DYEING OF PAPER PULP

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THE

DYEING OF PAPER PULP

BY

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TRANSLATED INTO ENGLISH AND EDITED WITH ADDITIONS
BY

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A Practical Treatise for the Use of Papermakers, Paperstainers, Students and others

WITH ILLUSTRATIONS AND 157 PATTERNS OF PAPERS DYED IN THE PULP

TRANSLATED FROM THE SECOND COMPLETELY REVISED EDITION

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AUTHOR'S PREFACE.

THE first edition, which has been out of print for many years, has undergone a complete revision in the present volume.

The author has endeavoured to make its contents as concise as possible, and suitable for practical requirements.

For this reason a number of dyed patterns with the corresponding recipes have been added, as these are of greater value than written explanation.

The use of the coal tar colours most extensively employed in paper-making is exhaustively dealt with. Special attention has been paid in this work to saving in cost of production, obtaining clear backwaters, and to the behaviour of the colouring matters towards the different kinds of fibres.

JULIUS ERFURT,
Director of the Czenstochau Paper Mill.

January, 1900.

TRANSLATOR'S PREFACE.

THE great success of the first German edition of Erfurt's *Färben des Papierstoffs,* and the fact that the new edition is the only work which is specially devoted to the dyeing of paper pulp, induced me to undertake the translation of this work into English.

The addition of numerous patterns of dyed papers, illustrating the results obtained with the various colours, greatly enhances the value of the book. Twelve new patterns of papers dyed in the pulp, manufactured in England, have been embodied in the English edition.

The full recipes for these as to pulp mixture, colours, etc., are given in the text.

I venture to hope that the translation will not only be of service to practical paper-makers, but also to those students and mill apprentices who may not be able to follow the text of the original.

I have to express my indebtedness to my friend and colleague, Dr. E. Knecht, F.I.C., for his advice and his kindness in reading the proofs.

JULIUS HÜBNER.

MANCHESTER, *November*, 1900.

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THE DYEING OF PAPER PULP.

I. THE PAPER FIBRES AND THEIR BEHAVIOUR TOWARDS COLOURING MATTERS.

PAPER is made almost exclusively from vegetable fibres. In the direct dyeing of paper pulp the same principles are generally observed, according to which textile fibres such as cotton or linen are treated.

The behaviour of the vegetable fibres towards colouring matters differs considerably from that of the animal fibres, such as wool and silk, which are dyed readily without previous preparation. Except in the case of those mineral colours which are fixed direct upon vegetable fibres, fixing agents are necessary for dyeing which are termed "mordants".

The dyeing of paper pulp is not only a question of forming coloured precipitates, but of obtaining, as far as possible, a thorough combination of these precipitates with the fibres, by fixing the soluble colouring matter in an insoluble state on the fibres by means of a suitable mordant.

The mordanting is the preparation of the fibres, and has therefore always to precede the dyeing. There are only a few colours which form an exception to this general rule (direct cotton colours, catechu, etc.).

The vegetable fibres which are generally used in papermaking, such as flax, hemp, jute, cotton, wood, straw and esparto cellulose are rarely used individually. The various fibres which are mixed in the beater have to be all treated in the same manner during the dyeing process, though the fibres may have a different chemical composition and different physical properties, which are not without influence on their behaviour towards colouring matters.

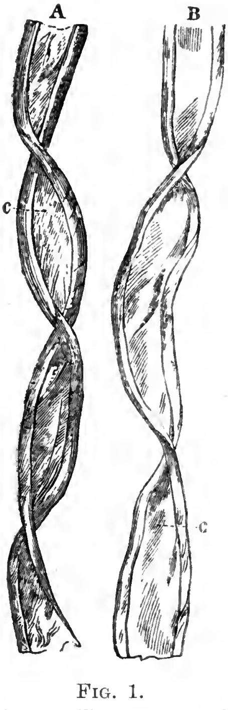


FIG. 1.
Cotton, according to Wiesner, magnified 400 times.
A, in air; *B*, immersed in water; *c*, cuticula.

Cotton.—The chief characteristic of the nearly opaque cotton fibre is its flexibility, which is due to a large extent to its structure. Under the microscope the cotton fibre appears like a flattened, usually twisted, band, the side walls thickened, tubular, and with a slightly developed parenchym. See Fig. 1. (Fig. 999, from Carl Hofmann's *Praktisches Handbuch der Papier-Fabrikation*).

Cotton consists principally of pure cellulose, with a slight admixture of other matters, from which it may be readily freed by boiling with weak alkaline solutions. During this boiling operation the fibres should be entirely covered by the milk of lime, as they are considerably weakened if exposed to the direct steam.

Hot bleaching solution has a similar action, for which reason cotton has to be bleached cold.

Strongly bleached cotton shows a certain affinity for basic colours, probably due to the formation of some oxycellulose during the bleaching operation.

In the manufacture of some filter papers the anatomical structure of the cotton fibre is artificially weakened by freezing the half-stuff. During the freezing the individual fibres are mechanically burst, through which operation the felting properties of the original fibres are considerably altered.

Flax and Hemp.—Under the microscope the bast filaments of the linen and hemp fibres appear as tubes, thick-walled, and with a very narrow central canal. See Figs. 2 and 3 (Figs. 1,002 and 1,003 Hofmann). The flexibility of these fibres is not as great as is the case with the cotton fibre; their strength is, however, remarkable, especially that of the hemp. The cells which are highly incrustated with pectic acid and colouring matters are of a silky white appearance if in a pure state. Boiling with alkaline solutions destroys the brownish colour of the fibres; the pectic acid is converted into metapectic acid, and the fatty matters are saponified.

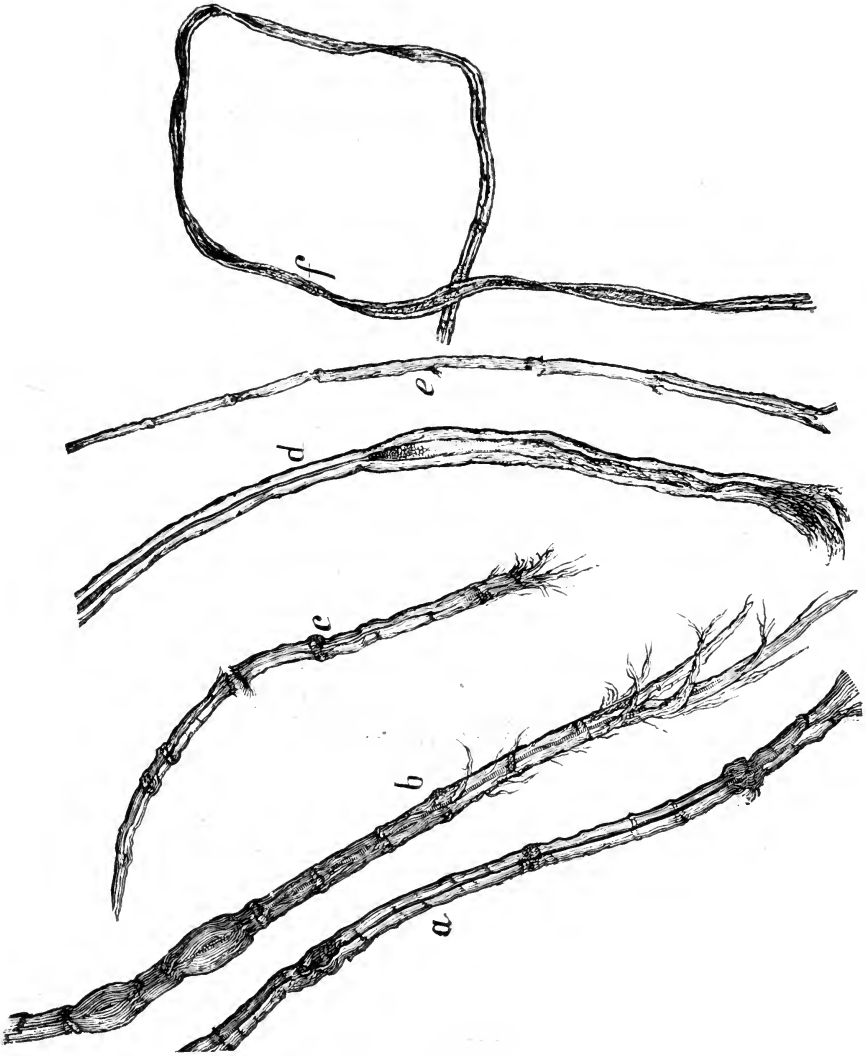


FIG. 2.

Linen fibre from dyed paper, according to Herzberg, magnified 350 times.

Section nearly round; medium diameter, 0·0141 mm. Characteristics: The narrow canal; the fibre is widened in some places, and this repeats itself sometimes at short intervals; the fibre walls are penetrated by numerous pores running from the outside to the central canal (see *a*, *b* and *c*); fibres *b*, *d* and *f* have been subjected to great pressure during the process of manufacture, and appear therefore like cotton fibres.

The remaining light grey colour of the fibres is completely destroyed in the bleaching.

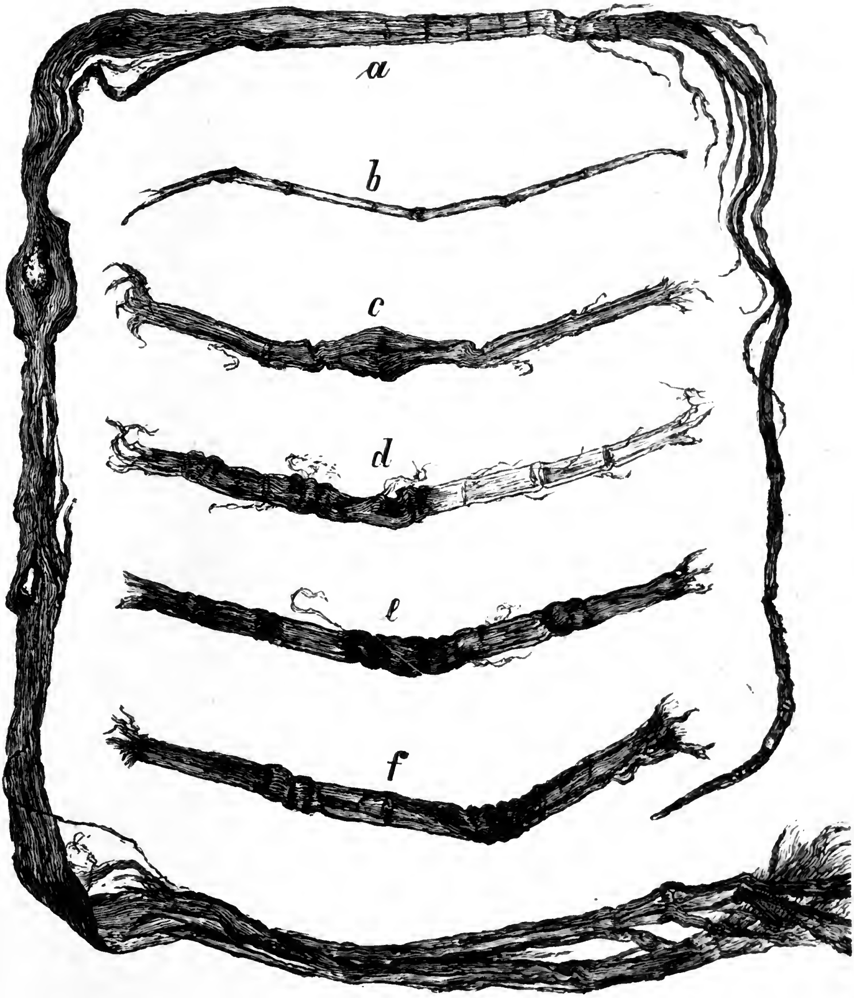


FIG. 3.

Hemp fibre taken from dyed paper, according to Herzberg, magnified 350 times. Similar to flax fibre; thicker; medium diameter, 0·017 mm. Widenings, *f*; bulbs, *c*; frilled ends, *a*; like flax, but central canal narrower; fibres strongly striated lengthways.

Flax fibre is more readily attacked by hypochlorites and by caustic lyes than the cotton fibre, for which reason the concentration of the solutions used in bleaching, etc., has to be carefully controlled.

Flax fibre is not so easily dyed as the cotton fibre: insufficiently separated pectic acid compounds may be the explanation of this.

Esparto (Alpha).—The physical structure of the esparto fibre is very similar to that of flax. See Fig. 4 (Fig. 1,014 Hofmann).

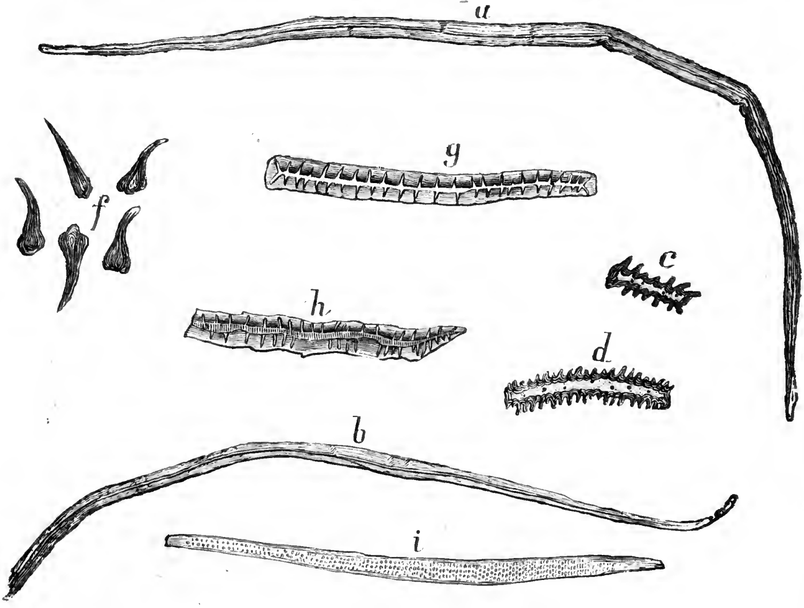


Fig. 4.

Esparto or alpha cellulose taken from paper, according to Herzberg, magnified 350 times.

a and *b*, bast cells; *g* and *h*, sklerenchym elements; *f*, pear-shaped cells from the leaves; *c* and *d*, serrated cuticular cells; *i*, pitted vessel.

Strong, but more elastic than flax; it is extensively used as a substitute for linen rags. Paper made from it appears uniform and translucent and has a nice feel; for which reasons we may place esparto in the front rank of rag substitutes.

Jute.—Jute belongs to the bast fibres, and appears in compact bundles.

The walls of the jute fibre vary in thickness, and the central canal is very narrow in some and considerably wider in other parts. See Fig. 5 (Fig. 1,009 Hofmann).

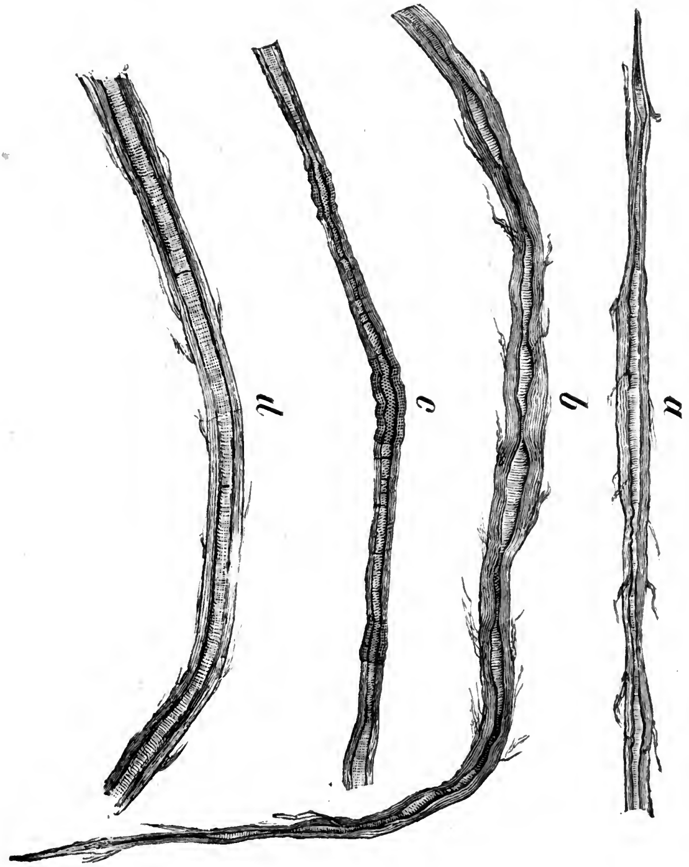


Fig. 5.

Jute fibres taken from dyed paper, according to Herzberg, magnified 350 times. Walls of the fibre vary in thickness; central canal often narrow, sometimes invisible, *a* and *b*; some fibres uniformly thick, *c* and *d*.

The presence of chemical compounds related to the tannic acid series in the jute fibres may give some explanation for the great affinity which this fibre shows towards numerous coal tar colours, especially the basic ones. They dye jute without the use of mordants.

Strong mineral acids destroy the fibre rapidly.

Jute which has been boiled with alkali can only be incompletely bleached with chloride of lime, as the fibre becomes brittle and tender. Better results may be obtained by using sodium hypochlorite in place of the ordinary bleaching powder, and avoiding in this way the formation of insoluble lime compounds.

The process of bleaching is generally conducted in the following way:—

Acid is added to the engine containing the bleaching liquor; the pulp is afterwards washed with the addition of soda lye.

The yellowish colour is then converted into a whiter tone by treating this pulp with sodium bisulphite.

If potassium permanganate is used as a bleaching agent, a 1 per cent. solution will be found sufficiently strong.

It is generally necessary to repeat the bleaching operation.

The loss of fibre is however in every case considerable.

Straw Cellulose.—See Fig. 6 (Fig. 1,013 Hofmann).

The porous bast fibre of straw possesses neither the softness of the cotton nor the strength of the linen fibre, and is therefore of considerably less value as a rag substitute than the esparto. The affinity which straw evinces for colouring matters is very similar to that of jute.

Wood Cellulose and Mechanical Wood Pulp.—The wood fibre, like the jute, if in a pure state, possesses a distinct affinity for numerous aniline colours; the mechanical wood pulp however is short of the qualities possessed by the jute fibre. To fix a mordant on this fibre as on the flax or cotton fibre is impossible, for the simple reason that mechanical wood pulp is always in an incrustated state.

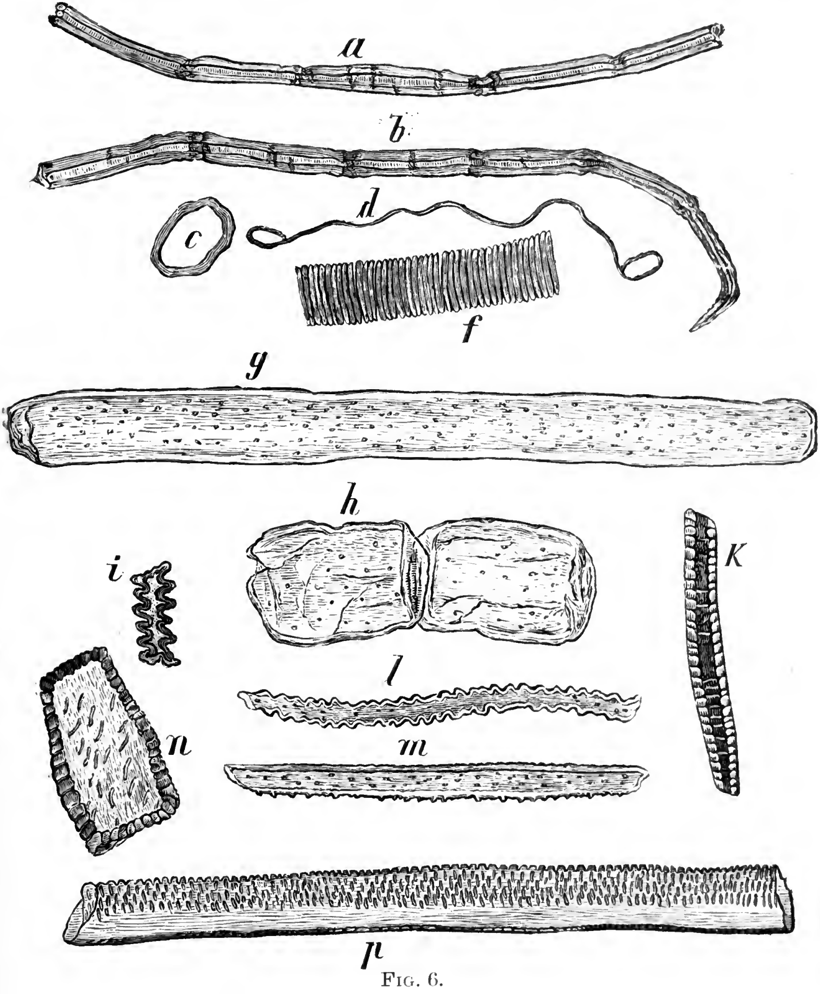


FIG. 6.
Straw cellulose from paper, according to Herzberg, magnified 350 times.
a and *b*, bast cells; *c*, ring; *d* and *f*, spirals; *g* and *h*, cuticular cells; *k* and *n*, sklerenchym elements; *p*, pitted vessel.

Of all the colouring matters, the basic aniline colours are most suited for the superficial dyeing of mechanical wood pulp.

The colour solution penetrates the fibres quicker at a higher temperature.

The beater in which pulp containing mechanical wood is to be dyed should therefore be provided with a steam pipe.

Wood pulp which has been treated in the edgerunner (Kollergang) previous to the dyeing, will take the colours more evenly.

Generally speaking, the following rule will hold good for the manufacture of coloured papers; pure, clear, light shades can only be obtained on well-bleached pulp, whilst for deep dark shades the use of unbleached pulp is more economical, with the exception of deep shades where besides depth, brilliancy is of importance.

Mixed Fibres.—The proportions in which various kinds of fibres are mixed together, as is necessary for the manufacture of certain papers, vary considerably according to the different requirements and the purposes for which the papers are used.

The different affinity of the fibres for colouring matters influences more or less the level appearance of the surface of the papers.

The white loading materials and the mineral colours (earth colours) are in these instances a very useful medium for reducing the contrast of the shades.

China clay, etc., added to the pulp will take up colours very evenly, and after settling in the interstices between the fibres will impart to the shade of the paper surface a level appearance.

To benefit as much as possible by this characteristic of the clay, and to avoid at the same time interference with the mordants used, loading materials are always added after the dyeing, but before the sizing of the pulp.

Only in cases where it is desired to obtain a certain new shade according to pattern, this rule is reversed as far as the trial beater is concerned, for the reason that the shade is altered according to the quantity of the loading material added.

The high specific gravity of some of the loading materials accounts for a certain proportion being lost in the manufacture of the paper.

The loss is, however, considerably reduced by mixing them with farina (potato starch).

Theory of Dyeing.—The changes which take place during the dyeing of the fibres with colouring matters have not yet been fully ascertained. It is impossible to say if the changes which take place are entirely of a mechanical character, or if chemical reactions play a certain part in them. The peculiar affinity which the fibres show towards the so-called direct-dyeing colouring matters no doubt favours the theory that a chemical reaction takes place, whilst the weaker adjective colours, which are fixed by means of mordants on the fibres, have apparently no direct affinity for the fibres.

As far as the dyeing of paper pulp is concerned, it is however impossible to draw a strict comparison between the colours which dye direct and those which dye on mordants, as a number of colours dye vegetable fibres direct, though not producing very heavy shades.

