved up and down between the frames by hydraulic power, according as the beamed fabric between the rollers is to be subjected to or released from pressure. The press cylinders *p* for this purpose are double acting and are firmly secured to the bearings of the lower bowl, the plungers *r* operating the bearing *s*, of the upper bowl, through crossheads and the draw bars *d*, and thus indirectly acting on the journals of the cloth beam. These are enclosed above by the bearings *y* (open below), which can be raised and lowered along with the bearings *s* of the pressure bowl by means of the guides *x* and rods *g h*. The lowering is affected by the cylinders *p* alone, but for raising, they are assisted by the small, single-action cylinders *q*, with plunges *r*. The hydraulic pressure for both sets is furnished by a pump, with wind chest *w* and feed pipe *l*. The valves *a*, *b*, and pipes *u*, *e* admit pressure into the cylinders, whilst the valves *c*, *d*, and main *t* allow the spent water to escape into the storage tank *z* for use over again.

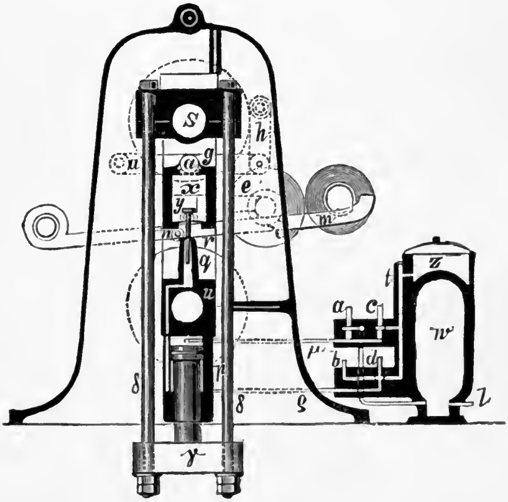


FIG. 58.—Gebauer's hydraulic box-mangle.

Without going into the elaborate details given by the maker with regard to the operation of the valves, the method of working may be summarised as follows: When the cloth, either folded or beamed, has been mangled, the upper bowl is raised by setting the valves according to instructions, whereupon the beam can be drawn out from between the bowls and rolled away on the rails *m*, a fresh beam of cloth being rolled down the rails and inserted between the bowls. The valves are then set to lower the bowl and the bearings for the cloth beam, so as to hold the latter in position for mangling. Hence there is no need for the attendants to touch the beams either during insertion or removal.

Other patterns of this mangle are supplied with, for instance, a single-action cylinder below, and another above, the pressure bowl. Modifications are also introduced by the provision of levers, pinion racks, and friction couplings, for filling and emptying the mangle; but the sloping rails are retained in all patterns.

Embossing Machine.

This type of machine operates by impressing the design of an engraved roller on lengths of fabric or paper of all kinds. The fabrics usually embossed are: lawn, leather cloth, silk, velvet, plush, bookbinder's cloth, etc. From the nature of the work, which is performed by the aid of heavy pressure, it is evident that careful workmanship in building the machines is essential; not only must the pressure be distributed uniformly over the whole working surface

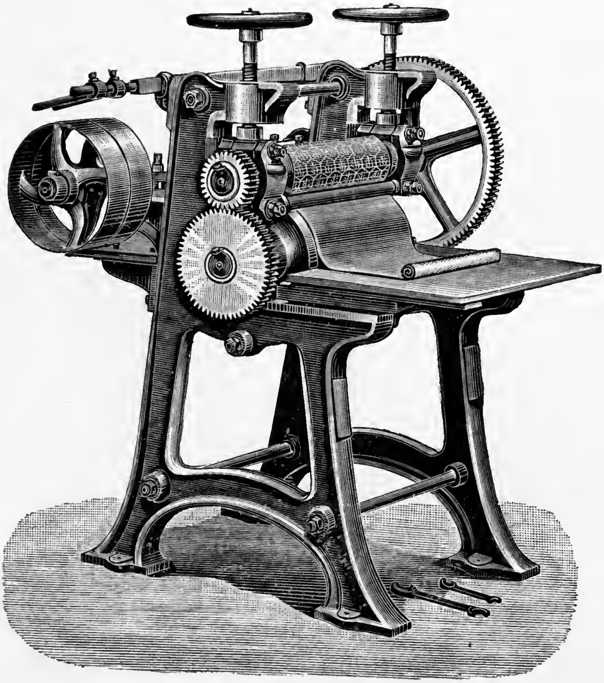


Fig. 59.—Eck's embossing machine.

of the roller, which is about 10 feet long, but also there must not be any alteration in the appearance of the design in the longitudinal direction of the fabric, and the latter must be fed in such a manner that creases are impossible. Convenience in the changing of the rollers is also a point of no inconsiderable importance.

Two-roller and 3-roller embossing machines are shown in Figs. 59 and 60, both intended for long or short lengths of fabric.