As an explanation of the direct dyeing, the behaviour of cellulose has been compared with the ability possessed by charcoal to absorb colours from their solutions.

It is, however, far more likely that chemical combinations actually take place, due to the stronger affinity of the colour to cellulose than to the liquid in which it is kept in solution.

The number of colours which combine with cellulose is very small.

The chemical relation of cellulose to substantive colours, such as indigo, catechu, annatto, turmeric, and especially the basic aniline colours, is illustrated by the varying depth of colour which paper shows that is made from pulp which has not been thoroughly freed from the intercellular substance.

In the dyeing of adjective colours, the mordant, having the stronger chemical affinity to the colouring matter, plays the *rôle* of the cellulose.

The vegetable fibres are porous cellular tissues, penetrated by central canals of varying diameter, which, like capillary tubes, strongly imbibe liquids.

This physical property of the vegetable fibres is the explanation for the mechanical fixing of colouring matters. If wet pulp is impregnated with the solution of a salt, the salt will be mechanically separated by diffusion, the cell walls acting, so to speak, as dialysers. The acid passes into the water round the cells whilst the base remains behind. The decomposition will be more perfect the better the capillary tubes in the cells have been opened by a thorough treatment of the fibres with alkalies. Cellulose, if prepared in this manner, is able to take up and precipitate a considerable amount of the mordant.

If now a colour solution is added to a pulp prepared thus, providing that oxide deposited in the cells forms a suitable mineral basis for the organic compound contained in this solution, a chemical combination between these two substances will take place, and an insoluble coloured salt will be precipitated in the cells without the chemical nature of these cells being much altered.

The inorganic fixing medium therefore combines, on the one hand, mechanically with the fibres while on the other hand, it forms a chemical compound with the colouring matter contained in the solution, producing in this way a close combination between fibre and colouring matter.

If the oxidising of the mordant is conducted at a higher temperature, the osmotic penetration of the mordant into the capillary opening of the fibres is considerably accelerated. Different mordants will give different results with one and the same colouring matter, and the mordant will have therefore to be chosen according to the shade required.

The prime consideration is, however, the entire utilisation of the colouring matter; a distinctly coloured backwater indicates that the colouring matters have not been sufficiently fixed on the fibre. It must not, however, be forgotten that the suction boxes always extract part of the mineral colour and of the coloured loading materials, from which the backwater will appear coloured

Pulp intended for dyeing should always be thoroughly washed to free it from bleaching residues before the mordant is added.

It is clear that the mechanical decomposition on the fibre of the chemical compounds used as mordants does not take place instantaneously, and that a certain amount of time is required to convert the soluble into insoluble compounds. Sufficient time should therefore be allowed for the mordant to penetrate the pulp thoroughly before the colour solution is added. The kind of mordant most suitable depends principally on the chemical characteristics of the colouring matter for which it is intended. The various combinations are so numerous that practical experience alone will tell, whilst theoretical rules would be of little use.

Colours in a fully developed state are called substantive or monogenetic colours; by using their solution the same shade is always obtained, either weaker or stronger, because they consist entirely of the pure colouring matter (methyl green, ultramarine, indigo, etc.)

As adjective or polygenetic colours, we consider substances containing colouring matters, the solutions of which we have to treat by chemical means to form the actual colour (vegetable lakes, etc.) All the adjective colouring matters behave towards mordants like acids; they form with metallic oxides or basic metallic salts insoluble precipitates on the fibre.

Of neutral lakes only a very limited number is known, and they are of no value for the dyeing of paper pulp. As mordants for colours of an alkaline nature, acids or salts, the acid of which possesses a stronger affinity to the colour than to the base of the salt, are suitable.

The importance of tannic acid materials as mordants is based on the property of the vegetable colours to absorb and fix tannic acid.

Tannic acid acts as a powerful fixing agent for both organic and inorganic basic colours.

In many cases an absolutely insoluble colour precipitate is formed by neutralising the tannic acid bath.

This is of great importance for the dyeing of fibres which are used for mixing in with white or light coloured papers.

The knowledge that acid colours may be used as fixing agents for certain basic colours has led to their being used extensively as mordants. Coal tar colours which form no precipitates with metallic salts, and which are not fixed in the fibres when the pulp is acidulated, are of no value for the dyeing of paper pulp.

Only few colouring matters dye the vegetable fibres direct (turmeric, safflower, annatto).

The soluble azo compounds, known as benzidine colours, which belong to the group of direct dyeing colours, are most of them not fast to light, and some of them change with acids; their principal use is for unsized papers.

As already mentioned, if china clay is added to the paper pulp a more evenly dyed paper is obtained. This is explained by the following: If a solution of a basic colour, *e.g.*, magenta, is mixed with china clay, the latter will take the magenta from the solution and will be coloured red. A colour lake, insoluble in water, is formed, which is probably the result of a chemical combination between the two substances.

This property of the china clay, ochre, etc., is utilised in the manufacture of paints.

The after treatment of the so-called loading materials with the resin soap and aluminium sulphate precipitates the colour completely.

This is another instance which shows the important part which the sizing with resin plays in the manufacture of coloured papers.

The sizing animalises the pulp; that is, the fibre surrounded by the finely divided resin obtains the valuable property possessed by the animal fibres to fix more or less numerous colours without the application of a mordant.

The bulk of the cheaper coloured papers which are put on the market no doubt owe their origin to this fortunate circumstance.

It depends on the chemical characteristics of the colouring matter of either vegetable, animal, or mineral origin whether a mordant of a basic, acid, or of a salt-like character should be used.

The colour acids, especially those contained in the dyewoods, form insoluble coloured lakes with acid aluminium salts, and with the oxides of tin, iron and copper. For this reason these oxides are extensively used for the fixing of the colours of logwood, brazil-wood, fustic, cutch, etc.

The colour contained in these woods is, however, not an acid body, but is only formed into one by exposure to the oxygen of the air.

In the wood itself the colour is not present as an acid, but in an indifferent capacity.

Of the greatest importance as mordants for coloured papers are the acid salts of alumina, which, on account of their simple application and their affinity to numerous colouring matters, are very extensively used.

II. MORDANTS (COLOUR FIXING AGENTS).

ALUM.

UNDER this name we understand generally the double salts resulting from the combination of aluminium sulphate with an alkaline sulphate. There are various such compounds which have an analogous composition.

As mordant, potash alum is almost exclusively used; it contains about 11 per cent. of Al_2O_3.

Alum crystallises in colourless octohedra or cubes. The latter quality is preferred to the former, which frequently contains traces of ferric oxide, which has an injurious action on many colouring matters. The simplest test for the presence of iron in alum is the following: An ounce of powdered alum is dissolved in a beaker containing hot distilled water or pure rain-water, and then 30 to 40 grs. of yellow prussiate added. If a blue precipitate is formed after a short time, it will indicate that the alum contains iron, which will render it unsuitable for red and yellow shades.

The octohedral alum may be readily converted into the cubical in the following manner: Potassium carbonate is added to a solution of ordinary alum saturated at 122° F., when a precipitate of basic aluminium sulphate is formed, which however dissolves again by stirring the solution.

If this solution is allowed to cool, the alum will crystallise out of it in cubes without its chemical composition having altered.

Cubical alum is free from iron, for the reason that it crystallises only from solutions containing an excess of alumina.

The cubical form of the alum may therefore be considered a guarantee of its purity.

Potash alum is soluble in 80·4 parts of cold water, requiring however only 0·75 parts of boiling water for its solution.

Alum which has been stored for a considerable time in a dry place loses some of its water of crystallisation, its value thus depreciating.

The strength of alum or other solutions of salts is ascertained by means of the Twaddle hydrometer.

By adding potash and chalk to a solution of alum in water in the following proportions neutralised alum is obtained :—

12 parts of alum.
1 part pearlash.
3 parts chalk.

On adding a solution of neutralised alum to paper pulp a decomposition takes place, by which alumina remains as an insoluble substance on the fibre.

ALUMINIUM SULPHATE.

Sulphate of alumina is comparatively cheaper and contains a higher percentage of alumina than alum, for which reasons it is now more extensively used as a mordant.

In commerce aluminium sulphate occurs in the form of blocks or of irregular lumps, the purity of which varies.

Of principal importance is the absence of ferric oxide, ferrous oxide and free acid.

Aluminium sulphate is the raw material for all the aluminium mordants, as it is readily decomposed by alkali.

ALUMINIUM ACETATE.

Under this name we do not mean the aluminium acetate prepared by dissolving aluminium hydrate in acetic acid, but a combination of pure aluminium acetate with other salts, which possesses either basic or neutral properties.

The simplest method for the preparation of aluminium acetate is to mix solutions of 3 parts by weight of aluminium sulphate (15 to 16 per cent.) and 2 parts by weight of sugar of lead. The precipitate is allowed to settle, and the necessary quantity of the clear liquor added to the pulp.

Excess of acid will prevent the colours from fixing on the fibres.

To neutralise the free acid, an addition of 5 to 6 per cent. of soda crystals of the weight of the aluminium sulphate is recommended.

TIN CRYSTALS (STANNOUS CHLORIDE).

Ordinary tin crystals is a compound of tin and chlorine corresponding with stannous oxide. Stannous salts are of no importance as mordants; they change when exposed to the air by absorption of oxygen. If tin is dissolved in hydrochloric acid at an elevated temperature hydrogen is evolved, and crystals containing about 50 per cent. of tin are separated out.

Stannous chloride is readily soluble in water; the solution absorbs oxygen from the air. After standing for a time a white powdery precipitate is formed, consisting of basic chloride, which can be re-dissolved by adding hydrochloric acid; it is therefore recommended to add tin crystals to the beater without dissolving them previously.

Stannous chloride added to solutions of ferric or cupric sulphates will take part of the oxygen from the oxides and convert them into a lower state of oxidation. For this reason it should never be used in conjunction with these two salts.

Stannous chloride has a tendency to brighten various colours or to modify shades in conjunction with other mordants, for which purpose it is principally used.

The artificial organic colouring matters have, however, substituted these colours, in so many cases that tin mordants are scarcely now in use for dyeing paper pulp.

Brilliancy and purity of shade can now be obtained far cheaper and better by using suitable coal tar colours.

For the dyeing of some of these colours, especially the resorcin, acid and nitro colours, combined tin mordants may be effectively employed.

The most usual combinations are: Stannic chloride and alum, stannic chloride and aluminium sulphate or acetate, sodium stannate and neutralised alum or aluminium sulphate or acetate.

In conjunction with sugar of lead or with tannic acid tin crystals are used for some of the basic coal tar colours.

More detailed explanation in what particular cases these mordants are used will be found under the dyeing instructions given for the various colours.

COPPERAS (FERROUS SULPHATE).

Oxide of iron forms dark-coloured compounds with the colour acids. Its special use is for precipitation of colours like logwood and catechu, and for the saddening of basic coal tar colours, such as methylene blue, brilliant green, malachite green, etc.

As iron mordants for low-class papers a solution of ordinary copperas is used. Copperas is formed by dissolving iron in sulphuric acid. On the large scale, however, it is manufactured from pyrites.

Commercial copperas consists of green monoclinic crystals, which in places show a rusty appearance, due to precipitation of basic ferric sulphate.

Before using copperas it is advisable to boil the solution with clean iron borings, as this will prevent the formation of white powdery precipitates in the paper pulp.

Ferrous sulphate has an astringent metallic taste, and possesses a peculiar sweetish sickly smell.

The quality of the commercial article varies considerably. A good quality should be free from zinc, alum, but especially copper.

The presence of the latter is easily detected by putting a polished steel knife into the copperas solution; if any copper is present the knife will become coated with copper.

Copperas solution as used for the saddening of shades is best added after the colour solution has been run into the beater, so that its decomposition takes place after the fibres have been thoroughly saturated with the colour solution.

Copperas is extensively used for the production of iron buffs on paper pulp.

More important iron mordants, especially for dyeing black with logwood, are the nitrate and the acetate of iron. The colouring matter of logwood (hematine) forms the darkest precipitates with these two iron mordants.

The shade of black produced by nitrate of iron is of a brownish hue, whilst that produced by the acetate of iron has a bluish cast.

Iron mordants act as loading agents of the pulp, a fact which is of great importance in the manufacture of black papers, as light-coloured loading materials cannot be added on account of the large amount of colour they would absorb. It would therefore be necessary to add mineral blacks, which, however, are far too expensive.

The loss of these specifically heavy mineral blacks on the wire of the paper machine is considerable; the depth and brilliancy of the adjectively formed logwood black is besides detrimentally influenced by their addition.

It is, therefore, not necessary to try to save by reducing the quantities of the iron mordants added to the pulp, as all the iron is precipitated on the fibre, the colour is deepened, and the gaining in weight amply repays their cost.

NITRATE OF IRON (FERRIC SULPHATE).

A good nitrate of iron is produced by gradually adding—

15 parts copperas

to a mixture of—

6 parts water.
2 parts sulphuric acid, 168° Tw.
3 parts nitric acid, 64·0° Tw.

A large glazed earthenware vessel, which should be only filled about one-third by the acid mixture, is best used for this purpose.

Care has to be taken to add the copperas gently and gradually to the acid. If too large a quantity is added at the time the reaction may cause the liquor to run over, thus incurring a loss.

It is necessary to stir the solution frequently, and the vessel should be connected with a suitable flue to take away the dangerous nitrous fumes, which are formed during the reaction.

Copperas is again added when the expulsion of gas slackens.

The liquor is boiled for a few hours with live steam, after all the ferrous sulphate has been added to complete the reaction by expelling all the remaining nitrous acid gas.

When the boiled solution becomes clear, it is necessary to add some clean iron borings, to convert part of the ferric oxide into ferrous oxide.

If this is omitted, paper mordanted with ferric oxide will show a white precipitate, which sometimes appears in considerable quantities, and causes much waste. The formation of these specks is caused by the precipitation of neutral anhydrous ferric sulphate, which is a white powder, and a certain amount of ferrous sulphate is always necessary to keep the neutral sulphate in solution. This excess of ferrous sulphate, on the other hand, detracts from the solubility of the basic ferric sulphate; and for this reason it is necessary to dissolve the copperas only gradually.

The iron mordants used in the trade contain generally nearly all the same amount of oxide of iron and sulphuric acid, but only small quantities of nitric acid.

An excess of iron in the manufacture of the mordant is of little consequence.

An excess of strong acid, such as sulphuric and nitric acid, must, however, be carefully avoided, as this may cause weakening or even destruction of the vegetable fibres.

In any case, it is to be recommended to either wash the mordanted pulp or neutralise with a little potash solution before the colouring matter is added, especially if the pulp has been previously mordanted with tannic acid, as the precipitated oxide of iron cannot be removed from the fibres by simply washing.

ACETATE OF IRON (BLACK IRON LIQUOR, PYROLIGNITE OF IRON).

By using acetate of iron in combination with tannins instead of the nitrate, superior blacks may be obtained on paper pulp. Black iron liquor is manufactured by dissolving scrap iron in pyrolignic acid. The material best suited for this purpose is clean old sheet iron.

To be certain that a complete saturation of the pyrolignic acid has taken place, an excess of iron is used.

The tannins best suited for the fixation of this mordant are catechu and quercitron bark, as both add considerably to the depth of the black obtained with logwood.

Though nitrate of iron is cheaper than the pyrolignite, the latter is more suited for the purpose, because its dark colour means a saving in the more expensive colouring matters.

The gain in weight through the iron precipitated in the pulp depends upon the amount of tannins used.

Black iron liquor generally comes into the market at a strength varying from 12° to 28° Tw.

It is more economical to buy the strongest liquor obtainable, to save carriage, and to avoid the addition of too large a quantity of liquor to the pulp.

With the weaker liquors it would be in many cases impossible to find sufficient room in the beater for the large quantities which necessarily would have to be used.

ACTION OF TANNIC ACID.

By fixing iron mordants with tannic acid, compounds of a dark grey colour are formed, which act saddening on other colours.

They are, however, also useful as self colours.

The great affinity of tannic acid to the vegetable fibres explains the importance of materials containing tannic acid for the production of fast, insoluble colours.

The tannic acid thoroughly mixed with the pulp brings about the decomposition of the other salts which are employed as mordants.

The developing and fixing of the inorganic bases, such as alumina, oxides of tin and iron, which form suitable mordants for colours of an acid character, is in this way strengthened.

On the other hand, tannic acid as a mordant may be used for the precipitation of basic colours, the tannic acid replacing the acid of the colour.

To render the colour compound formed on the fibre as insoluble as possible, it is advisable to neutralise the acid liberated.

In the case of basic coal tar colours, it is preferable to neutralise by forming an insoluble compound of the tannic acid and a metallic salt (tannic acid antimony mordant) instead of using common soda.

Generally speaking, it is of little importance which tannic acid materials are used as a mordant, as long as they do not act as colours themselves.

The quantities used have, however, to be in proportion to the amount of tannic acid which they contain.

An excess of tannic acid tends to make the insoluble lakes formed with basic colours again partly soluble.

Percentage of tannic acid contained in various materials :—

Catechu	42-54 per cent.
Nutgalls	60-65 ,, ,,
Elmbark	about 30 ,, ,,
Young willowbark	barely 5 ,, ,,
Young oakbark	barely 20 ,, ,,
Sicilian sumac	20 ,, ,,

MORDANTING OF PAPER PULP WITH TANNIC ACID.

The raw material containing tannic acid is well disintegrated and then boiled for half an hour with pure water (1 lb. of sumac boiled in about 1 gallon of water). The liquor is then filtered.

For 100 lb. of dry pulp the addition of 5 to 6 lb. of sumac containing 19 per cent. tannic acid is generally sufficient. In combination with iron mordants, 12 oz. of nutgalls or 3 lb. of oakbark will be found to suffice.

For the dyeing of blacks those materials are generally chosen which contain, along with the tannic acid, a colouring matter that will assist in the production of deep full shades (catechu, quercitron bark, etc.).

The quercitron bark extract must not be cleared with glue as the quercitannic acid would be thrown out of solution by the gelatine.

The mordanting of the pulp with tannic acid is generally done in the beater or poacher with the application of heat.

After the half-stuff has been thoroughly washed the tannic mordant is well mixed with it.

The pulp is then run into a draining chest which has been previously closed and allowed to remain in contact with the tannic acid solution for 18 to 24 hours. During this time the half-stuff absorbs nearly all the tannic acid, and is now prepared for the further treatment with iron mordant.

Sufficient iron liquor is added until the liquid in the beater shows a strength of 0·6° to 1·4° Tw.

For the fixing of basic coal tar colours the tannic acid solution is added in the beater and then fixed with tartar emetic ($\frac{1}{2}$ lb to $\frac{3}{4}$ lb. per 100 lb. of dry pulp) or tin spirits.

The same result may be obtained by adding glue solution after the tannic acid; a precipitate is readily formed and fixed on the fibres.

For hard-sized papers the glue and tannic acid precipitate is a better mordant than the tannic acid and tartar emetic precipitate. Glue is preferable to the sparingly soluble tartar emetic, which must always be used in excess.

BLUESTONE (SULPHATE OF COPPER).

Oxide of copper is also used to act on the colour acids of logwood and catechu.

To produce oxide of copper on the fibres, copper sulphate is generally employed.

It forms a blue-coloured compound with hematine, in a similar manner in which the black compound is produced by using oxide of iron.

The commercial bluestone contains mostly small quantities of ferrous sulphate, an impurity which is, however, of no detrimental influence on its quality as a mordant.

Bluestone is manufactured from copper ores. It is soluble in two parts of boiling or four parts of cold water.

Oxide of copper forms with hematine an insoluble blue-coloured compound, which, however, is only of value for dyeing pulp used for unsized papers, as the blue colour changes into violet again on addition of alum or aluminium sulphate.

Bluestone is mostly used in conjunction with copperas, bichromate of potash, or with copperas and chromate of potash.

Oxide of copper in combination with oxide of iron and chrome produces browns, blacks, and other so-called mode shades (drabs, fawns, etc.).

POTASSIUM BICHROMATE (BICHROME).

Of all the compounds of chromium with oxygen, the one which is isomorphous with alumina and ferric oxide is of the greatest importance as a mordant on account of its fastness to alkalies and acids, and on account of the fastness of the colours which are produced on the chromium basis.

For the production of oxide of chromium on the fibres a solution of potassium bichromate is used. The product obtained by treating potassium chromate with acid is potassium bichromate, which crystallises out of the solution in yellowish red crystals, containing no water of crystallisation.

Ten parts of cold, or a considerably less quantity of hot water is required for dissolving this salt.

Potassium bichromate is principally used for the oxidation of catechu previously absorbed by the fibres. Insoluble brown colours are in this way produced in the pulp. It is further used as a fixing agent in combination with the oxides of iron and chromium in the dyeing of mode shades.

The name of *mode shades* is given to colours which do not belong to any distinct class of shades, as, for instance, the various combinations of browns and greys, such as the brownish grey, yellowish grey, bluish grey, reddish grey, etc.

Such shades produced with catechu possess a remarkable fastness.

By using potassium bichromate and copper sulphate along with basic colours (chrysoidine, Bismarck brown, etc.) their fastness to light is improved. For the same purpose copper sulphate by itself may be used.

The most valuable property of chromium oxide is that even small quantities produce rich deep shades of remarkable fastness.

SODIUM BICHROMATE

is often used on account of its low price instead of potassium bichromate.

It replaces the same in many cases for the production of chrome yellow and as an oxidising agent.

Sodium bichromate should be stored in a dry place.

Besides tannic acid, which is used either as a mordant or as a fixing agent for mordants, the following substances are used for the fixing of mordants :—

CHALK (CALCIUM CARBONATE).

For the precipitation of aluminium mordants.

SODA CRYSTALS (SODIUM CARBONATE).

For the fixing of the acid iron mordants.

TARTAR EMETIC (ANTIMONY POTASSIUM TARTRATE).

To form precipitates with tannic acid solutions.

III. INFLUENCE OF THE QUALITY OF THE WATER USED.

One of the most important necessities for the manufacture of paper is a pure soft water. Spring, well and rain water contain frequently mineral and vegetable impurities depending on the strata through which the water passes. Ordinary vegetable impurities which are distributed in a finely-divided state in the water, and which appear as spots on the surface of the paper, have only very little influence on mordants and colours. Inorganic impurities, such as iron, lime, magnesia, are mostly found in spring and well water. These may act on both mordants and colours, and are often the causes of bad shades.

So-called hard water nearly always contains sodium carbonate, lime and magnesia in solution; these salts act as neutralising agents on aluminium and iron mordants, and may cause the formation of insoluble compounds with the tannic acid lakes of colouring matters.

In the shape of bicarbonates they influence the yield by partial precipitation of the basic coal tar colours (brilliant green, malachite green, magenta, methyl violet, Bismarck brown, etc.) and of the natural vegetable colour lakes (logwood excepted).

Water possessing considerable hardness is therefore treated with acetic acid before use.

The detrimental influence which bicarbonates of iron have on the bleaching of half-stuff is well known.

A precipitate of brownish oxide of iron is formed which injures the purity of light shades.

Water containing humic acid after it has been in contact for some time with iron has a similar action.

The purification of river water which has been poluted by effluents coming from dye-houses and wool scouring places, etc., situated above the paper mill, presents exceptional difficulties. The chemical composition of these effluents varies constantly, and if the quantity of water in the river is not sufficiently large, it will under these circumstances be of no use for a paper mill.

The arrangements for the mechanical purification of water are well known. Frequently the mistake is made that they are constructed too small, or a number insufficient for the amount of water required is erected.

Previous to the filtering of the water it should remain for some time in a large tank, so as to allow the heavier impurities to settle. The filters will then last for a considerably longer time.

These cleaning tanks will prove especially useful during heavy rains and during heavy thaws.

The utility of these tanks may be considerably improved by fixing partitions in such a way that the water is compelled to rise frequently; this will greatly facilitate the settling of the heavier particles.

The extensive sand filters, which were formerly in use, and the cleaning of which was a tedious and expensive operation, will now only be found in a few mills.

More extensively used are the filtering arrangements in which the gravel is cleaned by means of agitators and a strong current of water, or where by means of air compressors and a back current of water the gravel is thoroughly agitated and cleaned. With either of these arrangements the filter can be used again after a few minutes without interruption of the filtering process.

To purify water completely, an addition of aluminium sulphate is nearly always necessary.

The amount of aluminium sulphate required for this purpose is dissolved in water to the strength of 2° to 4° Tw.

This solution is then added by means of a bucket-wheel to the water which has to be filtered. To regulate the inflowing amount of this solution, the small bucket-wheel is directly driven by the stream of water coming from the pumps.

The quicker the flow of water the more rotations the bucket-wheel will perform, and correspondingly a proportionate larger quantity of aluminium sulphate will be added or *vice versâ*.

The processes which are mostly in vogue for the softening of hard water are nearly all based on Clark's method, that is, the carbonates of magnesia and lime are only soluble in water, which contains free carbonic acid gas, which it is necessary to bind, so as to accomplish the precipitation of the carbonates.

Clark's original method by which lime-water is used for this purpose has been lately considerably improved upon, one of these new processes being that of Gaillet Huet.

It consists of an apparatus specially constructed for this purpose, and in the use of soda lime solutions. It is absolutely necessary in every case to analyse the water which is to be purified, so as to ascertain the exact amount of lime and soda required.

IV. INORGANIC COLOURS.

1. ARTIFICIAL MINERAL COLOURS.

IRON BUFF.

To produce iron buff (oxide of iron) a solution of ferrous sulphate (copperas) is added to the pulp, the amount varying according to the shade required, which ranges from the very lightest to the deepest buff.

By means of the after treatment with an alkaline solution (for 4 parts copperas 1 part lime, or for 2 parts copperas 1 part ammonia soda) ferrous hydrate is precipitated.

Both solutions may be mixed together and then run into the beater, but care has to be taken that no colour is lost, as the reaction may cause the liquor to run over.

The pulp appears first of a dull green shade, which, however, during the run in the beater, coming in contact with the air, is soon converted into a buff.

The conversion into ferric hydrate may be accelerated by the addition of chloride of lime solution, a procedure which is often desired if a shade has to be dyed exactly to pattern.

If it is necessary to produce the colour rapidly, nitrate of iron is used in place of the ferrous sulphate. The ferric hydrate is formed immediately on the addition of a small quantity of milk of lime, no further oxidation with bleaching powder being necessary.

Iron buff is a cheap colour, absolutely fast to light and alkalies, but not fast to acids. In nature it occurs as brown iron ore.

Frequently the pulp, which has been dyed with iron buff, is afterwards topped with earth colours, especially with ochre. Various shades may be obtained in this way, and uneven pulp mixtures may be somewhat covered.

MANGANESE BRONZE.

If, as shown in the case of the formation of iron buff, a strong base (alkali) meets a salt which consists of a combination of a metallic oxide and an acid, the latter will combine with the alkali as the body for which it has the greater affinity, whilst the metallic hydrate is liberated.

This reaction is used in the dyeing of dark browns which result from the precipitation of manganese hydrate on the fibres in a fine state of division.

By exposure to the air the manganese hydrate takes up oxygen and is soon converted into a dark brown layer of hydrated peroxide of manganese.

For the purpose of precipitating manganous hydrate as a deep brown powder on the fibres, the liquor obtained from the chlorine stills (manganese chloride, bronze liquor) is used on account of its cheapness.

The pulp is first thoroughly impregnated with the solution of the manganese salt, after which caustic soda solution is added. The oxidation may be accelerated by adding a small quantity of sodium hypochlorite.

Manganese bronze is remarkable on account of its fastness to light, acids and alkalies.

Manganese hydrate in combination with peroxide of manganese occurs naturally and is known as "manganite". This colour is frequently used, especially for inferior papers, in combination with other natural mineral colours, such as umber, etc.

Manganese bronze is used as a bottom for other brown mineral colours in the same way in which iron buff is used as a bottom for ochre.

CHROME YELLOW (LEAD CHROMATE).

The production of mineral colours on paper pulp depends on the mutual decomposition of two salts, that is, the fibres are impregnated with a soluble compound of a metallic base and an acid; the metallic oxide is then converted by means of another metallic salt into an insoluble salt, the stronger acid of the second salt supplanting the weaker one of the first. Chrome yellow is a compound of chromic acid and oxide of lead, in which the lead oxide plays the *rôle* of a mordant, the chromic acid that of a colour.

To form chrome yellow on the fibres the paper pulp is first impregnated with nitrate of lead or acetate of lead (sugar of lead), and after this a solution of either potassium bichromate or of the cheaper sodium bichromate is added. Lead oxide is precipitated on the fibres, the nitric or the acetic acid forming with the alkali of the bichromate a soluble salt, whilst, at the same time, the stronger chromic acid combines with the lead oxide forming chromate of lead.

The dyeing with solutions of lead and alkaline chromates is at present extensively used in paper mills for the production of various yellow and orange shades.

Lead salts are dangerous poisons. They are readily soluble in cold water, heating is therefore not necessary. The use of chrome yellow is limited on account of its poisonous character.

The sulphide of lead (galena), which occurs in nature in cubical crystals, corresponds with the lead oxide which combines with acids to form neutral salts. Sulphide of lead is decomposed by strong hot nitric acid, free sulphur is to a large extent separated, and the lead is converted into soluble nitrate of lead. Nitrate of lead often contains copper.

The acetate of lead, known in commerce under the name of "sugar of lead," is a neutral acetate of lead which is manufactured by dissolving litharge either in acetic or pyrolignic acid, filtering and afterwards evaporating the liquor. It crystallises in clear monoclinic prisms which are purified by recrystallisation. One part of sugar of lead is soluble in 1½ parts of cold water.

Chrome yellow, as sold in commerce, is not always free from adulterations, such as baryta, chalk, china clay, etc. It is certainly safest and best to produce the colour in the pulp. A pure yellow can only be obtained on a bleached pulp. The acid remaining in the pulp after bleaching should be removed either by a careful washing of the pulp or by neutralising. The fixing of the colour on the fibres and the evenness of the shade will be improved if the chrome yellow has been produced in the pulp. The pulp is impregnated with the cold solution of the lead salt shortly before the sizing, then allowed to run for ten minutes, after which time the cold solution of sodium bichromate is added.

To produce a very pure yellow heating of the pulp must be avoided, and the size as well as the aluminium sulphate have to be added cold. Alkalies have to be carefully avoided, as traces suffice to darken the shade. In case the water which is used for dissolving contains lime or traces of carbonic acid, it will be necessary to acidulate the sugar of lead solution with a little acetic acid to avoid the formation of insoluble basic lead carbonate.

According to the use of stronger or weaker colour solutions, all the various shades of yellow, from a pure canary to a light sulphur yellow, may be obtained.

The following proportions should be adhered to in the dyeing of this colour: 3 to 4 parts of lead salt to 1 part of chromium salt.

To avoid irregularity in shade in the manufacture of paper dyed with chrome yellow, it is advisable to add part of the aluminium sulphate required for the sizing to the dyed pulp before the rosin size. Chrome yellow is perfectly fast to light, but is destroyed by hydrochloric acid. Chromate of lead is found in nature as red crystals belonging to the monoclinic system.

CHROME ORANGE (BASIC LEAD CHROMATE).

Pulp dyed with chrome yellow is converted into chrome orange by adding 2 parts of caustic soda to the 5 parts of sodium bichromate, or by treating it with hot milk of lime. The neutral chromate of lead is partly converted by the action of the alkaline solution into the basic compound.

The steam, by means of which the pulp in the beater is heated for this purpose, is shut off as soon as the shade required is obtained. The pulp is then immediately washed with cold water.

Aluminium sulphate changes the orange back into chrome yellow, as the orange does not stand the sizing of the pulp.

Chrome orange is basic chromate of lead. The base the oxide of lead, must always be in excess during the dyeing of this colour, and it is, therefore, necessary to replace the neutral oxide of lead partly by basic lead acetate.

The colour is poisonous, and not suitable for sized papers. If it is desired to produce light bronze shades which resist the sizing, chrome orange is replaced by topping pulp, previously dyed with chrome yellow, with red lead.

RED LEAD.

Red lead as sold in commerce is not an uniform compound of lead and oxygen, but a mixture of oxide of lead and peroxide of lead, made by heating oxide of lead in a furnace.

Various orange shades, fast to light, may be obtained by topping pulp dyed with chrome yellow with red lead. To obtain perfectly level shades, it is necessary to use the red lead very finely ground. The commercial article is specially suitable for this purpose. Before adding it to the pulp it should be boiled in pure water for a few minutes. If red lead is used by itself it is advisable to prepare the pulp previously with sulphate of zinc.

Used in small quantities, red lead dyes a faint flesh pink which is fast to light, and which is well suited for note and card papers.

The colour is not suitable for heavy yellowish red shades. Red lead is specifically heavy, and the quantity required of it (30 to 40 lb. per 100 lb. of pulp) is so large that especially for thinner papers a very strong pulp mixture would be necessary; the shades obtained are always warmer and fuller if pulp slightly bottomed with chrome yellow has been used. If inferior qualities of red lead are used, there is always the danger of numerous red specks appearing on the surface of the paper, due to the colour not being sufficiently ground.

Chrome orange and red lead can now be entirely dispensed with, their place being taken by numerous coal tar colours in the market, which are sufficiently fast to light, and by means of which the same result may be obtained at less cost.

CHROME GREEN

is produced by adding blue (Paris blue, Prussian blue, ultramarine) to a chrome yellow dyed pulp, or by mixing both colours together before the dyeing. It is principally used for note paper. It will often be noticed in a paper dyed with chrome green that one side is considerably darker than the other. This is avoided by adding a suitable alumina mordant before the Prussian blue, and by reducing the action of the suction boxes on the moist web as much as possible.

BLUE WITH YELLOW PRUSSIATE.

The use of this product for the dyeing of blue shades on paper pulp has been greatly limited by the numerous blue coal tar colours. It is, however, still extensively used for the dyeing of a bottom which is afterwards topped with water blue, with the object of increasing the fastness of the latter.

In the neutral state it is, however, also used as a self colour for the dyeing of full fast shades. Yellow prussiate forms yellow crystals soluble in about twice their weight of water.

The characteristic reactions of iron and prussic acid are no longer noticeable in this double compound.

By adding a solution of potassium ferrocyanide to one of a metallic salt the potassium is replaced by an equivalent quantity of the metal in solution, with the formation of a new ferrocyanide.

Ferrous salts form a white precipitate with potassium ferrocyanide, which, if exposed to the air, rapidly turns blue (Prussian blue).

Prussian blue is an organic compound, but as it contains iron it is classed among the mineral colours. The quantities necessary for the decomposition of the yellow prussiate with ferrous sulphate can only be ascertained by means of trials.

The figures obtained by calculation from the chemical formulæ are of no use for practical work.

Yellow prussiate is considerably higher in price than ferrous sulphate. The reaction is therefore always conducted so as to show an excess of iron, whilst any excess of ferrocyanide is carefully avoided.

For the formation of the colour, 1 part of copperas is sufficient for 1 part of yellow prussiate.

In practical work it is, however, better to be on the safe side, and to use 3 parts of copperas to 2 parts of yellow prussiate.

PRUSSIAN BLUE.

To produce this colour on paper pulp it is necessary to dye the fibres first with iron buff as described above. The colour is then developed with a cold solution of potassium ferrocyanide and afterwards soured with sulphuric acid in the proportion of 1 part of sulphuric acid, 168° Tw., to 2 parts of potassium ferrocyanide.

The deeper the iron buff bottom, *i.e.*, the more oxide of iron has been precipitated on the fibres, the fuller will be the blue developed on the fibre.

To develop Prussian blue in the pulp the following proportions should be used :—

3 parts copperas.
2 ,, yellow prussiate.
1 part sulphuric acid, 168° Tw.

A more indigo-like shade is obtained by mordanting the pulp with nitrate of iron and by brightening with stannous chloride.

Besides the proportions given already for the manufacture of nitrate of iron, two may be added here which give specially useful results for the production of Prussian blue :—

(1) 30 lb. of sodium nitrate are dissolved in a spacious cask containing 6 gallons of water. This solution is acidulated with 12 lb. of sulphuric acid, 168° Tw., after which old iron is gradually added until an excess of it is present. Or,

(2) 4 parts of nitric acid are diluted with 1 part of water. This mixture is poured into a thoroughly cleaned petroleum cask, and to this old iron is gradually added. A strong reaction takes place through the dissolving of the iron, and the addition of further quantities of it should be suspended until the development of gas relaxes.

At the finish of the operation some undissolved iron should be in the liquor. After the liquor has been boiled up with steam the clear solution is decanted and is ready for use.

The specific gravity varies between 76° to 87° Tw. The solution becomes more concentrated on storing, which, however, has no influence on its quality.

According to the concentration of the nitrate of iron $2\frac{1}{2}$ to 3 parts of this mordant, with the addition of

5 per cent. of stannous chloride, are used for 1 part of potassium ferrocyanide. (The stannous chloride may also be added in an undissolved state to the pulp dyed with the iron buff.)

The pulp prepared in this manner is then dyed with the acidulated cold solution of yellow prussiate.

Prussian blue is frequently and especially used for packing papers, saddened with logwood extract and topped with water blue.

Prussian blue which has been oxidised in the pulp shows sometimes the disadvantage that the dyed paper goes red after a certain time, a fault which is generally first noticeable at the edges of the sheets. This may be prevented by washing the pulp until the water coming from the drumwashers no longer gives a strong acid reaction. The washing has naturally to be completed before the loading materials are added. A more durable and an invariably uniform shade is obtained if instead of washing in the beater a Prussian blue washed free from acid is used. Such a colour produces a purer shade than a blue developed in the pulp.

The addition of acid or bleaching powder only serves to accelerate the oxidation of the compound formed between the ferrous sulphate and the yellow prussiate. The shade goes deeper the more this oxidation is aided. The addition of acid should be continued until the colour ceases going deeper in shade.

For the preparation and precipitation of Prussian blue a vessel should be employed the height of which is considerably more than its width. From the centre to the top wooden taps or bungs should be fitted in distances of about 3½ inches. During the reaction which takes place prussic acid is developed, which is very injurious to the health of the workmen.

The opening of the vessel should therefore be connected with a chimney having a powerful draught which will remove the prussic acid fumes immediately. In the cover of the tub an opening is provided for the stirrer, and at the side enters a pipe, through which the solutions may be added.

METHOD FOR PRODUCING PRUSSIAN BLUE FREE FROM ACID.

50 lb. of potassium ferrocyanide are dissolved in 18 gallons of boiling water. After the solution has been allowed to cool to 96° to 104° F., it is mixed, with continuous stirring, with 75 to 80 lb. of ferrous sulphate which has been previously boiled with 5 lb. of iron borings. After cooling the colour is oxidised with either 5 lb. of sulphuric acid, 168° Tw., diluted with 2 gallons of water, or with 9 lb. of hydrochloric acid diluted with 3 gallons of water and 38 gallons of clear bleaching powder solution, 5·8° Tw. The tub should be of such dimensions that the above quantities will not fill it more than half. Fresh water is now run in until the tub is nearly full, then the liquor is well stirred and allowed to rest for twenty-four hours, after which time the clear liquor which separates from the blue precipitate is run off. The tub is now again filled with fresh water, and the contents are well stirred, and the next day the clear liquor run off as before. After this operation has been repeated five or six times the colour will be ready for use.

According to another method the blue precipitate is formed by using a solution of nitrate of iron in the following proportions: 2 parts of potassium ferrocyanide, 5 parts nitrate of iron solution, 1 part sulphuric acid and 4 to 5 per cent. of tin crystals calculated on the quantity of yellow prussiate used. A peculiar reaction, which has not yet been explained, takes place when paper dyed with Prussian blue is exposed to the sunlight for a considerable time—prussic acid is formed, and the shade is partly decolourised. If paper after having been exposed in this manner is kept in a dark place and in contact with the oxygen of the air the original colour is restored.

Caustic soda destroys the colour, forming ferric hydrate, which is restored by the addition of acids.

Paris blue and milori blue are commercial names for Prussian blue, the value of which depends on their strength, which can be readily ascertained by means of dye trials made on the small scale.

ULTRAMARINE.

The chemical composition of this inorganic colour, for which there is no perfect substitute for the manufacture of high-class paper, is not yet exactly known. It is supposed that the blue shade of ultramarine contains a silicate of aluminium and sodium combined with sodium penta-sulphide, whilst in the green shade the place of the latter is taken by sodium sulphide.

Ultramarine is manufactured in various shades, ranging from pure green, greenish-blue and pure blue to reddish-blue. The ultramarines are absolutely fast to light, not influenced by the action of the atmosphere and not changed by weak alkaline solutions. The colour is decomposed by hydrochloric and sulphuric acid with the expulsion of sulphuretted hydrogen.

The violet brands of ultramarine are not stable to alum and sulphate of alumina, and therefore unsuited for the dyeing of sized paper pulp.

To ascertain the fastness to alum of a sample of ultramarine, dissolve 3 oz. of aluminium sulphate in 3 pints of water and mix with 30 grs. of ultramarine. If the shade is not distinctly altered after half an hour's time, the ultramarine may be considered to be sufficiently fast to alum for technical purposes. The fastness to acids of an ultramarine is quite independent of its fastness to alum.

15 grs. of ultramarine are dissolved together with 5 oz. of oxalic acid in 4 pints of water. The colour will be considered the faster to acid the longer it will take for its decolourisation.

The comparative tests to ascertain the dyeing value of various ultramarines are done in the following way: equal quantities of the various samples are weighed out and then each of them mixed with 5 parts of china clay and made into a paste with equal parts of water.

The sample which shows the deepest shade contains the strongest ultramarine. This comparison should, however, only be made between ultramarines of nearly equal shade, as it is extremely difficult to compare, for instance, a greenish with a reddish-blue mixture.

The degree of disintegration of an ultramarine is not dependent upon its value; it is therefore an inevitable necessity to strain the colour through silk gauze, flannel, or linen cloth to avoid coarse suspended particles getting into the paper, thus depreciating its value.

The fast delicate white shades obtained with ultramarine cannot be produced with any other colouring matter.

To prevent the decomposition of the ultramarine through the acid left in after the bleaching, it is necessary to add some soda crystals to the pulp. To cover the greenish tone, which the strongly reduced blue produces on the yellowish white pulp, and to convert the ultramarine blue into a pure violet, the addition of a pure bluish red (Rhodamine B, magenta, etc.) will be found to be necessary.

2. NATURAL MINERAL COLOURS (EARTH COLOURS).

The vast deposits of earth colours found in nature, the formation of which is due to volcanic and atmospheric influences, are mineral colours mixed with other substances.

They are of no use in the raw state until they have undergone a mechanical and in many cases a chemical treatment. The raw colours are ground, and the finer particles are separated from the coarser ones by washing with water, and by these means converted into a fine powder free from grit. Various shades are obtained by heating the colour to a certain temperature.

The natural mineral colours and the coloured clays are of the greatest importance for the dyeing of paper pulp on account of their cheapness, their fastness to light, and their resistance to atmospheric influences.

As far as fastness is concerned these coloured earths cannot be approached by any other class of colours. Convincing examples of the above are the Egyptian Pyramids, in the interior of which the wall decorations painted with earth colours have retained their freshness and beauty for thousands of years. The author is in the possession of a book dated from the beginning of this century containing written recipes and patterns for the manufacture of dyed hand-made papers. Those of the patterns dyed with vegetable colours are nearly all strongly faded, whilst those dyed with mineral colours appear quite fresh.

The shades of the natural mineral colours are very numerous on account of the various natural admixtures. They belong throughout to the subdued shades such as are specially in demand for packing and wall papers. The earth colours require no mordants, they are only mechanically fixed on the pulp.

The fine state of division of these colours is of the greatest importance for the production of evenly dyed papers.

The disintegration of the colour by mechanical means can never equal the fine state of division obtained with colours which have been produced by chemical means. The fact that very large quantities of these earth colours are required, in comparison with other colours, to produce deep shades may be partly attributed to this division not being sufficiently minute. On the other hand, the shades obtained with the natural mineral colours possess a depth and a solid appearance which is superior to that obtained with the ordinary pure pigment colours, though all the mineral colours share the one characteristic of the monogenetic colours, to invariably appear, even if dyed in any depth, of *one shade only*, either lighter or darker.

These special properties characterise the earth colours and the coloured clays as "loading materials".

The more plastic these materials are, that is, the more fatty their nature, the better are they adopted to give a smooth finish and the greater is their suitability for this purpose. The plasticity grows in proportion to the amount of pure hydrated aluminium silicate they contain; the presence of clay is therefore no disadvantage. It is, however, absolutely necessary that quartz sand should be entirely absent. The minute particles of sand cause holes in the paper and damage the surface of the press and calender rollers. Very finely-divided earth colours show a perfectly smooth surface if spread on a paper with the blade of a knife.

Mixed with a little water and placed on a piece of paper it should be easy to rub them quite evenly with the tip of the finger. By trying them between the teeth it should be impossible to detect any particles of grit.

The presence of china clay or any of the other white loading materials naturally reduces the depth of the original colour.

YELLOW EARTH COLOURS.

The composition of the brownish-yellow earth colour known under the name of "ochre" varies greatly. According to their shade they contain either ferric oxide or hydrated ferric oxide in a preponderating proportion, sometimes also manganite, along with clay, etc.

The ochre earths as found in nature are products of the decomposition of minerals containing iron, for example, Thuringian ochre, Sienna earth.

Ochre is sold in numerous light and dark shades, ranging between yellow and brown. The finest ochre appears as a dull finely-divided powder with a soft touch. Dark-coloured brands which possess plastic properties are generally the best and the richest in colour, as this indicates purity and a larger precentage of ferric oxide or hydrated ferric oxide.

For better class papers the use of an ochre under the name of *Satinober*, for wall and packing papers *gold ochre* or *iron ochre*, which is already more of a brownish shade, may be recommended.

Chrome and *brilliant ochre* is nothing else than an ordinary ochre which has been topped with chrome yellow. A great variety of shades, giving the same result, may however be obtained by mixing the two colours, or by dyeing the pulps first with chrome yellow and then topping it afterwards with ochre.

Some inferior brands of ochre are put on the market which are by-products of the manufacture of ferrous sulphate from iron pyrites.

An excellent yellow mineral colour is the unburnt *Terra di Siena*. In the burnt state it produces fiery brownish red shades.

RED EARTH COLOURS.

The actual colouring substance contained in the red earth colours is ferric oxide in an amorphous state. It forms the principal part of red hematite found in nature, and is the raw material for numerous earth colours. Some of the iron ores mixed with silicic acid and clays are also used as raw materials for the manufacture of red earth colours. A great number is manufactured by heating clays which contain hydrated ferric oxide to redness. According to the shade either having been yellowish or brownish, a yellowish or brownish red ochre will be the result. The more hydrated ferric oxide has been converted into ferric oxide the more pronounced yellowish red the shade will be.

The violet red earth colour, known as *caput mortuum* (rouge powder), is a by-product of the manufacture of sulphuric acid from copperas. It is manufactured by heating copperas to redness, ferric oxide remaining as a red powder.