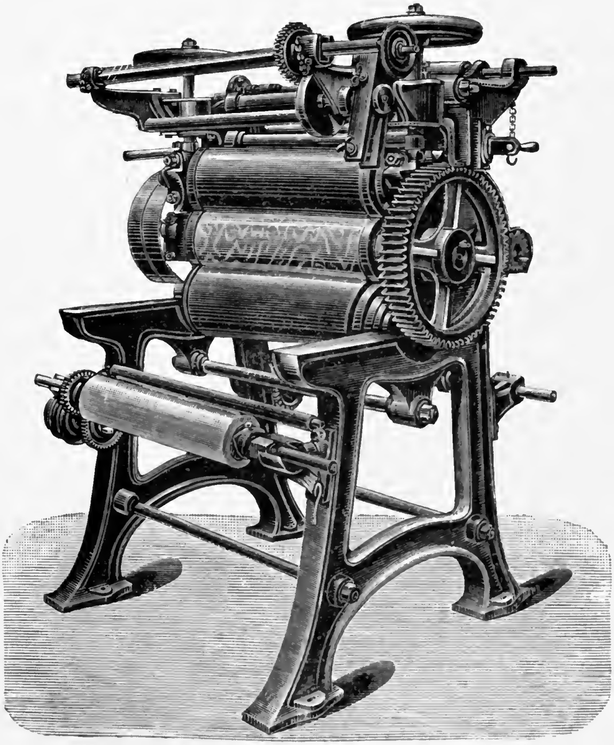


FIG. 60.—Eck's 3-roller embossing machine.

The second machine has the advantage of a quicker change of rollers, and it is impossible for the rollers to bend in any way. Both machines are constructed with great precision, with best phosphor-bronze bushes to the bearings and accurate feed, discharge, and lateral adjustment. The engraved roller is equipped with heating devices for gas and steam, heat being requisite for embossing certain fabrics. The production of watered effects on smooth fabrics is another operation performed by these machines.

CHAPTER XXIII

TESTING DRESSINGS

THE practical finisher rarely resorts to chemical examination, and is content for the most part to rely on the feel and on his own experience, to judge what preparation has been used in the dressing and how the same can be imitated by the use of various ingredients. It is certain, however, that the chemist can afford more reliable information—though at greater expense—as to the compounding of a given dressing, on the basis of a sample supplied.

In examining a fabric with a view to ascertain how it has been dressed, the eye has first to judge whether it has been glazed, calendered, or double-starched. By looking through the material, one can also tell whether and how it has been starched or loaded. If heavily dressed, it will feel hard, but softens when rubbed between the fingers. The appearance of dust when a small piece is torn off the end, indicates loading. Finally, a strong magnifier will reveal whether the dressing is merely on the surface or has penetrated the interior, and whether mineral matters are present.

In testing for the kind of dressing used, the first point is to determine the amount of moisture in the fabric. This is effected by drying a weighed sample at 100° C. until practically constant, the weighings being performed in a tightly closed receptacle, owing to the hygroscopic character of the vegetable fibres. The difference between the weights before and after drying, gives the loss in moisture, which can easily be calculated to percentages.

The dried sample is then extracted with benzol, or preferably anhydrous ether, to dissolve out the fat, rosin or wax, paraffin, etc., present in the dressing.

The extracts are collected and distilled, in order to recover the solids and determine their nature. The loss in weight during extraction gives the weight of the constituents soluble in ether.

The next thing is to extract the ingredients that are soluble in water, by prolonged boiling, which also detaches from the fibre the insoluble dressing ingredients, the sample being rinsed with boiling water until the latter ceases to run off turbid. The washings are collected and will contain the dextrin, glue, gum arabic, sugar, mucilage, and a considerable proportion of the starch. A portion of the water is concentrated by evaporation, and tested for starch by iodine. If no blue coloration is produced, there is no starch present, and the testing is continued with a two-fold volume of alcohol, which will throw down vegetable mucilage, glue, gelatine, gum arabic, and dextrin. Glue and gelatine are detected by the insoluble jelly thrown down when the original solution is treated with tannin. Gum arabic and dextrin are revealed by the polarimeter: dextrin giving a dextro- and gum arabic a levo-rotation. When both are present, however, no positive reading will be obtainable, and the best plan is to take as a basis the behaviour of pure arabin (the constituent of gum arabic), which is not precipitated by alcohol from neutral solution. If all these tests prove negative, the presence of Carragheen moss may be assumed. Sugar is tested for with Fehling solution, before and after inversion, with pure hydrochloric acid and boiling under a reflux condenser.