Caput mortuum is usually of a dull appearance; fiery violet and bluish brands are, however, also sold.

English red (*oxide red*) is mostly of a yellowish red colour and principally used for light shades, whilst with *Indian red* a heavy bluish red is obtained.

Pompeian and *Venetian red* are two very pleasing mineral colours. By using burnt sienna fiery brownish red shades, not unlike mahogany in colour, are obtained.

Brighter shades, as used for wall-papers, may be dyed by shading these mineral colours with red coal tar colours, such as Cerise, Magenta, Saffranine, Scarlet, Eosine, etc.

BROWN EARTH COLOURS.

The dyeing principle in the brown earth colours is hydrated ferric oxide in varying quantities. Some of these are mixed with brown-coloured organic bodies, due to the carbon contained in these products of vegetable decomposition. Colours of this description are quite unsuitable for paper manufacture.

By heating the hydrated ferric oxide prepared from copperas, reddish brown mineral colours, not unlike burnt sienna, are obtained, which are generally sold under the name of mahogany browns.

Velvet brown, chestnut brown, umber brown, etc., are mostly burnt ferric hydrate, whilst the real *umber* consists chiefly of manganese silicate. In its natural state umber is of a greenish brown; in its burnt state, of a rich deep brown shade.

Greyish brown shades are called *sepia.*

The brown earth colours are sold in numerous shades and varying concentrations. They are extensively used, frequently in connection with coal tar colours, in the manufacture of wall-papers.

GREEN, GREY, BLACK EARTH COLOURS.

These colours are only of secondary importance. They are principally used for shading other mineral colours or for the dyeing of various greys in combination with earth or artificial organic colours.

Green earth is supposed to be a product of the decomposition of a mineral called augite. It is of a dull green shade, due to its containing ferrous silicate. Green earth which contains ferric oxide has a more brownish shade. Mixed with ochre the specific shade of the silicate of iron is converted into olive green. In this combination green earth is brought on the market as olive green (bronze green). The strongest brands are recommended for the dyeing of olive-green wall-papers.

Similar shades may be obtained by dyeing pulp first blue and by afterwards topping with ochre or umber.

The so-called green ochre is produced in this way: ochre is stirred up with water and treated with a small quantity of hydrochloric acid which dissolves ferric oxide. This liquor is then mixed with a solution of potassium ferrocyanide and ferrous sulphate, and a green-coloured precipitate is the result. Stone grey, silver grey, are preparations which are used in few cases only, as similar shades may be obtained at much less cost by mixing a black earth colour with china clay.

Of the black earth colours, so-called *mineral black* or *Frankfurt black* is considered the lowest quality. *Velvet black* and especially *patent black* are in a very finely-divided state, and are strong colours for paper pulp. It must not be forgotten that the black mineral colours act principally as loading materials, and that for this reason their application should be limited to the shading of browns and greens and to the direct dyeing of greys.

Mixtures of ochre with black are used for subdued greenish shades on wall-papers.

The black *soot colours* obtained by the burning of vegetable substances with an insufficient quantity of air are quite unsuitable for the dyeing of paper pulp on account of their greasy or water-repellant nature.

WHITE EARTH COLOURS.

China Clay.—The colour of clay as it appears in nature is either bluish grey, brownish, or reddish, but seldom white. Chemically, white clay consists of aluminium silicate in combination with a small quantity of potassium silicate and water. Clay is often found mixed with quartz sand, calcium carbonate and other substances, which products have become incorporated with it in its formation from weathered granite. The more of these foreign substances a clay contains the leaner it will be. Only the fat clays, that is clay which when kneaded with water will give a plastic paste, are of value as colours and loading materials for paper pulp. This plasticity of clay is at the same time a guarantee of its purity. White clay (china clay, kaoline) results from a pure felspar free from iron. Clay possesses the less plasticity the more lime it contains. Dry clay free of lime will stick to the tongue. China clay dissolves in boiling sulphuric acid; addition of ammonia to the diluted solution precipitates aluminium hydrate.

If a paper pulp has been over-loaded with china clay, the paper made from it will be soft, ragged and weak. The first two faults may be partly remedied by adding potato starch.

White Gypsum (*Annaline*), *Alabaster White, Plaster of Paris, Pearl Hardening.*—The gypsum, as found in nature in solid, coloured and white masses, consists chemically of calcium sulphate. Gypsum is soluble in 350 times its weight of water. When heated, gypsum loses two molecules of water and is converted into anhydrous calcium sulphate, commercially known as burnt gypsum. The mineral powder known as annaline is finely ground anhydrite, which is anhydrous calcium sulphate, which, however, unlike burnt gypsum, is not capable of absorbing water. Gypsum possesses a weak covering power and a comparatively high specific gravity. The sizing is injuriously influenced by gypsum, for which reason it is of little importance only for use as a loading material. Towards colours gypsum behaves indifferently.

Alabaster, a fine granular transparent gypsum, is also used as a finely-ground powder for loading of white paper pulp.

Heavy Spar (*Blanc fix, Baryta, Permanent White*).—Barium sulphate very finely ground is used as a white-dyeing and loading material for the manufacture of white papers. The mineral known as baryta possesses a very high specific gravity (4·5), for which reason it is not recommended for use as a loading material. It is necessary to use at least equal weights of starch and baryta powder, and to boil them well together with water, otherwise small quantities only will be retained in thin papers.

In buying minerals which are to be used as loading materials, the preference should always be given to those which are in the finest state of division, *viz.*, the finest powder.

The finest powder possesses naturally the greatest covering power, and shows the least loss. These are therefore well suited in order to make the shade of the pulp lighter, to load it, to help to fill the interstices between the fibres and render the paper opaque.

Gypsum, baryta, talc, etc., are colourless substances, which appear white because the light which falls on them is reflected without refraction. The impression of a pure white on the eye will be therefore the stronger the more light is reflected. Minerals containing oxide of iron cannot appear white for this very reason.

Powdered baryta in no way injures the other pigments, and is therefore sometimes used for the adulteration of chrome yellow and other mineral colours.

Artificial barium sulphate is manufactured by precipitating a solution of a barium salt with sulphuric acid. It is a finely-divided voluminous precipitate, is of a more brilliant white, and possesses a by far greater covering power than the powdered natural baryta.

It is sold under the names of blanc fixe, permanent white, and Chinese white. Blanc fixe is neither soluble in water nor in acids.

Magnesium carbonate, found in nature as magnesite, or together with the isomorphous calcium-carbonate in dolomite. It forms the finest and specifically lightest loading material, and is of a pure white. The high price of magnesium carbonate prevents, however, its general adoption as a loading material. For very high-class paper, especially for copperplate printing, it is without doubt the best loading material.

The finest magnesia powder is obtained by mixing weak warm solutions of magnesium chloride and sodium carbonate. The precipitate is collected by filtering the liquor through linen.

Talc, Soapstone.—Natural talc is a fatty, glossy substance, which, when converted into a fine powder, is of a pure white colour.

Soapstone consists of magnesium silicate; its special characteristic is its fatty feel. The specific gravity of these minerals is comparatively low (2·75). In a finely-powdered state they fix very well on the fibres, a property which makes soapstone valuable as a loading material, especially for copperplate printing paper.

The chemical composition of talc is about two-thirds silicic acid and one-third magnesia. Pigments are not injuriously influenced by either carbonate or silicate of magnesia; they act like all the white mineral colours, namely, they reduce the strength of the colour with which they are mixed.

V. ORGANIC COLOURS.

1. COLOURS OF VEGETABLE AND ANIMAL ORIGIN.

Only few of the natural organic colouring matters are now used for the dyeing of paper pulp (logwood extract, catechu). The coal tar colours, which are constantly increasing in number, offer a perfect substitute for them.

(a) SUBSTANTIVE (DIRECT DYEING) COLOURING MATTERS.

Annatto is derived from the fruit of the annatto tree (*Bixa orellana*), which grows in Central America and in India. The cayenne annatto comes packed in casks; the Brazil annatto in bast packing. The former is richer in colour; it contains about 14 per cent. of the pure colouring matter. The moistened, broken cayenne annatto is of a brilliant fiery red colour, whilst the Brazil annatto is more of a bluish red.

To prevent fermentation of the annatto, it is necessary to moisten it slightly from time to time with a solution of soda or potash.

According to the investigations of Chevreul, annatto contains two colouring matters: a yellow one, which is soluble in water and alcohol (orsellin), and a red one, which is soluble in ether and alcohol (bixin), and which dissolves in strong sulphuric acid with an ultramarine blue colour.

Annatto was formerly principally used for the dyeing of orange.

Before being used for dyeing the raw colour should be washed with clean water, disintegrated and dissolved in boiling water, with the addition of soda or potash, 1 lb. of annatto to 1 to 2 lb. of crystal soda, and 3 gallons of water.

The boiling with alkali should be stopped as soon as the colour is dissolved. The colour solution is then filtered through calico, and thus prepared will keep for a considerable time.

The temperature of the pulp, as well as the quantity of alkali used, influence the shade of this polygenetic colouring matter.

Excess of alkali produces yellower, aluminium sulphate redder shades. The colour is costly and fugitive, and may be perfectly substituted by azo-orange.

Turmeric.—The roots of the *curcuma tinctoria* are of a sandy colour; the better qualities are yellowish red inside, the lower ones brownish orange.

The best brands are the Chinese, which are recognisable by their peculiar nauseous smell.

Turmeric is sold in powder form. The actual colouring matter, the "curcumine," contained in the root is extracted by boiling it with water.

The colour is fast to acid, and shows the advantage of dyeing paper pulp direct yellow; its disadvantages are the fugitiveness and its sensitiveness to alkalies. Even very small quantities are sufficient to turn the yellow colour into a reddish brown.

Safflower.—This colour is obtained from the petals of the *carthamus tinctoria.* It is imported from East India as Bombay or Bengal safflower.

These safflower blossoms contain besides the carthamine, which produces a beautiful pink, a yellow colour which greatly influences the purity of the red shade.

The yellow colour may be extracted by soaking and washing the blossoms in cold water.

An extract of the colour is sold under the name of safflower carmine.

It is not necessary to mordant the pulp for the dyeing with this colour. To obtain level shades it is necessary to make the colour slightly alkaline with soda and to acidulate with tartaric or acetic acid after the colour solution has been added to the pulp. Too much of one of these organic acids make the shade yellower.

The pink shades produced with safflower carmine are remarkable for their beauty. They are, however, fugitive to air and light, and possess therefore no advantages over the corresponding brilliant shades obtained by using the eosines. The dyeing with safflower carmine is more costly than with eosine, and has therefore been substituted by the latter.

The original shade of the safflower red is considerably altered at high temperatures, especially if the paper is dried too quickly on the drying cylinders of the paper machine.

Before the discovery of the coal tar colours a very costly pure scarlet was produced by dyeing pulp first with annatto and afterwards topping it with safflower carmine.

(*b*) ADJECTIVE (INDIRECT DYEING) COLOURING MATTERS.

Redwood.—Shades produced with the woods of the various species of *Caesalpinia* are not very fast to light; their use is only very limited now.

The wood which comes from Pernambuco is the richest in colour. It is imported into this country in the form of heavy logs of a yellowish-red colour; of nearly the same richness in colour are the Bimas and Japan redwood; Lima or Costarica wood, which is imported in long thick logs, is inferior.

Pernambuco wood has been principally used for the dyeing of pinks; Costarica wood for shadings of red-brown colours.

Whilst logwood itself has been nearly dispensed with through the introduction of the extract, the dry redwood extract has not been successful in replacing the wood.

To ascertain the amount of colour contained in given samples of redwood, equal quantities of the rasped woods are boiled with equal quantities of pure water. A strip of unsized paper is immersed for half an hour in each of the solutions. The strip which shows the strongest shade after drying points to the wood richest in colour.

For the extracting of redwood, and in fact of all the dye woods, pure soft water is indispensable. To extract as much colour as possible, the rasped or chipped wood should be steeped before the boiling for one to two days in pure river water. The greater yield in colour well repays this extra trouble.

Wood prepared in this manner is boiled for about one hour with steam; this is repeated three to four times with fresh water, until all the colour is extracted from the wood.

For the first boiling 12 gallons, for the second 8 gallons of water is sufficient. The decoctions are then mixed, filtered, and the whole allowed to stand a few days.

The sediment which is formed may be used for the dyeing of packing papers.

The colouring matter contained in the redwood is brasileïn, which appears in yellow crystals in the pure state.

It may be mentioned that under the names of "Red lake," "Laque à la cochenille," "Venetian, Florence and Berlin lake," redwood preparations are sold in the market which produce rather faster shades than can be obtained with most of the scarlet coal tar colours.

Pinks obtained with Pernambuco wood on a mordant of aluminium sulphate are somewhat faster than magenta shades, but dull, and have not a pleasing appearance.

A combination of stannous chloride and alumina used as mordant produces better results. Oxide of tin produces brighter and more yellowish-red shades with the colouring matter of redwood; alumina, duller and more bluish shades.

In most cases where the adjective vegetable pigments are used as colouring matters, the alumina-tin oxide mordant will be preferable to the pure alumina mordant.

With the double mordant of tin and alumina and the colouring matter, a brighter and faster shade results. The colouring matters also exhaust easily and thoroughly on the fibres coated with alumina and tin. The influence of the alumina in making the shade bluer shows itself in every case, so that it is necessary if purer scarlets are required to either top with a yellow colouring matter, or to dye the pulp first with annatto, orange, etc.

For light shades the dyeing is done cold; for darker ones the pulp may be kept at a lukewarm temperature.

The redwoods sold in the market under the names of sanders, caliatur, bar and camwood are of no interest for the dyeing of paper pulp.

Cochineal (*Kermes, Lac Dye*) is of a greyish or reddish colour. The large granulous Zaccatille or Honduras cochineal is considered as the one containing the largest percentage of colour. Of less value are the Teneriffe and Java cochineal.

The colouring matter is adulterated by giving weight by the addition of soapstone, which is, however, noticeable by the fatty appearance of the product.

Cochineal is now rarely used for the production of pinks on paper pulp. The colour dyes vegetable fibres only with difficulty, and imperfectly.

The so-called ammoniacal cochineal is, however, used on account of its pure shade and its fastness for the toning of high-class white papers.

PREPARATION OF AMMONIACAL COCHINEAL.

In a glazed stoneware vessel 20 lb. of powdered Zaccatille or Honduras cochineal are slowly mixed with 60 lb. of ammonia. The vessel is then allowed to remain in a warm place (for instance, over the boiler) for a few days until the liquid becomes thick. The ammoniacal cochineal improves by storing it for some time.

Weld.—Of the various brands of weld met in commerce, botanically known as *Reseda luteola*, the one coming from Cette is the most valuable. The thin stalks are thickly covered with blossoms, which contain the yellow colouring matter called "luteolin". The colour is extracted by boiling with pure soft water. Luteolin cannot be fixed completely on vegetable fibres. A dull yellow, which changes with alkalies, and which is turned orange by sulphate of copper, is obtained with alumina mordants.

A golden yellow is produced with weld on pulp mordanted with tin crystals, and perfectly fast bronze shades are obtained by preparing the pulp with either sodium or potassium bichromate.

Weld has been extensively used for combination shades, for instance, with logwood extract for subdued greens, for high-class papers on annatto bottom for orange, with ultramarine for pure leaf green, and on iron mordanted pulp for delicate olive shades.

At the present time weld is of no importance. The same may be said of the colouring matter contained in *Persian berries*. In its behaviour as a polygenetic dyeing principle it is very nearly identical with luteolin, but possesses still less affinity to the vegetable plant cells.

Fustic Extract is not used for dyeing yellow shades. It is, however, of importance for the saddening of logwood blacks, for which purpose it is especially suited on account of the large quantity of tannic acid which it contains.

1 lb. of fustic extract contains about the same quantity of morin as 4 lb. of fustic.

Quercitron is the powdered bark of the *Quercus tinctoria*, a black oak which is found in North America. The best qualities are of a yellow or buff colour, and possess an astringent taste. The colour contained in quercitron is "quercitrin," which is a glucoside and crystallises in pale yellow needles. It is the principal constituent of quercitron extract, the characteristic properties of which are similar to those of fustic extract. Quercitron extract is of great importance, on account of it being the most suitable colouring matter for the saddening of blacks.

For the production of yellow shades the decoction of the disintegrated bark is more suited than the commercial quercitron extract. It is used in the same manner as weld.

Though quercitrin, which occurs together with tannin, does not produce a pure yellow, the fixing of the same with glue is not advisable, as the colour is then only imperfectly fixed on the pulp.

Catechu or *Cutch* is the dye-stuff extract obtained from the *Mimosa catechu* which grows in the East Indies. Its value is sometimes reduced by adulterations. A good quality of catechu should have an astringent taste, break easily, and dissolve perfectly in boiling water. It is imported in irregular lumps, weighing about a hundredweight, and wrapped in bast bags. The colour contains between 40 to 50 per cent. of tannin.

For the dyeing of brown shades which have to be fast to light, acids and alkalies, catechu has not yet been replaced by any artificial colouring matter. The so-called prepared cutch which is sold in commerce is not suitable for the dyeing of paper pulp.

The large amount of tannin contained in catechu explains its great affinity to the vegetable fibre. The complete fixing by means of mordants is therefore always done after the dyeing operations.

The principal colouring compound contained in catechu is "catechin," a white crystalline body, which rapidly absorbs oxygen from the air, forming a brown substance known as japonic acid. The shades obtained vary with the mordants employed for the oxidation of the catechu.

The shades of brown, grey and olive obtained in this way are very numerous, and are all remarkable for their fastness. In case no other colours have been used for shading, the shades obtained with catechu are not much altered by bleaching powder solution.

Pure catechu brown is obtained by precipitating the catechin with sodium or potassium bichromate: 1 part of mordant to 8 parts of catechu.

The colour will turn out more level if the pulp has been warmed. It may be mentioned here that a higher temperature is always beneficial in cases where potassium bichromate is used as a fixing medium; the shades will be fuller and richer.

Dark browns and similar shades are, with the exception of the very highest classes of papers, always produced on unbleached pulp.

The solution of the powdered catechu is allowed to settle, then filtered and added to the pulp directly after the washing operation is completed. Considerably stronger shades will be obtained if 5 to 8 per cent. of copper sulphate dissolved in water is added to the catechu solution.

It is advisable to allow sufficient time for the colour solution to penetrate the fibres thoroughly before the chromium mordant is added. In a beater in which the pulp circulates freely, half an hour is generally sufficient time for this purpose.

Before the loading materials are added a short washing will be found necessary to clear the shade.

With catechu and aluminium sulphate the shade obtained is duller than with tin mordants, and distinctly yellower. Yellowish-brown shades are better produced by topping catechu-dyed pulp with ochre, paper yellow or metanil yellow, chrysoidine, etc.

The various shades of greyish-brown are developed with iron mordants; for the darker ones logwood extract is used for topping.

By shading catechu with Orange II., Bismarck brown, or Magenta, reddish-brown shades are obtained.

In the dyeing of blacks catechu plays a most important *rôle.* The high percentage of tannin contained in catechu makes it specially suitable for the preparation of the pulp. To support and accelerate the combination of the catechu with the fibres, the dyeing is best conducted in the beater, at a fairly high temperature.

The stuff is afterwards run into the draining boxes, the outlets of which are previously closed. In these it remains for one day or even longer.

The stuff is now brought into the hollander and mordanted with nitrate of iron, which is fixed by means of the tannin of the catechu ; after a few minutes' washing the pulp is dyed with a solution of logwood extract, which is then precipitated as a black lake on the pulp by means of potassium bichromate.

If a pure jet black is required it will be necessary to sadden the logwood colour with quercitron extract. To avoid the peculiar bronzy appearance of the shade produced with iron a small quantity of bluestone should be added.

The characteristic bronzy lustre disappears after the sizing under the influence of the aluminium sulphate.

The dyeing of black may be also done in one operation. The pulp is dyed brown as described above (for 100 lb. of dry pulp 12 to 15 lb. of catechu, $\frac{3}{4}$ to 1 lb. of copper sulphate, $1\frac{1}{4}$ to $1\frac{1}{2}$ lb. of potassium bichromate), mordanted with pyrolignite of iron, and the black developed with logwood and a small quantity of either quercitron or fustic extract, which is finally completely fixed on the pulp by means of a little potassium or sodium bichromate.

Logwood Extract.—This important colouring matter is obtained from logwood or campeachy wood (*Haematoxylon campechianum*), which grows abundantly in Central America and India. The extract is brought into the market either in a solid or in a liquid state containing a varying percentage of hematine, which is the real colouring matter contained in the logwood.

Hematine forms violet precipitates with tin mordants, blue with copper mordants, grey or black with iron or chromium mordants.

Violet produced with aluminium sulphate and logwood extract is not fast, nevertheless it is often used on account of its cheapness for the saddening of blue, violet, brown and other shades for wall and packing papers.

With stannous chloride a brighter, somewhat redder, purple is produced, which, however, can be obtained at less cost by topping with Magenta.

The blue produced with copper sulphate is very unstable. It was formerly extensively used in the manufacture of green straw paper. Logwood blue cannot be used for sized papers, aluminium sulphate converting the shade into violet.

Red has been produced on yellow straw paper with logwood extract in the following simple manner: to the pulp, impregnated with the extract, a sufficient quantity of hydrochloric acid was carefully added until the desired change had taken place.

Hematine in conjunction with iron and chromium is principally used for the production of blacks and greys.

The raw materials best suited for the manufacture of black paper are unbleached cellulose, indigo blue and black linen and cotton rags, which, of course, are not boiled with alkali, but which should be carefully washed. Deep black shades may, however, also be obtained on boiled, undyed, unbleached, but always well washed raw materials by using a correspondingly larger quantity of colouring matters.

Black is produced with iron salts, or tannin materials, iron mordants and wood colours, and also with potassium and sodium bichromate, copper sulphate and wood colours. The indispensable colouring matter is logwood or logwood extract.

The simplest and cheapest way to produce a shade which may be called a near approach to a proper black, which is, however, very loose, is the one in which copperas (ferrous sulphate) is used for mordanting the pulp, which is afterwards dyed with logwood extract.

By far better results are, however, obtained by the use of either ferric sulphate or pyrolignite of iron as mordant, which may be fixed with soda. The mordanted pulp should be washed before the dyeing.

A faster black is obtained on pulp mordanted with tannin and iron. Substances containing tannin are seldom free from gallic acid, the presence of which however has no deleterious influence on the formation of blacks, as it forms bluish black precipitates with oxide of iron similar to the precipitates produced by tannic acid.

The tannic acid has, however, also to serve another purpose, namely, to assist in developing the colour of the logwood and to render a larger proportion of the hematine available.

It is of little consequence which of the tannin materials is used for the preparation of the pulp as long as the quantities used are in proportion to the percentage of tannic acid which they contain. As far as the shade is concerned, it must be borne in mind that the tannin of nutgalls forms a blue-black precipitate with ferric salts, whilst the precipitate formed with the tannin of sumac is more of a greenish-black shade.

If nutgalls are used, and if it is required to exhaust the tannin as completely as possible, the pulp should be previously treated with alum.

Tannin materials which contain a yellow colouring matter (quercitron), or which contain a compound which fastens the colours (catechu), sadden and deepen the shade of the black at the same time.

Pure black is obtained by mixing quantities possessing equal colouring power of yellow, blue and red. It is therefore impossible to obtain deep black shades without the use of the corresponding yellow colouring matters, such as quercitron and fustic.

Quercitron produces darker shades than fustic. The latter is generally used together with sumac, and added to the pulp before the logwood solution.

As already pointed out, ample time should be allowed for the fixing of the tannin on the pulp. The preparation with iron mordants has to be done in the cold. Sufficient iron mordant should be added to make the liquor in the beater show 2° to 3° Tw.

Excess of acid should be neutralised with milk of lime.

Black for cartridge papers is almost exclusively dyed on chrome mordant.

For chrome black the logwood extract should be dissolved with 8 to 10 per cent. of ammonia soda.

The pulp is first mordanted with 5 lb. of copper sulphate for every 100 lb. of fibres, heated to 122° to 140° F., dyed, and lastly treated with sodium or potassium bichromate, of which 6 to 8 lb. for 100 lb. of fibres will be found sufficient in most cases.

For grey shades correspondingly less colour is used, and the copper sulphate is replaced by ferrous sulphate.

It may also be mentioned that aluminium sulphate makes the shades rather duller and more bluish, whilst a redder tone is developed with tin crystals.

2. ARTIFICIAL ORGANIC (COAL TAR) COLOURING MATTERS.

The revolution which the coal tar colours have made in dyeing, and especially in the dyeing of paper pulp, make this class of colours of the greatest importance to us. The author therefore has not only relied on his own experience, but has in this matter consulted the well-known Badische Anilin- und Soda-Fabrik in Ludwigshafen a. Rhein, which has devoted considerable attention to the subject. Thanks to the courtesy of this firm, he obtained valuable practical information about the various coal tar colours specially suitable for the dyeing of paper pulp, their properties and the methods best suited for their application, besides a number of patterns of paper dyed in the pulp, which are appended.

For the standard samples of colours which are frequently used in this work, and for the careful dyeing of these on paper pulp, the author begs to express his indebtedness to Mr. Dierdorf, the colourist of the above firm. The patterns are dyed of such a strength as is most suitable to show the particular colour in its purest state. They will be of service in judging the strength of the colours used.

The pulp on which the standard shades are dyed is composed of—

40 per cent. unbleached sulphite wood, and
60 ,, mechanical wood (pine).

The shades would be correspondingly purer if dyed on bleached pulp.

The aniline colours are, generally speaking, superior to the others in the following respects—

Brilliancy and purity of shade,
Colouring power,
Solubility,
Simple application,

whilst the want of fastness to light forms one of their weak points.

In commerce we frequently meet with one and the same colour in a varying concentration reduced by the addition of dextrine, salt, Glaubers salt, sugar, etc.

These so-called reduced colours must, however, not be considered as adulterated products, their prices being, as a rule, proportionately lower.

As far as the dyeing of paper pulp is concerned, the aniline colours may be divided according to their properties and their mode of application into the following groups :—

(1) Acid dyeing colours or so-called "acid" colours designated with the letter ^{o} after the name.

(2) Basic colours, designated with the letters ^{oo}.

(3) Colours of the eosine group, designated with the letter ^{x}.

(4) Substantive (direct) colours, designated with the letters ^{xx}.

Acid colours are generally *faster to light* and more easily soluble than basic colours ; on the other hand, their colouring power and their affinity to the vegetable fibres is generally weaker. Neither metallic salts nor tannic acid will fix acid colours permanently on the fibres.

To obtain heavy shades with acid colours a *strong sizing* of the pulp is indispensable.

The colour solution should always be added to the unsized pulp; and only when thoroughly mixed the size ought to be added. In this way a better fixation is obtained.

For unsized papers the acid colours are not suitable at all. Their weak affinity to vegetable fibres, which causes them to dye the pulp very evenly, makes them valuable for the production of light shades.

Basic colours possess a very strong dyeing power, are very brilliant and bright, but not fast to light.

China clay and other loading materials fix basic colours readily at a temperature from 104° to 122° F. Only a very small addition of aluminium sulphate is necessary for their fixation.

The backwater is only slightly tinted, and excessive heating on the drying cylinders, which causes acid colours to produce a deeper shade on the one side of the web, rarely affects basic colours. The greater affinity of basic colours to the vegetable fibres allows of their use for dyeing of both unsized and sized papers. For the latter an excess of aluminium sulphate is to be avoided.

As the affinity of basic colours is not the same to each of the different classes of fibres contained in the pulp, unevenly dyed paper will result if a small quantity of alum has not been added to the pulp previous to the dyeing and if too concentrated a colour solution has been used.

The basic colours may be used in conjunction with each other, for instance, methyl-violet and green, etc.

Far better results will be obtained if the pulp is first dyed with a basic and afterwards topped with an acid colour.

A precipitation of the two colours will take place, the result of which is that the colours will be more economically used, the fastness of the shade is improved, and the backwater will be colourless. Great care should be taken that every colour is dissolved separately, and that any fresh solution is only added to the beater after the previous one has been thoroughly mixed with the pulp. Mixing of the solutions themselves would cause a premature precipitation.

As already mentioned, basic colours may be employed for the dyeing of unsized papers. If the shades have to be fast to water, as, for instance, in the use of mottling (melange) fibres, mordanting of the pulp with tannic acid will be necessary.

Characteristic of the group of colours known as *eosines* is their unsurpassed brilliancy and the purity of the pink and scarlet shades which they produce. They are only mixed with other colours to improve the fastness to light of the eosine colours or to produce a cheaper red.

The eosines are easily soluble in water; mineral acids affect their shades, whilst alkalies have no influence. Their affinity to vegetable fibres is a very weak one. The fixing on the pulp is actually done through the sizing.

Excess of aluminium sulphate should be avoided, and for the purest shades aluminium acetate should be used instead.

The addition of sugar of lead to eosine pink will make the shade bluer, whilst excess of aluminium sulphate makes it yellower and duller.

Substantive (*direct dyeing*) *colours* are exclusively used for the dyeing of unsized pulp containing principally cotton, *e.g.*, for copying and blotting papers, and for cotton half-stuff for mottled papers. The great affinity of the direct dyeing colours to the cotton fibre explains the simple mode of application. With the addition of 10 per cent. of Glaubers salt (of the weight of the dry fibres) shades are obtained fairly fast to water and usually faster to light than those obtained with the basic colours.

DISSOLVING OF COAL TAR COLOURS.

It is scarcely necessary to mention that aniline colours must never be added in an undissolved state to the paper pulp, as specks caused by the undissolved colour and great loss of colour would be unavoidable. The dissolving is best done in a glazed earthen- or stoneware vessel. Hot condensed water should be poured over the colour whilst constantly stirring until all the particles are dissolved.

Some colours are decomposed if boiled with live steam or over a direct fire.

To prevent decomposition of a colour it is better to dissolve a fresh lot for every dyeing operation instead of making a larger quantity of colour solution for stock. In the case of basic colours particularly, part of the colour will separate out of the solution in the cold, which necessitates heating the solution before it can be used. Every colour solution should be carefully filtered before use either through a hair sieve or through felt previously wetted out with hot water.

The amount of water to be used for the dissolving of a colour depends on its solubility and on its strength.

Whilst some of the basic colours require from 150 to 200 parts of water for their complete solution, the acid colours dissolve in by far a smaller quantity of hot water.

Condensed water should always be used for dissolving aniline colours.

Hard water, if used for dissolving, may produce tarry separation of either the base or the colour acid.

When, however, hard water only is available, the addition of 1 part of acetic acid to 1,000 parts of water is advisable.

In the foregoing the character of the aniline colours has been considered as far as it is of importance for practical use.

In studying the various colours separately, it will not be necessary to divide them in groups as before mentioned, as the mark following the name will indicate to which of the four groups the colour belongs.

The following *standard colour shades* were dyed by the Badische Anilin- und Soda-Fabrik, and, as the paper has not been made on the paper machine, we have to make allowance for the surface and the evenness in looking through. This does, however, not come into consideration, as the patterns are solely intended to show the shade produced, and to give the exact quantity of colour necessary for it.

The weight of colour given in each case is intended for 100 lb. of dry fibres.

Auramine$^{\circ\circ}$.

1 lb. Auramine II.
(Pattern No. 1.)

Auramine O, I, II. (Auramine O is three times as strong as auramine II) Sulphur yellow powder. Strong, brilliant, pure yellow with slightly greenish tone.

Solution—1 oz. in 3 galls. of hot water (140° to 176° F.) The colour decomposes if the solution is boiled.

Auramine is suitable for soft and hard sized pulp of any composition.

The best results are obtained on unbleached sulphite wood and on mechanical wood.

On bleached pulp consisting of rags, straw and wood cellulose a very pure yellow is produced, but the colour is not entirely exhausted.

In these cases it is advisable to make a combination with naphthol yellow.

Auramine II, 3 parts, with naphthol yellow S, 1 part, produces strong yellow shades and colourless backwater.

This combination is extensively used as a substitute for chrome yellow.

More greenish yellow shades may be obtained by using quinoline yellow in the proportion of 3 parts of quinoline yellow to 2 parts of auramine II.

For golden yellow and redder shades (substitutes for very deep chrome yellow and chrome orange) auramine in combination with metanil yellow or orange II is used, this giving likewise perfectly colourless backwater.

Auramine is also useful for the shading of other colours. The shades obtained with this colour have a depth and richness at a low cost, which, in many cases, cannot be produced with any other yellow. Of these combinations with auramine, I will only mention those with erythrine P and saffranine P for cheap scarlets fairly fast to light; with Bismarck browns for Havannah browns; with diamond green for parrot greens; other useful ones with brilliant black B and new blue S.

As a general rule it may be stated that on unsized or soft-sized pulp auramine is used by itself, whilst on hard-sized pulp it is used in combination with naphthol yellow S and quinoline yellow.

NAPHTHOL YELLOW S °.

Golden-yellow powder, easily soluble in boiling water.

Naphthol yellow dyes a very pure yellow shade, but is only used in combination with auramine for deep brilliant yellows, which on account of being non-poisonous and cheaper, are extensively used instead of chrome yellow.

QUINOLINE YELLOW °.

Yellow powder soluble in hot water.

Dyes a pure sulphur yellow. Rarely used by itself, better in combination with auramine for sized pulp. Shades thus obtained are faster to light than the combination with naphthol yellow.

Metanil Yellow °.

1 lb. 12¾ oz. Metanil Yellow.
(Pattern No. 2.)

Metanil yellow extra,° PL °. Brownish-yellow powder, readily soluble in hot water, solution clear. Colour crystallises from a concentrated solution by cooling the same. Bleached sized sulphite and soda wood and mechanical wood are dyed very well with metanil yellow, and a colourless backwater is obtained.

Satisfactory results may as well be obtained on other pulp mixtures with this colour.

If too large a quantity of aluminium sulphate has been used in the sizing of the pulp, the shade will go considerably redder in the drying of the paper if compared with a sample of the pulp taken direct from the beater.

The fastness to light of metanil yellow is satisfactory ; it is not affected by alkalies.

Both by itself and in combination with orange, metanil yellow is an excellent substitute for chrome orange. On account of its fastness it is a valuable colour for the shading of packing and wall papers.

In combination with vesuvine BL, new blue S, diamond green B, cerise D and JV, methyl violet, brilliant black B, coal black, fast red A, fast blue R, etc., a most extensive range of perfectly level mode shades may be obtained at a low cost, the bath in every case being well exhausted.

Paper Yellow °.

1 lb. Paper Yellow.
(Pattern No. 3.)

Perfectly soluble in hot water, solution appears somewhat turbid.

Paper yellow should only be used for sized paper pulp. From pulps consisting of rags and cellulose a clearer backwater is obtained than with metanil yellow.

Paper yellow is considerably faster to acid than metanil yellow, for which reason shades obtained with it are pure and rich without becoming redder on the drying cylinders.

This colour is extensively used for parcel address papers, etc.

AZOFLAVINE RS °, S °.

Ochre-coloured powder, soluble in boiling water.

Azoflavine produces colourless backwater in combination with auramine, like paper yellow.

COTTON YELLOW G ^{xx}, R ^{xx}.

Light yellow powder, easily soluble in hot water.

COTTON YELLOW G.

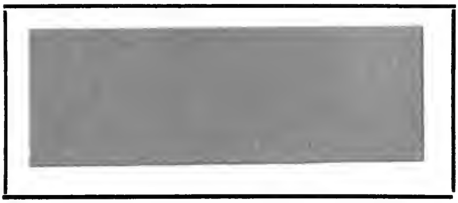
Brownish yellow, very fast to light, alkali and chlorine.

COTTON YELLOW R.

Considerably redder than G, fades rapidly when exposed to light.

Cotton yellow is specially suited for the manufacture of yellow copying papers, as paper dyed with it does not stain when in a moist state during the copying process.

Orange II °.



1 lb. 8 oz. Orange II.
(Pattern No. 4.)

Yellowish red powder, easily soluble in boiling water.

Orange N °, II °, IIP °, RS ° produce brilliant shades on paper pulp. On account of the splendid fastness to light, the low price and the high colouring power, these colours are very extensively used.

Orange II is specially valuable as a substitute for red lead and the red shades of chrome orange, whilst the redder brand, orange RS, corresponds with the shade of the saturnine red.

Orange N is considerably yellower, very near the shade of metanil yellow, but not as strong.

Hard sizing is necessary, especially if dark shades have to be dyed with these orange colours.

Orange II is a useful shading colour, giving brilliancy and warmth of tone.

Approved combinations which will give nearly colourless backwater, and which dye the various fibres in pulp mixtures as evenly as possible, are :—

Orange II with

Auramine.
Saffranine PP: deep rich scarlet, well fixed.
Magenta powder A: deep inexpensive crimson.
Diamond green B: deep olive.
Chrysoidine A: full orange shades.

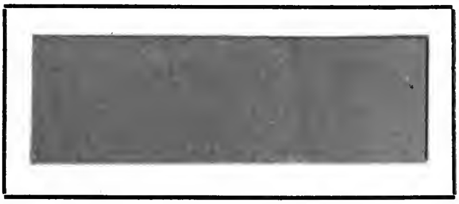
The combination of orange with cotton scarlet, which produces pure brilliant scarlets, may yet be mentioned. The backwater from these is, however, not as clear as with saffranine.

CHRYSOIDINE A $^{\circ\circ}$, RL $^{\circ\circ}$.

Dark reddish brown powder, soluble in hot water. The colour is decomposed if kept in solution for a long time. Dyes brownish orange shades, principally used for the shading of browns, olives, reds, or for the topping of catechu, ochre, auramine and saffranine.

The colour dyes well on soft and unsized pulp, especially on mechanical wood pulp and cellulose. Too high a temperature during the dyeing operation should be avoided.

Vesuvine extra °° (Bismarck Brown).



1 lb. 8 oz. Vesuvine extra.
(Pattern No. 5.)

Dark greyish brown powder. To be dissolved best in water of about 140° to 158° F.; solution not to be boiled.

For dissolving use 20 gallons of water with the addition of a little acetic acid for 1 lb. of colour.

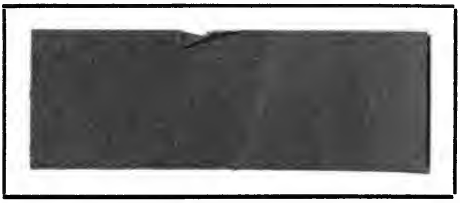
Vesuvine shows a greater affinity to mechanical and chemical wood than to bleached rags.

To prevent this colour dyeing a deeper shade on the wood fibres in a mixed pulp, an acid colour, *i.e.*, orange II, should be added. The colours will then dye considerably slower, and level shades will be the result.

Vesuvine is not fast; the fastness to light is improved if the pulp is either mordanted with bluestone and sodium bichromate, or if cutch brown or ochre is used as a bottom.

The backwater should be slightly coloured or colourless, providing a suitable stuff-mixture and sizing have been used.

Vesuvine BC°°.



2 lb. of Vesuvine BC.
(Pattern No. 6.)

Fuller and redder than vesuvine extra.

Very numerous are the shades (heavy browns and mode shades) obtained by mixing vesuvine BC with new blue S, metanil yellow or orange II. These are extensively used as substitutes for cutch shades.

The vesuvines are often used along with auramine, chrysoidine, diamond green B and methyl violet B.

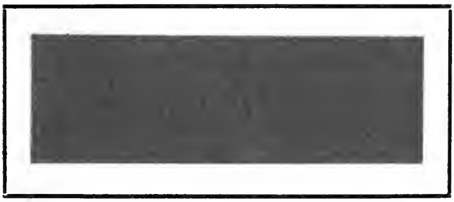
As examples the following may be given: dark green wrapping paper for match boxes, made from neutralised straw pulp, dyed with vesuvine BC, diamond green B and methyl violet B; further deep bright green, for a mixture of cellulose and mechanical wood pulp, dyed with vesuvine BC, diamond green B and metanil yellow or paper yellow.

Other browns well suited for paper dyeing, and which are considerably faster to light than Bismarck browns, are—

FAST BROWN °, NAPHTHYLAMINE BROWN °,

often used as substitutes for English red and burnt ochre.

Water Blue IN °.



½ lb. Water Blue IN.
(Pattern No. 7.)

Soluble in hot water. 1 lb. of colour in 5 gallons of water. Solution clear.

Water blue IN is valuable on account of its pure brilliant greenish blue shade, which does not alter its tone in artificial light. Compared with other aniline colours, it stands exposure to sunlight well and is fast to acids.

Sulphite lye reduces the colour, and it is very sensitive to alkalies.

When dyeing with water blue, it is of the greatest importance to keep the pulp acid until the colour is fully developed. According to practical experience, the best plan is to add before the dyeing part of the aluminium sulphate required for the sizing. The sulphuric acid is always added after the dyeing.

The diluted sulphuric acid should never be added to the colour solution, but always to the pulp in the beater previously heated to about 140° to 158° F., as only in this way level dyed paper can be obtained.

If dyed in a neutral bath, considerably larger quantities of colour would be necessary to obtain a certain shade, and the pulp would appear much darker as soon as the aluminium sulphate required for the precipitation of the rosin size has been added.

The amount of sulphuric acid necessary depends on the quality of the water.

If it is an ordinary water, 3 parts of acid to 2 parts of colour will be sufficient; if it contains a considerable amount of lime, correspondingly more acid has to be used; in any case the pulp should be sufficiently acid to turn blue litmus paper distinctly red.

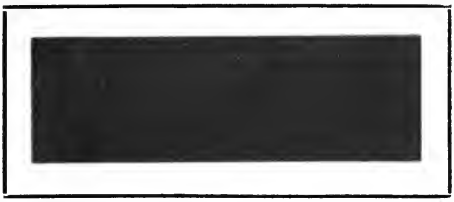
To prevent splashing, the acid should be diluted with four or five times its weight of water.

Water blue IN is readily fixed on hard-sized pulp consisting of either bleached or unbleached fibres, but the backwater always remains slightly coloured. If a basic colour is used simultaneously, the backwater will be perfectly clear and colourless.

Bright deep blue shades are obtained by topping water blue with Victoria blue.

Various shades of blue may be obtained by using methylene blue, nile blue, diamond green B, light green SF blue shade and methyl-violet in combination with water blue. In many cases the bluer and redder shades of water blue are mixed, or the pulp is bottomed with Prussian blue. For cheap dark blue shades logwood extract is generally used along with water blue.

Water Blue TB °.

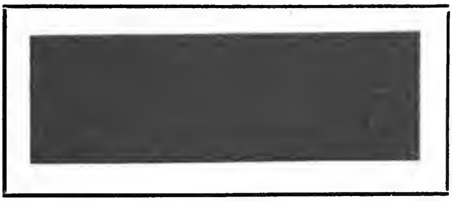


12¾ oz. Water Blue TB.
(Pattern No. 8.)

This colour is redder and fuller in shade than water blue IN, but is used in exactly the same way. Other blue colours which dye in an acid bath are: water blue PP 3376, HA and 3R. The 3R is, on account of its extreme red shade, specially suitable for white paper. Pure blue P, pure blue I, II, and fast blue R and 5B greenish are all useful for the dyeing of paper pulp.

To fix water blues better on half-sized papers, the application of 2 to 3 per cent. of sodium stannate as a mordant will be found useful.

Victoria Blue B °°.



½ lb. Victoria Blue B.
(Pattern No. 9.)

Crystalline bronzy powder. Condensed water is best suited for dissolving it. If this is not obtainable, an equal quantity of acetic acid should be first poured over the colour and the hot water after this.

Victoria blue B is the purest and most brilliant blue known, and surpasses in this respect even the finest water blue.

The ultramarine-like tone of Victoria blue R is also very beautiful. Still redder than this in shade and about equal to marine blue R, but more brilliant, is Victoria blue 4R.

The pure shade of these colours is not altered in artificial light. They resist alkaline solutions, and are fairly fast to acids.

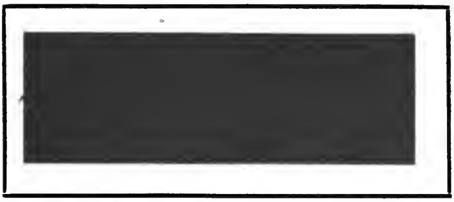
The fastness to light, however, is inferior to that of the water blues.

Victoria blues have a strong affinity to vegetable fibres. They dye equally well on sized and unsized pulp consisting of all kinds of fibres, and the backwater remains perfectly colourless even when heavy shades have been dyed.

Medium shades can readily be obtained by mixing the redder with the blue shade, and faster colours may be obtained by using Victoria blues for the topping of pulp dyed with Prussian blue. For unsized papers the addition of a little acetic acid to the pulp will be found useful.

In any case the pulp should be mordanted with aluminium sulphate.

Methylene Blue MD$^{\infty}$.



12 oz. Methylene Blue MD.
(Pattern No. 10.)

Bronze-coloured powder soluble in hot water.

Methylene blue is fairly fast to alkalies and to acids, and is of greater value for the dyeing of unbleached than for bleached fibres.

The backwater is only slightly coloured.

The rich greenish blue shade of methylene blue MD appears still greener in artificial light.

The colour is very useful for the topping of Prussian blue.

The pulp should be mordanted with aluminium sulphate, as a more evenly dyed paper will be obtained in this way.

Methylene blue B, BH, BZ, etc., as well as the so-called marine blues (navy blues), differ only in shade from methylene blue MD.

Nile Blue R$^{\infty}$.

$\frac{1}{2}$ lb. Nile Blue B.
(Pattern No. 11.)

Greenish bronzy crystalline powder. Requires careful dissolving in water.

Deep shades are produced with this colour on mechanical wood pulp and unbleached cellulose. On bleached pulp this colour dyes stronger shades than methylene blue. Its greenish tone is not altered in artificial light.

Of the two brands BB and A, the latter is the one nearest in shade to methylene blue MD.

New Blue S$^{\circ\circ}$.

1 lb. New Blue S.
(Pattern No. 12.)

Belongs to the more sparingly soluble basic colours, which, if not treated carefully, produce specks in the finished paper.

Hard water has to be corrected with acetic acid ($\frac{1}{2}$ to 2 parts of acetic acid to 1,000 parts of water), and the colour solution has to be carefully filtered. New blue S is similar in shade to Paris blue, and forms a cheap substitute for this colour.

New blue dyes deep and even shades on mechanical wood and unbleached sulphite pulp. Backwater slightly coloured.

Dyed on pulp consisting of various kinds of fibres, the shades obtained are perfectly level, and the colour is therefore specially useful for combination shades. With fast red and metanil yellow saddened with new blue S, ochre and umber shades may be perfectly imitated.

Numerous mode shades, such as grey, silver grey, and stone green, are produced by mixing new blue with vesuvine BL and metanil yellow, etc., shades which are often demanded for book-back and wall-papers.