To determine the solubles, the acqueous extract is evaporated to dryness and the residue is weighed, bearing in mind that this latter will also contain any soluble mineral matters: alum, zinc chloride, etc., in the dressing. The insoluble residue, left on boiling the sample in water, will contain fragments of starch and flour (chiefly gluten) and insoluble mineral matters (loading and filling ingredients, such as lenzinite, China clay, talc, gypsum, etc.). To detect rosin and shellac, a portion of the fabric is boiled with carbonate of soda, which dissolves out the rosin, the latter being then easily identified.

The residue is tested for the mineral matters by the usual simple chemical tests, or a piece of the fabric is incinerated and the ash examined, the amount of the latter, if more than inconsiderable, indicating whether any further test for loading ingredients is necessary.

Prior gives the following instructions for testing the ash of textile fabrics. The ash is boiled with nitric acid, strong effervescence indicating earthy carbonates. It is then evaporated to dryness on the steam bath, taken up with nitric acid and water, filtered off from any insoluble residue and treated with sulphuretted-hydrogen water. A black precipitate denotes lead. This is filtered off, dissolved in nitric acid, and tested with sulphuric acid, chromate of potash, and other confirmatory reagents. The filtrate is tested for iron with ammonia and ammonium sulphide, and the filtrate from this precipitate tested for barium, calcium, and magnesium, for which purpose the ammonium sulphide is decomposed with hydrochloric acid and the sulphuretted hydrogen expelled, the liquid being neutralised with ammonia and treated with ammonium chloride and carbonate. Any precipitate formed is filtered off, washed, dissolved in dilute HCl and tested with calcium sulphate solution. An immediate precipitate denotes barium, no precipitate indicating calcium, in which case ammonium oxalate is added as a confirmatory test. The filtrate from the ammonium carbonate test (or the original liquid if no precipitate is formed) is tested for magnesium with sodium phosphate.

The ash insoluble in nitric acid may contain silica, from the decomposition of silicate of magnesia or of water-glass, together with barium sulphate, tin oxide, gypsum, or clay, and any undissolved iron oxide. The insoluble is boiled with carbonate of soda, which will dissolve the silica and decompose gypsum. After filtration the precipitate is washed, dissolved in cold, dilute HCl and tested, as above, for iron and calcium chloride. The filtrate is acidified with HCl, evaporated to dryness, and the residue taken up with water and HCl. Any insoluble residue of silica is separated and the filtrate tested for sulphuric acid with barium chloride.

The remainder of the residue, undecomposed by sodium carbonate or insoluble in HCl, may contain barium sulphate, clay or tin oxide, and is dissociated by fusing with 10 parts of sodium carbonate in a porcelain crucible, the melt being treated with sodium bicarbonate and water, and filtered. The washed residue is boiled with strong HCl, and the liquid treated with sulphuretted-hydrogen. A yellow precipitate indicates tin, which is filtered off, and half the filtrate is tested for alumina with ammonia, the other half for barium with sulphuric acid. The filtrate from the melt is treated with HCl and concentrated, to throw down silica, the soluble portion being tested for sulphuric acid with barium chloride.

In this way all the ingredients of the dressing may be determined quantitatively, the chief point, however, being the determination of starch, flour, dextrin, gum, glue, and fats, which is not a very expensive process.

According to Massot we have always to bear in mind, in analysing dressings, the fact that the ingredients may have become decomposed by fermentation or mould fungi. Thus starch may have been partially changed into dextrin or sugar, and these decomposed by fermentation, a similar fate often befalling vegetable mucilage, and destroying its adhesive properties. Soaps are changed by the separation of fatty acids. A more difficult task is the analysis of dressed fabrics, especially when full information is required as to the composition of the dressing, in view of the small quantities left on the fabric in the case of light dressings, and the change that may have been sustained by the ingredients and the fabrics. It is therefore possible that analysis will not give satisfactory results when the fabric has been stored for a long time and under unfavourable conditions. Owing to the various forms in which the subject of analysis may occur, the testing operations will have to be modified accordingly. In all cases there will be two lines of investigation to pursue; the simple testing for inorganic substances and the more difficult determination of organic compounds. A portion of the fabric should always be incinerated in the first place, the ash being tested for silicates, in the form of China clay, water glass, talc, etc. A preliminary examination should also be made for boric acid and large amounts of sodium salts. In the soluble ash constituents, magnesium salts hold the first place. To ascertain the form of combination of the salts, acids should be tested for in the aqueous extract of the dressing, or if this be impracticable, a melt should be prepared by fusing the dressing with potassium-sodium carbonate and saltpetre, the melt being dissolved in water, acidified and tested, chiefly for chlorides and sulphates.

In many cases it is not difficult, after analysis, to reconstitute the original form in which the salts were present, these forms being usually simple. Some value attaches to the microscopical examination of the insoluble sediments and residues left on boiling the dressings in water, or on extracting dressed fabrics. In the latter case, if hot water be used, the insoluble heavy mineral particles will usually settle down quickly on standing, along with organic residues. Tungstates and titanium compounds can be determined by the usual chemical tests.

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