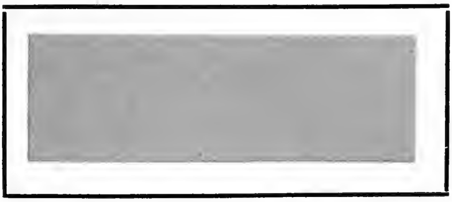
Indoïne Blue 2 B $^{\circ\circ}$.

1 lb. Indoïne Blue 2 B powder.
(Pattern No. 13.)

Soluble in hot water ; dyes very full shades ; fastness to light, acids and alkalies comparatively good. Indoïne blue is the cheapest light and medium blue. For very strong shades it is, however, more expensive than a combination of methyl violet, diamond green, and vesuvine. With the exception of mechanical wood, this colour is easily fixed on any kind of sized or unsized pulp, leaving the backwater colourless.

Artificial light does not alter the shade.

Eosine 442 N^{x}.



1 lb. Eosine 442 N^{x}.
(Pattern No. 14.)

In hot water (1 part in about 100 parts of water) readily soluble. Beautiful brilliant pink, specially suited for any kind of sized or unsized pulp.

Excess of aluminium sulphate turns the shade yellower and duller.

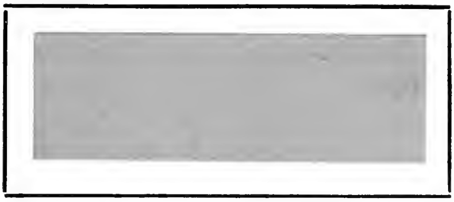
The purest shades are obtained and nearly all the colour is precipitated by adding 5 to 10 lb. of aluminium acetate, $13\frac{1}{2}°$ Tw., to every 100 parts of dry fibres after the sizing is completed. Sugar of lead blues the shade. The larger the quantity added the bluer the shade will be, and the fastness to light will be increased accordingly. The sugar of lead mordant is, however, poisonous, and is therefore only employed in special instances.

According to the brilliancy required, bluer shades may be obtained without difficulty by mixing eosine with rose bengale or saffranine, and for lower class papers with erythrine or magenta. The beautiful pink and red shades obtained by topping eosine with rhodamine deserve special mention. It is scarcely possible to obtain such brilliant shades in any other way and to get the backwater at the same time nearly colourless. For cheap papers eosine is rather too high in price. In cases where the cost is to be considered, it should be dyed in combination with cotton scarlet; the shades will be faster and cheaper, but not so brilliant and clear.

Somewhat purer shades are obtained by mixing eosine with erythrine 2 R. Eosine is sold under numerous names, and the various brands range from the yellowest to the bluest shades (eosine A, BN, RG, etc.)

Erythrosine and rose bengale, two colours belonging to the eosine group, are extensively used for the dyeing of tissue papers for the manufacture of artificial flowers.

Phloxine BBN^{x}.



½ lb. Phloxine BBN.
(Pattern No. 15.)

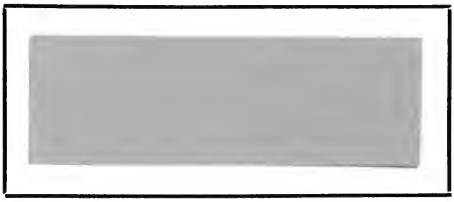
The phloxines are, on account of the pure brilliant shades which they produce, nearly always used as self colours. Their principal use is for the production of geranium shades for tissues used for artificial flower manufacture. The mode of application is the same as for eosine. For bluer shades sugar of lead, for yellow ones aluminium acetate, is used as mordant.

The backwater is nearly colourless, even where deep shades have been dyed, and the loss of colour is therefore only slight.

Phloxines are affected by acids, brown precipitates being formed.

Other brands of phloxine, such as the H, GN, BN, are used for similar purposes as the BBN.

Rhodamine B ^{oo}.



½ lb. of Rhodamine B.
(Pattern No. 16.)

Readily soluble in soft water at the boil; hard water should be corrected by adding acetic acid.

The rhodamines, though belonging to the eosine group, possess a weak basic character, on account of which they may be considered as a separate class of colours.

All the various brands of rhodamine are used principally for dyeing brilliant pink shades for tissue papers.

To preserve the incomparable pure brilliant shades of these self colours on paper pulp, the bleached fibres should be sized after the dyeing, and care should be taken that no excess of aluminium sulphate is used. The addition of 5 lb. of aluminium acetate, 13½° Tw., to 100 lb. of dry pulp will give the best result.

The rhodamine colours surpass even the phloxines and eosines in brilliancy, purity, fastness to light and acids.

Rhodamine B produces a purer shade than rose bengale NT, and is therefore very useful for the tinting of white papers, especially in combination with ethyl violet.

The backwater from rhodamine topped with eosine, is colourless.

Similar results are obtained with these colours on cellulose and mechanical wood by fixing by means of the rosin size after the dyeing.

RHODAMINE 6 G °°.

is considerably yellower in shade than rhodamine B. The beauty of shade produced with it is not obtainable with any other colour.

It dyes readily on unsized pulp, and produces the finest pink and scarlet shades known.

The shade of

RHODAMINE S °°.

lies between the B and the 6 G.

NAPHTHYLAMINE RED G°

dyes a strong, dull bluish-red shade.

FAST RED A°

dyes a deep brownish-red shade.

Both colours are used as substitutes for red wood, for blotting and special kinds of wrapping papers. The best results are obtained by using these colours in combination with brown and red basic colours.

The deepest shades are produced on unbleached cellulose.

A pleasing subdued maroon brown for wall-papers is obtained by using fast red A in combination with vesuvine extra (about 3 lb. of vesuvine and 1 lb. of fast red for 100 lb. of dry pulp.)

Cotton Scarlet °.

2 lb. Cotton Scarlet.
(Pattern No. 17.)

Easily soluble in hot water.

Cotton scarlet is principally used for cheap pinks and reds. It is fairly fast to light, acids and alkalies.

Mixed pulp containing various kinds of fibres is very evenly dyed with this colour, but heavy sizing is required for its proper fixation.

To obtain purer and especially deeper shades and colourless backwater, it is recommended to either mordant the pulp with barium chloride or to add aluminium acetate after the dyeing.

Very rich pink and scarlet shades and clear back-water may be obtained by forming a precipitate between the paper scarlet (basic) and cotton scarlet (acid).

The cotton scarlet is first dyed and then topped with the paper scarlet.

This is one of the instances mentioned before, where a basic colour is used to form a lake with an acid colour.

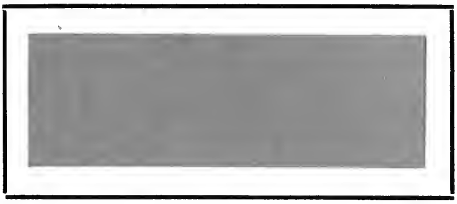
Specially good results are obtained by using saffranine. 12 oz. of this colour with 3 lb. of cotton scarlet produce a deep, fairly fast crimson and colourless back-water.

Phloxine or magenta may be used for the shading of cotton scarlet to obtain bluer, finer and cheaper reds.

The importance of this colour for the production of cheap pinks in combination with eosine and erythrine has been already mentioned.

The most brilliant vermilion and scarlet shades are obtained with cotton scarlet and orange II.

Erythrine RR °.



½ lb. Erythrine RR °.
(Pattern No. 18.)

Dyes bluer and more transparent shades, but is in other respects similar to cotton scarlet. Mixed pulps are dyed level with this colour, the shades obtained being fairly fast to light.

Faster and stronger than eosine, erythrine RR is frequently used in combination with this colour.

For the same purpose—

Erythrine X °

is used. Its shade is bluer than that of the 2 R brand.

A valuable combination is obtained by mixing it with saffranine T. Erythrine X is a useful colour for the toning of white papers.

Erythrine P °

dyes bright strong shades, and produces the cheapest Bordeaux reds. Its affinity to vegetable fibres is a very strong one.

Mixed with auramine and saffranine red shades are obtained which cannot be produced as advantageously by any other method.

Ponceau 2 R °
as well as
Fast Ponceau B ° and G °

are used for the same purposes for which the cotton scarlet has been recommended. They dye best on unbleached sized soda and sulphite pulp.

Paper Scarlet P °°.

1 lb. Paper Scarlet P.
(Pattern No. 19.)

Soluble in hot water; not as fast to light as erythrine or cotton scarlet, but faster to alkalies. The colour exhausts well on mechanical wood and unbleached sulphite pulp, producing a colourless backwater.

Saffranine PP °°.

½ lb. Saffranine PP.
(Pattern No. 20.)

Easily soluble in hot water ; solution clear.

Saffranine is a strong colour, specially useful for the dyeing of half-sized cellulose and mechanical wood pulp.

Pinks dyed with saffranine on news pulp are considerably cheaper than similar shades produced with phloxine.

Though not as fast to acids and to light as erythrine, saffranine resists the influence of alkalies better. Excellent, brilliant deep reds, with clear backwater, may be dyed with saffranine PP in combination with orange II.

On mixed pulps the bluer saffranine T extra is better used in combination with erythrine X. The backwater will be nearly colourless. For the production of yellower shades and of clear backwater saffranine P is used in combination with erythrine P and auramine. Other brands of saffranine, such as TK °° and XX °°, produce different shades, and may be used for special purposes.

As a rule saffranine in combination with a suitable acid colour will give better results, and the colours will be more economically employed.

Magenta Powder A°°.

9½ oz. Magenta Powder.
(Pattern No. 21.)

This colour has replaced the crystals in many cases; it dissolves better but possesses otherwise similar properties. Magentas are very extensively used on account of their extraordinary strength and cheapness for the dyeing of paper pulp.

The magenta sold in green brilliant crystals is rather difficult to dissolve, and if the solution is not very carefully filtered specks may appear in the finished paper.

For the complete solution of 1 lb. of magenta crystals, 10 gallons of a soft hot water should be used. The colour crystallises partly out of the cold solution, for which reason it has to be again heated before using.

It is better to dissolve in each case the quantity only which is necessary for every dyeing operation.

Magenta dyes well on mechanical wood pulp and on cellulose, especially if the fibres are only slightly sized.

Shades produced with magenta on mixed pulp always show the different kinds of fibres unevenly dyed, for which reason the colour by itself is only used for the lowest classes of paper.

Whenever suitable it is recommended to dye the pulp first with cotton scarlet or orange II, as apart from the more level shade obtained, the backwater will be colourless.

For the dyeing of yellowish red shades, magenta is unsuitable on account of its dull bluish shade. Weak solutions of magenta in combination with the redder shades of water blue are used for the toning of whites, especially for news, where cheapness is the principal consideration, whilst fastness is of secondary importance.

The peculiar greenish yellow shade produced by a blue colour in a pulp containing large quantities of mechanical wood is in this way converted into one more agreeable to the eye.

White papers which have been toned with magenta show the disadvantage of appearing darker in artificial light.

Deep brownish reds, such as are in demand for wall-papers, are produced by topping pulp dyed with magenta with methyl violet or orange II. Without methyl violet and with an excess of orange II the shades incline towards scarlet.

The strength of magenta, as already mentioned, is remarkable. 0·154 grs. of magenta will dye 1 quart of water a deep red; 0·00077 grs. will show a distinct pink coloration in the same quantity of water. A strip of unsized paper (filter or blotting-paper) put into this solution will, after a few hours, appear darker coloured than the colour solution.

The following explanation may be given for this: the colour contained in those parts of the solution which come into immediate contact with the unsized paper will go on to the paper; they will, however, be replaced immediately by other colour particles, so that the molecules are in a state of constant movement, which may continue until the solution is nearly entirely decolorised.

From this we may come to the conclusion that for practical work the exhausting of the basic aniline colour solutions will be the more complete the longer they are allowed to remain in contact with the paper pulp.

ACETATE OF ROSANILINE °°.

The excellent solubility of this colour is beyond comparison with the older brands of magenta. 5 oz. and even more may be dissolved without difficulty in 1 quart of cold soft water.

Strong solutions may be kept for a long time without any crystallisation taking place. Colour specks need not be feared, even if the solution is used without previous filtering.

CERISE D. IV °°.

By-product of the manufacture of magenta, producing dull brownish red shades.

1 lb. of cerise should be dissolved in 50 gallons of hot water to which a small quantity of hydrochloric acid has been added.

As a self colour cerise is scarcely used, whilst for mixing with other colours it is often employed.

In combination with diamond green and metanil yellow numerous mode shades and even black may be produced.

For wall-paper cerise is used in combination with new blue S, methyl violet, coal black, vesuvine, orange II., etc.

Crystalline bronzy powder. Condensed water is best suited for dissolving it. If this is not obtainable, an equal quantity of acetic acid should be first poured over the colour and the hot water after this.

Victoria blue B is the purest and most brilliant blue known, and surpasses in this respect even the finest water blue.

The ultramarine-like tone of Victoria blue R is also very beautiful. Still redder than this in shade and about equal to marine blue R, but more brilliant, is Victoria blue 4R.

The pure shade of these colours is not altered in artificial light. They resist alkaline solutions, and are fairly fast to acids.

The fastness to light, however, is inferior to that of the water blues.

Victoria blues have a strong affinity to vegetable fibres. They dye equally well on sized and unsized pulp consisting of all kinds of fibres, and the backwater remains perfectly colourless even when heavy shades have been dyed.

Medium shades can readily be obtained by mixing the redder with the blue shade, and faster colours may be obtained by using Victoria blues for the topping of pulp dyed with Prussian blue. For unsized papers the addition of a little acetic acid to the pulp will be found useful.

In any case the pulp should be mordanted with aluminium sulphate.

Fuller and redder than vesuvine extra.

Very numerous are the shades (heavy browns and mode shades) obtained by mixing vesuvine BC with new blue S, metanil yellow or orange II. These are extensively used as substitutes for cutch shades.

The vesuvines are often used along with auramine, chrysoidine, diamond green B and methyl violet B.

As examples the following may be given: dark green wrapping paper for match boxes, made from neutralised straw pulp, dyed with vesuvine BC, diamond green B and methyl violet B; further deep bright green, for a mixture of cellulose and mechanical wood pulp, dyed with vesuvine BC, diamond green B and metanil yellow or paper yellow.

Other browns well suited for paper dyeing, and which are considerably faster to light than Bismarck browns, are—

FAST BROWN °, NAPHTHYLAMINE BROWN °,

often used as substitutes for English red and burnt ochre.

Water Blue IN °.

½ lb. Water Blue IN.

(Pattern No. 7.)

Soluble in hot water. 1 lb. of colour in 5 gallons of water. Solution clear.

Water blue IN is valuable on account of its pure brilliant greenish blue shade, which does not alter its tone in artificial light. Compared with other aniline colours, it stands exposure to sunlight well and is fast to acids.

Diamond Green B^{oo}.

½ lb. Diamond Green B.
(Pattern No. 23.)

The basic colours, diamond green B (pure bluish green), diamond green G (pure yellowish green), brilliant green, new Victoria green, are all readily soluble in hot soft water. They fix best on soft sized pulp. If used on mechanical wood and cellulose the backwater is nearly colourless.

They are often used as self colours. For dark green it is better to mordant the pulp with pyrolignite of iron. Diamond green is, as already mentioned, extensively used in combination with methyl violet for Prussian blue imitations.

More brilliant shades of yellowish green may be obtained by mixing it with auramine, or grass green shades by mixing it with metanil yellow or orange. Auramine and vesuvine or chrysoidine in combination with diamond green produces mode shades, such as leaf green, mignonette green and greyish green. Various olive shades may be obtained by mixing green with metanil yellow and vesuvine, dark fir green with brilliant black and orange.

The shade of logwood extract may be imitated by mixing methyl violet, vesuvine and green.

Very numerous indifferent shades which lie between olive green, brown, grey and black may be produced by using cerise, metanil yellow and green in combination.

Nigrosine WL°.

½ lb. Nigrosine WL.
(Pattern No. 24.)

Soluble in hot water, should be carefully filtered before adding to the pulp.

The nigrosines, W, WG, WL, are superior to a number of coal tar colours on account of their fastness to acids, alkalies and light.

They belong to the same group as fast blue and induline, but are rather weak. They are fixed well on hard sized pulp with an excess of aluminium sulphate, and they dye mechanical wood pulp only slightly.

The use of nigrosine is therefore only a limited one. These colours are recommended for the production of light silver grey shades on high-class papers. The shades may be varied by mixing the nigrosines with metanil yellow or water blue.

Greys of similar shade, considerably cheaper, but at the same time much inferior as far as fastness is concerned, may be produced with methyl violet and auramine or metanil yellow.

Coal (Jet) Black°°.

½ lb. Coal Black.
(Pattern No. 25.)

readily soluble. Beautiful brilliant pink, specially suited for any kind of sized or unsized pulp.

Excess of aluminium sulphate turns the shade yellower and duller.

The purest shades are obtained and nearly all the colour is precipitated by adding 5 to 10 lb. of aluminium acetate, 13½° Tw., to every 100 parts of dry fibres after the sizing is completed. Sugar of lead blues the shade. The larger the quantity added the bluer the shade will be, and the fastness to light will be increased accordingly. The sugar of lead mordant is, however, poisonous, and is therefore only employed in special instances.

According to the brilliancy required, bluer shades may be obtained without difficulty by mixing eosine with rose bengale or saffranine, and for lower class papers with erythrine or magenta. The beautiful pink and red shades obtained by topping eosine with rhodamine deserve special mention. It is scarcely possible to obtain such brilliant shades in any other way and to get the backwater at the same time nearly colourless. For cheap papers eosine is rather too high in price. In cases where the cost is to be considered, it should be dyed in combination with cotton scarlet; the shades will be faster and cheaper, but not so brilliant and clear.

Somewhat purer shades are obtained by mixing eosine with erythrine 2 R. Eosine is sold under numerous names, and the various brands range from the yellowest to the bluest shades (eosine A, BN, RG, etc.)

Erythrosine and rose bengale, two colours belonging to the eosine group, are extensively used for the dyeing of tissue papers for the manufacture of artificial flowers.

Methylene Blue MD $^{\infty}$.

12 oz. Methylene Blue MD.
(Pattern No. 10.)

Bronze-coloured powder soluble in hot water.

Methylene blue is fairly fast to alkalies and to acids, and is of greater value for the dyeing of unbleached than for bleached fibres.

The backwater is only slightly coloured.

The rich greenish blue shade of methylene blue MD appears still greener in artificial light.

The colour is very useful for the topping of Prussian blue.

The pulp should be mordanted with aluminium sulphate, as a more evenly dyed paper will be obtained in this way.

Methylene blue B, BH, BZ, etc., as well as the so-called marine blues (navy blues), differ only in shade from methylene blue MD.

Nile Blue R $^{\infty}$.

½ lb. Nile Blue B.
(Pattern No. 11.)

VI. PRACTICAL APPLICATION OF THE COAL TAR COLOURS ACCORDING TO THEIR PROPERTIES AND THEIR BEHAVIOUR TOWARDS THE DIFFERENT PAPER FIBRES.

COAL TAR COLOURS WHICH RANK FOREMOST, AS FAR AS THEIR FASTNESS TO LIGHT IS CONCERNED.

As already mentioned, the acid colours may, generally speaking, be regarded as the fastest to light. Colours of the above group which possess this property are :—

Quinoline yellow, metanil yellow, paper yellow, azoflavine, cotton yellow G, orange II and N.

Fast brown, naphthylamine brown.

All the water blues and pure blue, alkali blue.

Cotton scarlet, erythrine 2 R, X, P, fast scarlet B and G, fast red A.

Wool green S.

Nigrosine, brilliant black B.

Of the direct dyeing colours, which, however, are almost exclusively used for either unsized paper pulp or for fibres which are intended for mixing into white pulp, may be mentioned—

Thiazine red G and R, oxamine red.

COLOUR COMBINATIONS WITH WHICH COLOURLESS OR NEARLY COLOURLESS BACKWATER IS OBTAINED.

It has been pointed out elsewhere that if a pulp bottomed with a basic colour is topped with an acid colour, or *vice versâ*, precipitation between the two colours ensues. The result of this is that the two colours are more thoroughly fixed on the fibres, the bath is completely exhausted, and the backwater produced is colourless.

As a rule it is better to use the basic colour first, as china clay, ochre, etc., mixed with water fix the dissolved colour so perfectly that it is impossible to wash it off, even with hot water. The combination is rendered in any case fast to water by the sizing which follows the dyeing.

With the combinations given below excellent results will be obtained. Auramine, in combination with an acid yellow—for example, 1 part auramine O or 3 parts auramine II with 1 part naphthol yellow S—produces full yellow shades with colourless backwater. 1 part auramine O or 3 parts auramine II with 4 to 5 parts quinoline yellow produces shades faster to light than with naphthol yellow.

For redder yellow and yellow orange shades auramine with metanil yellow or orange II gives a colourless backwater, auramine with paper yellow, azoflavine and others.

Orange II in combination with chrysoidine A is used for well-covered, full orange shades. Orange II and saffranine PP gives an excellent combination for a well-fixed scarlet with colourless backwater. Orange II with magenta powder A yields a cheap, heavy crimson. Orange II with diamond green B: for full olive greens; backwater only slightly coloured. Water blue in combination with basic blue—for example, water blue IN with Victoria blue B gives a brilliant heavy blue with colourless backwater. The same in other shades: water blue with methylene blue, nile blue, indoine

Very rich pink and scarlet shades and clear back-water may be obtained by forming a precipitate between the paper scarlet (basic) and cotton scarlet (acid).

The cotton scarlet is first dyed and then topped with the paper scarlet.

This is one of the instances mentioned before, where a basic colour is used to form a lake with an acid colour.

Specially good results are obtained by using saffranine. 12 oz. of this colour with 3 lb. of cotton scarlet produce a deep, fairly fast crimson and colourless back-water.

Phloxine or magenta may be used for the shading of cotton scarlet to obtain bluer, finer and cheaper reds.

The importance of this colour for the production of cheap pinks in combination with eosine and erythrine has been already mentioned.

The most brilliant vermilion and scarlet shades are obtained with cotton scarlet and orange II.

Erythrine RR °.

½ lb. Erythrine RR °.
(Pattern No. 18.)

Dyes bluer and more transparent shades, but is in other respects similar to cotton scarlet. Mixed pulps are dyed level with this colour, the shades obtained being fairly fast to light.

Faster and stronger than eosine, erythrine RR is frequently used in combination with this colour.

Phloxine BBN^{x}.

½ lb. Phloxine BBN.
(Pattern No. 15.)

The phloxines are, on account of the pure brilliant shades which they produce, nearly always used as self colours. Their principal use is for the production of geranium shades for tissues used for artificial flower manufacture. The mode of application is the same as for eosine. For bluer shades sugar of lead, for yellow ones aluminium acetate, is used as mordant.

The backwater is nearly colourless, even where deep shades have been dyed, and the loss of colour is therefore only slight.

Phloxines are affected by acids, brown precipitates being formed.

Other brands of phloxine, such as the H, GN, BN, are used for similar purposes as the BBN.

Rhodamine B$^{\infty}$.

½ lb. of Rhodamine B.
(Pattern No. 16.)

Readily soluble in soft water at the boil; hard water should be corrected by adding acetic acid.

paper pulp) will be found sufficient for mottling in most cases.

COLOURS SPECIALLY SUITED FOR JUTE DYEING.

Auramine, chrysoidine, vesuvine.

Saffranine, magenta.

Methyl violet, crystal violet.

New blue, marine blue, nile blue, Victoria blue, indoine blue, methylene blue.

Diamond green.

Coal black.

Jute possesses the property of absorbing basic aniline colours almost completely from their hot solutions.

To obtain shades on jute perfectly fast to water, the pulp should be heated to 158° to 168° F., and a solution of 5 per cent. of tannic acid (of the weight of dry fibres) added. The dyed fibres are allowed to remain in this tannic acid bath until perfectly cold. They are then filtered, washed and dried. 2½ to 4 lb. of dyed jute fibres are generally sufficient for 100 lb. of pulp.

COLOURS SUITABLE FOR WOOL FIBRES.

The dyeing of wool is done best with acid colours and in an acid bath. The fibres remain glossy and are not weakened. Of the acid colours which are considered fast to light, the following may be mentioned :—

Quinoline yellow, metanil yellow, azoflavine, orange.

Fast red, cotton scarlet, erythrine, fast ponceau.

Fast brown, naphthylamine brown.

Water blue, pure blue, alkali blue.

Wool green.

Nigrosine, brilliant black.

The wool is entered into the lukewarm dye bath, 2 to 4 per cent. of sulphuric acid, 168° Tw. (of the weight of fibres), is gradually added, the bath heated to the boil, and kept boiling for one hour. Should the colour not be perfectly fixed at this stage, 5 to 10 per cent. of Glaubers salt is added.

The dyed fibres are drained, rinsed and dried.

In place of the sulphuric acid and Glaubers salt, 5 to 10 per cent. of bisulphate of soda may be used in the manner described above.

3 to 5 lb. of dyed wool fibres are generally sufficient for 100 lb. of pulp to obtain a suitable mottled paper.

from the more level shade obtained, the backwater will be colourless.

For the dyeing of yellowish red shades, magenta is unsuitable on account of its dull bluish shade. Weak solutions of magenta in combination with the redder shades of water blue are used for the toning of whites, especially for news, where cheapness is the principal consideration, whilst fastness is of secondary importance.

The peculiar greenish yellow shade produced by a blue colour in a pulp containing large quantities of mechanical wood is in this way converted into one more agreeable to the eye.

White papers which have been toned with magenta show the disadvantage of appearing darker in artificial light.

Deep brownish reds, such as are in demand for wall-papers, are produced by topping pulp dyed with magenta with methyl violet or orange II. Without methyl violet and with an excess of orange II the shades incline towards scarlet.

The strength of magenta, as already mentioned, is remarkable. 0·154 grs. of magenta will dye 1 quart of water a deep red; 0·00077 grs. will show a distinct pink coloration in the same quantity of water. A strip of unsized paper (filter or blotting-paper) put into this solution will, after a few hours, appear darker coloured than the colour solution.

The following explanation may be given for this: the colour contained in those parts of the solution which come into immediate contact with the unsized paper will go on to the paper; they will, however, be replaced immediately by other colour particles, so that the molecules are in a state of constant movement, For the same purpose—

Erythrine X $^{\circ\circ}$

is used. Its shade is bluer than that of the 2 R brand.

A valuable combination is obtained by mixing it with saffranine T. Erythrine X is a useful colour for the toning of white papers.

Erythrine P $^{\circ\circ}$

dyes bright strong shades, and produces the cheapest Bordeaux reds. Its affinity to vegetable fibres is a very strong one.

Mixed with auramine and saffranine red shades are obtained which cannot be produced as advantageously by any other method.

Ponceau 2 R $^{\circ\circ}$
as well as
Fast Ponceau B $^{\circ\circ}$ **and G** $^{\circ\circ}$

are used for the same purposes for which the cotton scarlet has been recommended. They dye best on unbleached sized soda and sulphite pulp.

Paper Scarlet P $^{\circ\circ\circ}$.

1 lb. Paper Scarlet P.
(Pattern No. 12.)

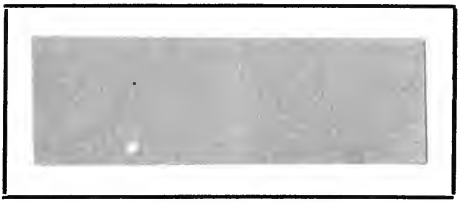
Soluble in hot water; not as fast to light as erythrine or cotton scarlet, but faster to alkalies. The colour exhausts well on mechanical wood and unbleached sulphite pulp, producing a colourless backwater.

(Pattern No. 27.)

Pulp mixture as in No. 26.
1 oz. 9 dr. 11 gr. naphthol yellow S.
1 oz. 1 dr. auramine O.

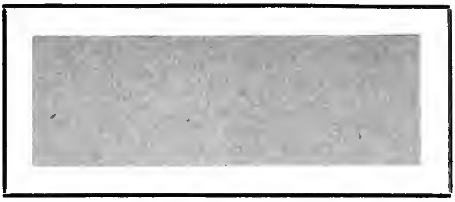
(Pattern No. 28.)

Pulp mixture as in No. 26.
12 oz. 10 dr. naphthol yellow S.
8 oz. 7 dr. auramine O.



(Pattern No. 29.)

Pulp mixture as in No. 26.
2 lb. 3¼ oz. naphthol yellow S.
1 lb. 12 oz. 3 dr. auramine O.



(Pattern No. 30.)

66 lb. = 10 per cent. No. 8 bleached.
66 lb. = 10 ,, No. 7 ,,
66 lb. = 10 ,, No. 23 ,,
66 lb. = 10 ,, No. 22 ,,
132 lb. = 20 ,, sulphite pulp II.
132 lb. = 20 ,, mechanical wood (pine).
132 lb. = 20 ,, china clay.
12½ lb. sugar of lead (cold solution).

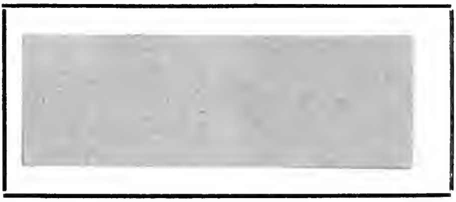
5 minutes later :

4 lb. 6½ oz. sodium bichromate (cold solution).

5 minutes later :

1 lb. auramine O.
5¼ oz. metanil yellow extra.
4 lb. 6½ oz. of aluminium sulphate.

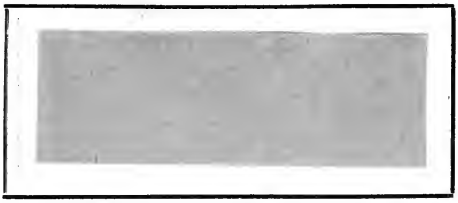
Half-sized.



(Pattern No. 31.)

66 lb. = 10 per cent. No. 8 bleached.
66 lb. = 10 ,, No. 23 ,,
99 lb. = 15 ,, sulphite wood.
396 lb. = 60 ,, mechanical wood.
33 lb. = 5 ,, china clay.
5¼ oz. auramine O.
10½ oz. metanil yellow extra.

Half-sized.



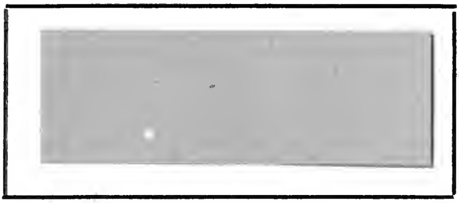
(Pattern No. 32.)

Pulp mixture as in No. 31.

2 lb. ½ oz. metanil yellow extra.

(Pattern No. 33.)

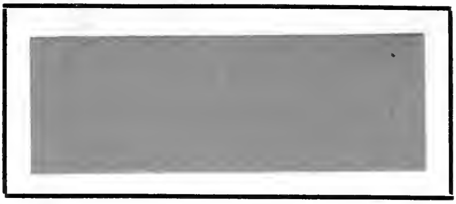
33 lb. = 5 per cent. No. 8 bleached.
33 lb. = 5 ,, No. 23 ,,
66 lb. = 10 ,, sulphite wood.
462 lb. = 70 ,, mechanical wood.
66 lb. = 10 ,, china clay.
5 oz. 10 dr. auramine O.
3 lb. 1 oz. 5½ dr. metanil yellow extra.



(Pattern No. 34.)

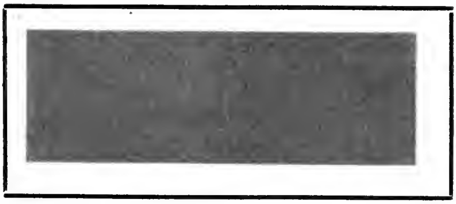
Pulp mixture as for No. 33.

2 lb. 12 oz. metanil yellow extra.
10½ oz. orange II.



(Pattern No. 35.)

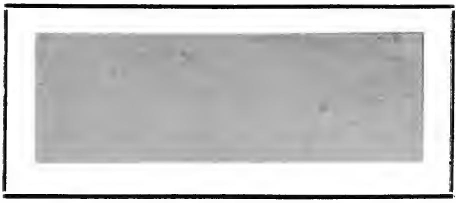
264 lb. = 40 per cent. No. 7 bleached.
66 lb. = 10 ,, No. 22 ,,
264 lb. = 40 ,, mechanical wood (aspe).
66 lb. = 10 ,, china clay.
24 lb. 3¾ oz. sugar of lead.
8 lb. 13 oz. bichromate of sodium.
13 lb. 3½ oz. red lead.
4 lb. 6½ oz. metanil yellow extra.
1 lb. 1½ oz. orange.
Half-sized.



(Pattern No. 36.)

Pulp mixture as for No. 33.

13 lb. 3½ oz. orange II.
Hard-sized.



(Pattern No. 37.)

Pulp mixture as for No. 33.

5 lb. 8 oz. orange II.
10½ oz. metanil yellow extra.

(Pattern No. 38.)

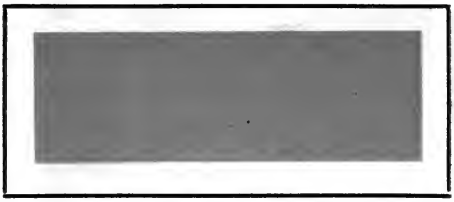
Pulp mixture as for No. 26.

2 oz. 1½ dr. orange II.
3 lb. 13¾ oz. golden ochre.

(Pattern No. 39.)

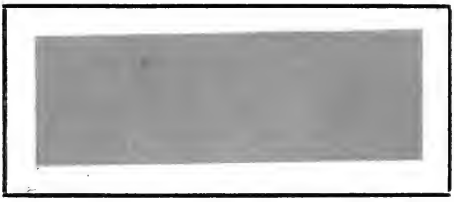
Pulp mixture as for No. 35.

Solution of 13 lb. 3½ oz. sulphate of zinc.
30 lb. 13½ oz. saturnine red.
4 lb. 6½ oz. red lead.



(Pattern No. 40.)

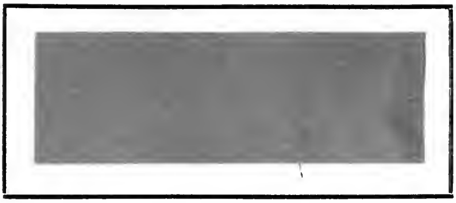
33 lb. = 5 per cent. No. 8 bleached.
33 lb. = 5 ,, No. 23 ,,
66 lb. = 10 ,, sulphite wood.
462 lb. = 70 ,, mechanical wood (pine).
66 lb. = 10 ,, china clay II.
6 lb. 9¾ oz. aluminium acetate.
6 lb. 9¾ oz. brilliant orange R.
Half-sized.
13 lb. 3½ oz. aluminium acetate, 13½° Tw.



(Pattern No. 41.)

Pulp mixture as for No. 31.

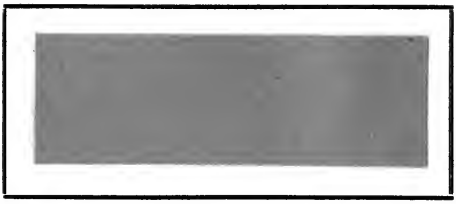
4 lb. 6½ oz. aluminium acetate, 13½° Tw.
7 oz. cotton scarlet extra.
2 lb. 3¼ oz. brilliant orange R.



(Pattern No. 42.)

Pulp mixture as for No. 33.

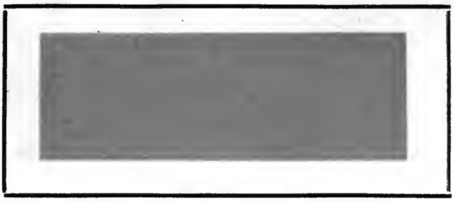
4 lb. 6½ oz. aluminium acetate, 13½° Tw.
6 lb. 1 oz. brilliant orange R.
10½ oz. cotton scarlet extra.
Three-quarter-sized.



(Pattern No. 43.)

Pulp mixture as for No. 33.

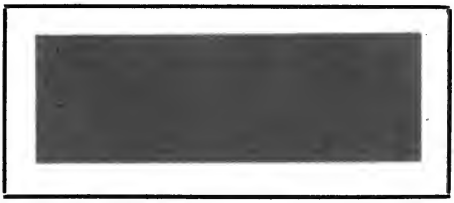
6 lb. 9¾ oz. aluminium sulphate.
3 lb. 4⅞ oz. orange P.
3 lb. 13¾ oz. ponceau 3 R.
8⅞ oz. cotton scarlet extra.
Three-quarter-sized.



(Pattern No. 44.)

Pulp mixture as for No. 31.

4 lb. 6½ oz. aluminium acetate, 13½° Tw.
4 lb. 1¼ oz. brilliant orange G.
3 lb. 3 oz. 2 dr. cotton scarlet extra.
1 lb. 12 oz. sugar of lead.
5 oz. 11 dr. magenta powder A.

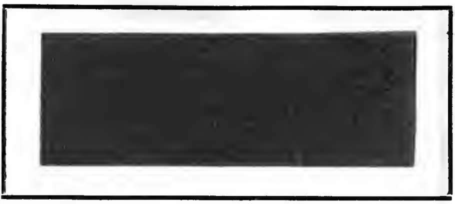


(Pattern No. 45.)

231 lb. = 35 per cent. No. 7 unbleached.
66 lb. = 10 ,, No. 22 ,,
297 lb. = 45 ,, mechanical wood (pine).
66 lb. = 10 ,, china clay.
11 lb. aluminium acetate, 13½° Tw.
17 lb. 8 oz. cotton scarlet extra.
13 lb. 13¾ oz. brilliant orange R.
14 oz. ,, ,, G.

Three-quarter-sized.

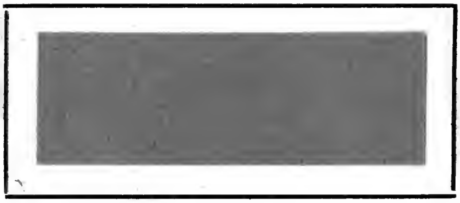
10 lb. 15 oz. aluminium acetate, 13½° Tw.



(Pattern No. 46.)

Pulp mixture as for No. 31.

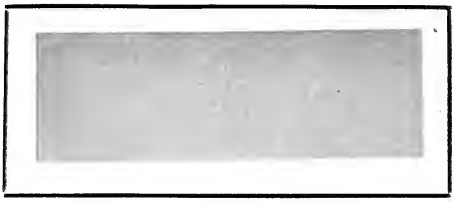
6 lb. 9 oz. aluminium sulphate.
7 lb. 10½ oz. brilliant orange G.
5 lb. 8½ oz. cotton scarlet extra.
2 lb. 12 oz. sugar of lead.
9½ oz. magenta powder A.
Hard-sized.



(Pattern No. 47.)

Pulp mixture as for No. 26.

4 lb. 6 oz. aluminium sulphate.
3 lb. 13¼ oz. brilliant orange G.
3 lb. 1 oz. cotton scarlet extra.
1 lb. 10¼ oz. sugar of lead.
Three-quarter-sized.



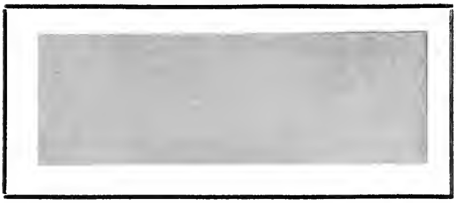
(Pattern No. 48.)

Pulp mixture as for No. 33.

2 oz. 5 dr. eosine.
3 dr. magenta powder.
$8\frac{3}{4}$ oz. ultramarine.

(Pattern No. 49.)

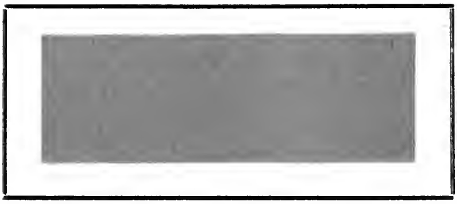
231 lb. = 35 per cent. No. 7 bleached.
99 lb. = 15 ,, No. 22 ,,
264 lb. = 40 ,, mechanical wood (pine).
66 lb. = 10 ,, china clay.
2 lb. 3 oz. aluminium acetate, $13\frac{1}{2}$° Tw.
$10\frac{1}{2}$ oz. eosine extra.
4 oz. 3 dr. ultramarine.
Three-quarter sized.



(Pattern No. 50.)

Pulp mixture as for No. 49.

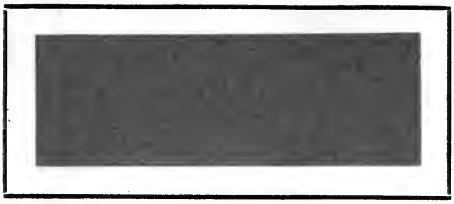
2 lb. 3 oz. aluminium acetate, 13½° Tw.
15¾ oz. eosine extra.
4 oz. 3 dr. ultramarine.



(Pattern No. 51.)

Pulp mixture as for No. 33.

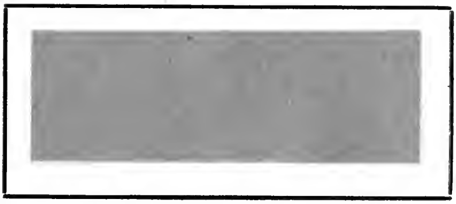
10½ oz. cotton scarlet extra.
7 oz. saffranine T extra.
4 lb. 6 oz. aluminium sulphate.
1 lb. 1½ oz. eosine extra.
Three-quarter sized.



(Pattern No. 52.)

Pulp mixture as for No. 33.

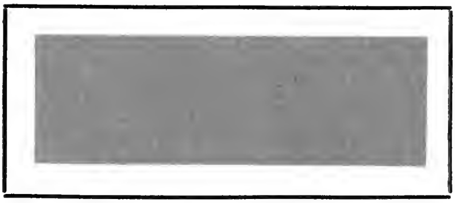
14⅞ oz. phloxine.
9 lb. 4¾ oz. sugar of lead.
4 lb. 6 oz. aluminium sulphate.
2 lb. 3 oz. eosine extra.
⅞ oz. magenta.



(Pattern No. 53.)

Pulp mixture as for No. 31.

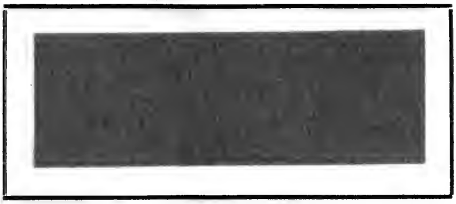
1 lb. 8½ oz. eosine extra.
⅞ oz. magenta powder A.



(Pattern No. 54.)

Pulp mixture as for No. 31.

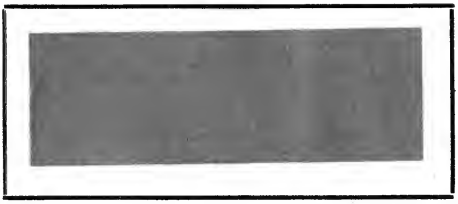
2 lb. 3 oz. aluminium sulphate.
12 oz. 15¾ dr. diamond magenta.
Quarter-sized.



(Pattern No. 55.)

Pulp mixture as for No. 33.

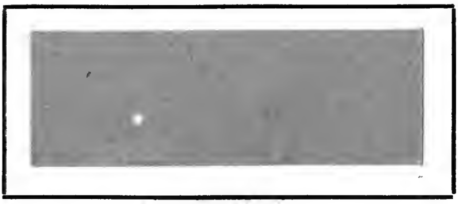
4 lb. 6 oz. aluminium sulphate.
1 lb. $1\frac{1}{2}$ oz. diamond magenta.
Quarter-sized.



(Pattern No. 56.)

Pulp mixture as for No. 26.

2 lb. 3 oz. aluminium sulphate.
14 oz. methyl violet R.



(Pattern No. 57.)

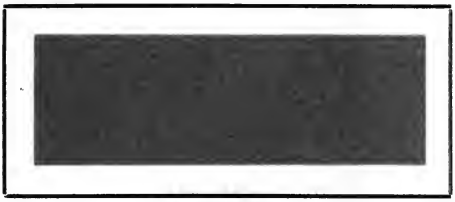
Pulp mixture as for No. 31.

2 lb. 3 oz. aluminium sulphate.
2 oz. $7\frac{3}{4}$ dr. methyl violet R.

(Pattern No. 58.)

Pulp mixture as for No. 31.

2 lb. 3 oz. aluminium sulphate.
10½ oz. methyl violet B.



(Pattern No. 59.)

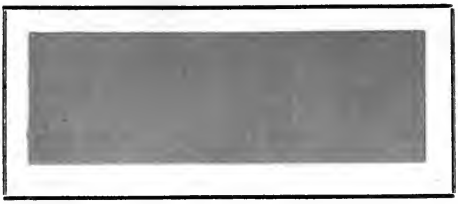
Pulp mixture as for No. 31.

4 lb. 6 oz. aluminium sulphate.
2 lb. 3 oz. methyl violet 5 B.
14 oz. logwood extract.

(Pattern No. 60.)

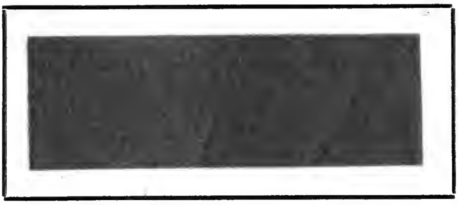
Pulp mixture as for No. 31.

3 lb. 13¾ oz. methyl violet 4 B.
1 lb. 1½ oz. brilliant black B.
4 lb. 14¾ oz. logwood extract.
4 lb. 6 oz. aluminium sulphate.



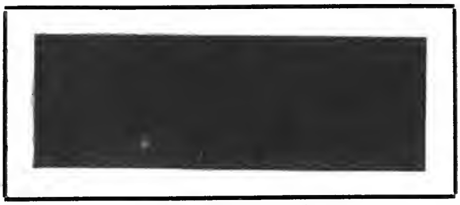
(Pattern No. 61.)

Pulp mixture as for No. 33.
4 lb. 6 oz. aluminium sulphate.
3½ oz. water blue TB.



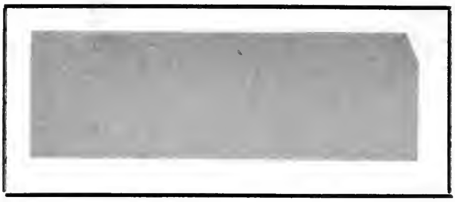
(Pattern No. 62.)

Pulp mixture as for No. 26.
6 lb. 9 oz. aluminium sulphate.
2 lb. 10 oz. water blue TB.
1 lb. 10¼ oz. ,, IN.
2 lb. 3 oz. sulphuric acid, 168° Tw.
Three-quarter-sized.



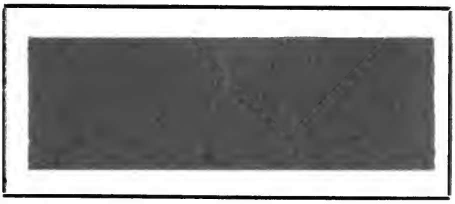
(Pattern No. 63.)

Pulp mixture as for No. 33.
3 lb. 1⅞ oz. methyl violet 2 B.
1 lb. 3 oz. 9½ dr. brilliant green.
2 lb. 3 oz. aluminium sulphate.



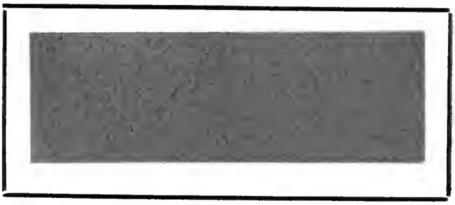
(Pattern No. 64.)

Pulp mixture as for No. 26.
4 lb. 6 oz. aluminium sulphate.
2 oz. 1½ dr. imperial blue.



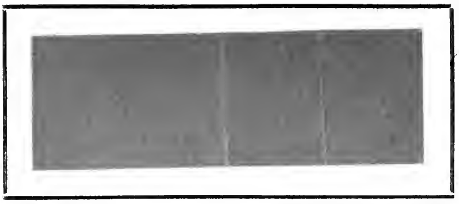
(Pattern No. 65.)

Pulp mixture as for No. 31.
6 lb. 9 oz. aluminium sulphate.
2 lb. ⅜ oz. imperial blue.
1 lb. 5¾ oz. water blue IN.
1 lb. 10¼ oz. sulphuric acid, 168° Tw.
Three-quarter-sized.



(Pattern No. 66.)

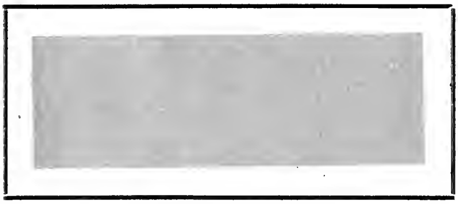
Pulp mixture as for No. 31.
4 lb. 6 oz. aluminium sulphate.
1 lb. 9⅜ oz. water blue IN.
1 lb. 1½ oz. sulphuric acid, 168° Tw.
Three-quarter-sized.



(Pattern No. 67.)

Pulp mixture as for No. 49.

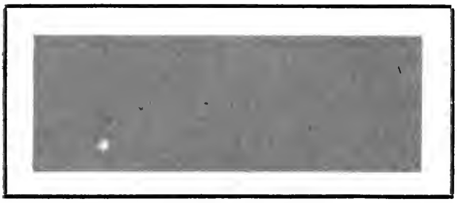
1 lb. 1 oz. 1½ dr. Victoria blue B.
10½ oz. water blue IN.
4 lb. 6 oz. aluminium sulphate.



(Pattern No. 68.)

Pulp mixture as for No. 26.

4 lb. 6 oz. aluminium sulphate.
5¼ oz. water blue IN.
8¾ oz. sulphuric acid, 168° Tw.
3 lb. 4½ oz. Prussian blue.



(Pattern No. 69.)

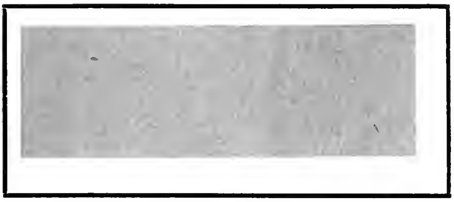
Pulp mixture as for No. 33.

1 lb. 11⅛ oz. malachite green B.
3 oz. 2½ dr. methyl violet 5 B.
2 lb. 3 oz. aluminium sulphate.

(Pattern No. 70.)

Pulp mixture as for No. 49.

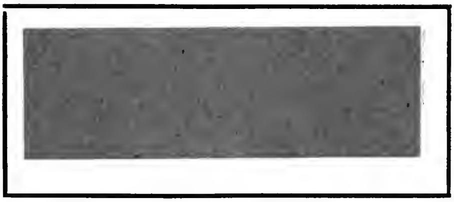
7 oz. ultramarine.
2¾ oz. malachite green extra.
2 lb. 3 oz. aluminium sulphate.



(Pattern No. 71.)

Pulp mixture as for No. 49.

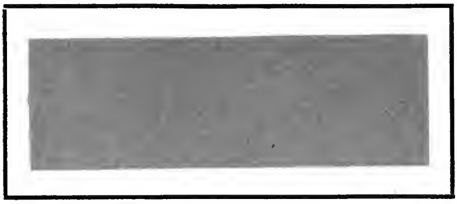
12 oz. ultramarine.
4½ oz. malachite green extra.
2 lb. 3 oz. aluminium sulphate.



(Pattern No. 72.)

Pulp mixture as for No. 31.

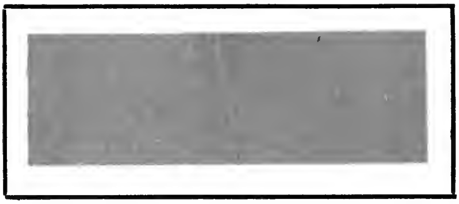
2 lb. 3 oz. aluminium sulphate.
1 lb. 1½ oz. malachite green B.



(Pattern No. 73.)

Pulp mixture as for No. 31.

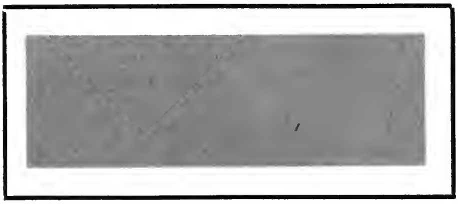
2 lb. 3 oz. aluminium sulphate.
1 lb. 1½ oz. brilliant green extra.



(Pattern No. 74.)

Pulp mixture as for No. 31.

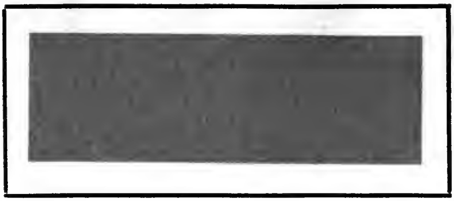
4 oz. 3 dr. naphthol yellow S.
2 oz. 13 dr. auramine O.
2 lb. 3 oz. aluminium sulphate.
14 oz. brilliant green extra.



(Pattern No. 75.)

Pulp mixture as for No. 31.

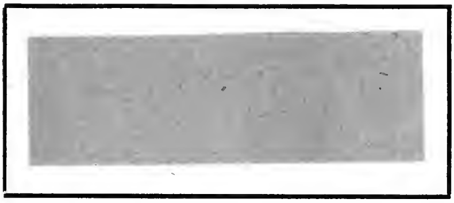
8 oz. naphthol yellow S.
5¼ oz. auramine O.
2 lb. 3 oz. aluminium sulphate.
14⅞ oz. brilliant green extra.



(Pattern No. 76.)

Pulp mixture as for No. 31.

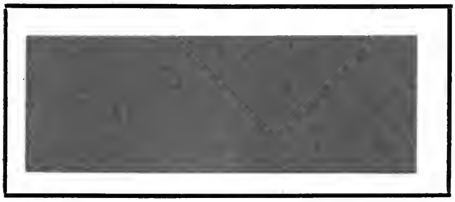
14 oz. 11 dr. naphthol yellow S.
10⅞ oz. auramine O.
2 lb. 6 oz. aluminium sulphate.
1 lb. 3¼ oz. brilliant green extra.



(Pattern No. 77.)

Pulp mixture as for No. 26.

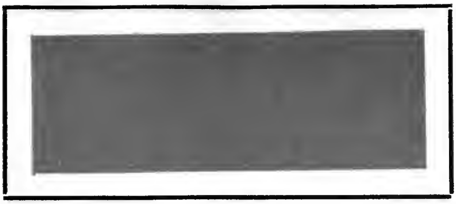
2 oz. 1½ dr. brilliant green extra.
4 oz. 3 dr. metanil yellow extra.



(Pattern No. 78.)

Pulp mixture as for No. 33.

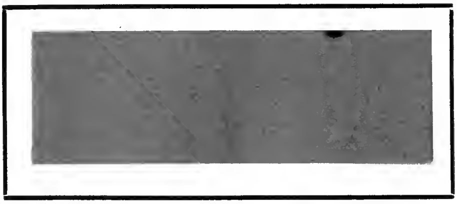
14 oz. brilliant green extra.
14 oz. metanil yellow extra.



(Pattern No. 79.)

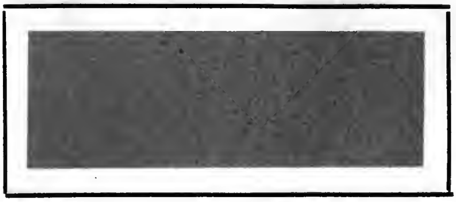
Pulp mixture as for No. 33.

6 lb. 9 oz. aluminium sulphate.
3 lb. 4½ oz. Prussian blue.
37 lb. sugar of lead.
15 lb. sodium bichromate.



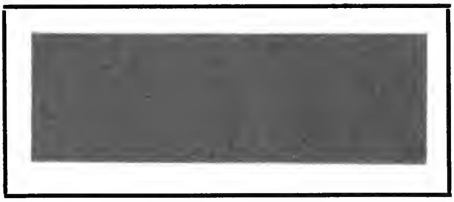
(Pattern No. 80.)

82½ lb. = 12½ per cent. No. 8 unbleached.
33 lb. = 5 ,, No. 3 ,,
49½ lb. = 7½ ,, sulphite wood.
429 lb. = 65 ,, mechanical wood (pine).
33 lb. = 5 ,, white clay.
33 lb. = 5 ,, golden ochre.
2 lb. 12 oz. logwood extract.
4 lb. 6 oz. aluminium sulphate.
2 lb. 3 oz. vesuvine extra.
11⅜ oz. orange II.
1 lb. 1½ oz. metanil yellow extra.
Half-sized.



(Pattern No. 81.)

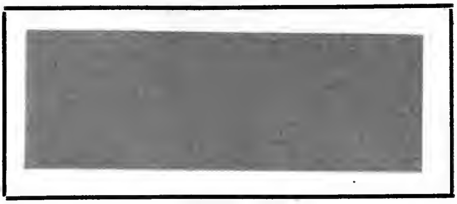
132 lb. = 20 per cent. No. 8 unbleached.
33 lb. = 5 ,, No. 22 ,,
66 lb. = 10 ,, sulphite wood.
363 lb. = 55 ,, mechanical wood (pine).
66 lb. = 10 ,, ochre.
1 lb. 6¾ oz. logwood extract.
2⅝ oz. potassium bichromate.
4 lb. 6 oz. aluminium sulphate.
2 lb. 11¾ oz. vesuvine BL.
15 oz. orange II.
1 lb. 4 oz. metanil yellow extra.
Half-sized.



(Pattern No. 82.)

Pulp mixture as for No. 81.

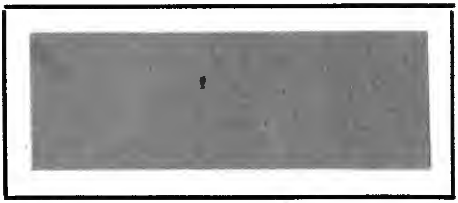
1 lb. 1½ oz. logwood extract.
2⅛ oz. potassium bichromate.
4 lb. 6 oz. aluminium sulphate.
2 lb. 11¾ oz. vesuvine BL.
1 lb. 6¾ oz. orange II.
1 lb. 15½ oz. metanil yellow extra.



(Pattern No. 83.)

Pulp mixture as for No. 81.

12¼ oz. logwood extract.
1¾ oz. potassium bichromate.
4 lb. 6 oz. aluminium sulphate.
3 lb. 1 oz. vesuvine BL.
1 lb. 12 oz. orange II.
2 lb. 3 oz. metanil yellow extra.



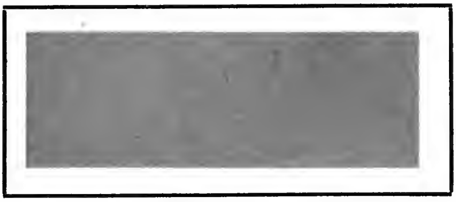
(Pattern No. 84.)

132 lb. = 20 per cent. of No. 8 unbleached.
33 lb. = 5 ,, of No. 22 ,,
66 lb. = 10 ,, of sulphite wood.
363 lb. = 55 ,, mechanical wood (pine).
39·6 lb. = 6 ,, white clay.
26·4 lb. = 4 ,, golden ochre.
1 lb. 10¼ oz. logwood extract.
4 lb. 6 oz. aluminium sulphate.
3 lb. 1 oz. vesuvine extra.
10½ oz. chrysoidine A.
10½ oz. orange II.
Half-sized.

(Pattern No. 85.)

Pulp mixture as for No. 80.

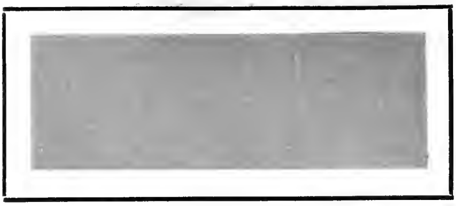
2 lb. 11¾ oz. logwood extract.
5¼ oz. potassium bichromate.
4 lb. 6 oz. aluminium sulphate.
3 lb. 4½ oz. vesuvine extra.
1 lb. 8½ oz. orange II.
1 lb. 10¼ oz. metanil yellow extra.



(Pattern No. 86.)

132 lb.	= 20 per cent.	No. 8 bleached.
33 lb.	= 5 ,,	No. 23 ,,
66 lb.	= 10 ,,	sulphite wood.
363 lb.	= 55 ,,	mechanical wood (pine).
66 lb.	= 10 ,,	china clay.

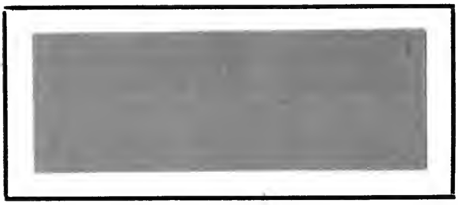
8 lb. 12 oz. golden ochre.
6 lb. 9 oz. brown ochre.
2 lb. 3 oz. aluminium sulphate.
3½ oz. Prussian blue (free from acid).
Half-sized.



(Pattern No. 87.)

Pulp mixture as for No. 86.

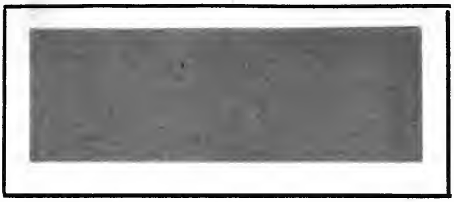
4 lb. 6 oz. aluminium sulphate.
10½ oz. nigrosine W.
7 lb. 10½ oz. ochre.
1¾ oz. Prussian blue.



(Pattern No. 88.)

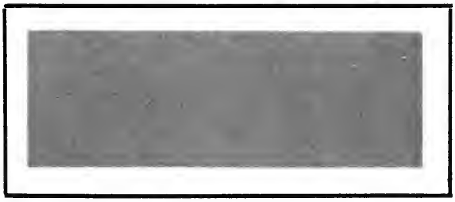
Pulp mixture as for No. 33.

4 lb. 6 oz. aluminium sulphate.
12¼ oz. nigrosine.
1 lb. 1½ oz. logwood extract.
12¼ oz. potassium bichromate.
2 lb. 3 oz. ferrous sulphate.
5 lb. 7½ oz. ochre.



(Pattern No. 89.)

132 lb. = 20 per cent. No. 8 unbleached.
33 lb. = 5 ,, No. 23 bleached.
66 lb. = 10 ,, sulphite wood.
363 lb. = 55 ,, mechanical wood (pine).
66 lb. = 10 ,, china clay.
10½ oz. vesuvine BB.
14 oz. nigrosine.
4 lb. 6 oz. aluminium sulphate.
12¼ oz. Prussian blue.
10 lb. 15 oz. ochre.
Three-quarter sized.



(Pattern No. 90.)

Pulp mixture as for No. 89.

1 lb. 2⅞ oz. vesuvine BB.
4 lb. 6 oz. aluminium sulphate.
12⅞ oz. Prussian blue.
15 lb. 5 oz. ochre.

BLACK CARTRIDGE PAPERS.

All the proportions are for a beater furnish of 660 lb. of dry fibres.

(Pattern No. 91.)

660 lb. = 100 per cent. unbleached sulphite wood.
4 lb. 9½ oz. brilliant black B with the decoct of 52 lb. 8 oz. of sumac leaves.

1 hour later :
13 lb. 12½ oz. coal black.
1 lb. 15½ oz. diamond green B.
1 lb. 15½ oz. methyl violet B.

P.S.—The tannin is extracted from the sumac in the following way : put the sumac in a bag, fasten at the top, and boil it in a vessel containing 15 to 20 times the amount of water for a quarter of an hour. The liquor is then ready for adding to the pulp.

(Pattern No. 92.)

Without tannin.

495 lb. = 75 per cent. unbleached sulphite wood.
33 lb. = 5 ,, ,, No. 23.
132 lb. = 20 ,, mechanical wood (pine).

32 lb. 13 oz. logwood extract.
4 lb. 14¾ oz. copper sulphate.
8 lb. 12 oz. sodium bichromate.
6 lb. 3¾ oz. coal black.
2 lb. 1¼ oz. brilliant black B

Then add :

10 lb. 15 oz. logwood extract.
10½ oz. methyl violet 2 B.
5¼ oz. diamond green B.
10½ oz. vesuvine extra.
14 oz. chrysoidine A.

$\frac{1}{1}$ sized.

(Pattern No. 93.)

660 lb. = 100 per cent. unbleached sulphite wood.
Decoct of 105 lb. sumac.

1 hour later :

26 lb. 4 oz. coal black.

P.S.—The coal black solution must be added to the beater slowly and through a sieve, and care should be taken that sufficient water has been used for the dissolving.

Three-quarter-sized.

(Pattern No. 94.)

Without tannin.

495 lb. = 75 per cent. of No. 18 unboiled and unbleached.
33 lb. = 5 ,, of No. 23 unbleached.
132 lb. = 20 ,, mechanical wood (pine).
32 lb. 13 oz. logwood extract.
4 lb. 14¾ oz. copper sulphate.
8 lb. 12 oz. potassium bichromate.

Add after this:

15 lb. 6 oz. logwood extract.
2 lb. 3 oz. fustic extract.
13 lb. 2 oz. patent black.
10½ oz. vesuvine.
10½ oz. methyl violet.
2⅝ oz. diamond green B.
10½ oz. brilliant black.
10½ oz. orange II.

$\frac{1}{1}$ sized.

(Pattern No. 95.)

660 lb. = 100 per cent. unbleached sulphite wood.
5 lb. 14½ oz. brilliant black B with the decoct of
52 lb. 8 oz. of sumac.

1 hour later:

17 lb. 11½ oz. coal black.
1 lb. 15½ oz. chrysoidine A.

Three-quarter-sized.

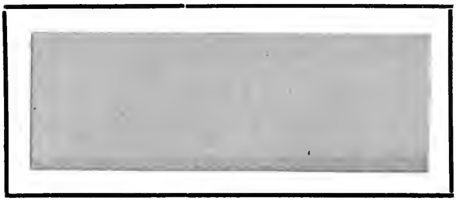
BLOTTING PAPERS.

The proportions given are all for a beater furnish of 660 lb. of bleached half-stuff.

The colours used are manufactured by the Badische Anilin- und Soda-Fabrik.

(Pattern No. 96.)

5¼ oz. cotton yellow R.
6¼ oz. vesuvine BL.
1 dr. 19 gr. indoine blue.
Unsized.



(Pattern No. 97.)

1 lb. 10¼ oz. thiazine red R.
Unsized.

MOTTLED AND MARBLED PAPERS, MADE WITH COLOURED LINEN, COTTON AND UNION RAGS, OR WITH COTTON, JUTE, WOOL AND SULPHITE WOOD FIBRES DYED SPECIALLY FOR THIS PURPOSE.

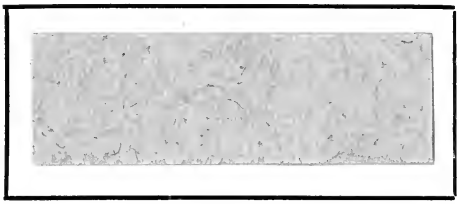
The following dyeing instructions are for a beater charge of 660 lb. of dry fibres.

MOTTLING WITH DARK BLUE LINEN.

Indigo blue dyed rags (No. 18) are carefully sorted, freed from seams, brought into the breaker without previous boiling with lye. Here they should be thoroughly washed, well stirred and beaten to half-stuff. According to the purpose for which the fibres are required they may be left shorter or longer.

The quantity necessary is then exactly measured and distributed in the beater after the china clay has been added, but before the sizing.

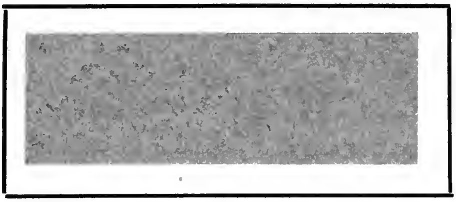
Generally speaking, cotton fibres are better suited for mottling than linen fibres.



(Pattern No. 98.)

132 lb. = 20 per cent. No. 22 bleached.
264 lb. = 40 ,, mechanical wood (pine).
66 lb. = 10 ,, sulphite wood.
99 lb. = 15 ,, china clay.
99 lb. = 15 ,, No. 18 unboiled.
2 lb. 3 oz. aluminium sulphate.
1 oz. 6½ dr. water blue 3 R.
1 dr. 19 gr. magenta.
Three-quarter-sized.

MOTTLING WITH DARK-BLUE LINEN AND DARK-BLUE COTTON.

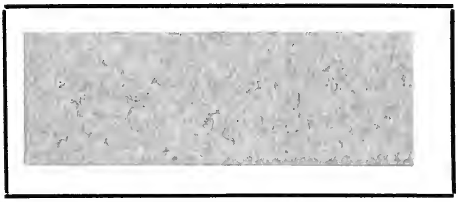


(Pattern No. 99.)

363 lb. = 55 per cent. No. 7 bleached.
33 lb. = 5 ,, china clay.
66 lb. = 10 ,, No. 18.
198 lb. = 30 ,, No. 24.
$8\frac{3}{4}$ oz. ultramarine.
$\frac{7}{8}$ oz. rhodamine.
$\frac{1}{1}$ sized.

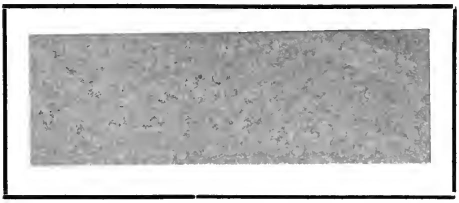
The cotton rags used for mottling are treated in the same manner as given for linen rags; the cutting out of the seams is, however, not always necessary.

MOTTLING WITH DARK-BLUE COTTON.



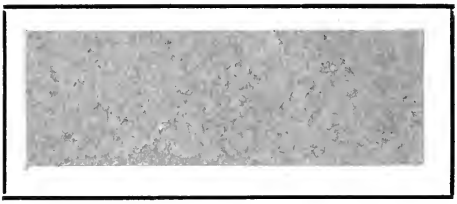
(Pattern No. 100.)

109·95 lb. = $16\frac{2}{3}$ per cent. No. 7 bleached.
92·4 lb. = 14 ,, No. 22 ,,
219·98 lb. = $33\frac{1}{3}$,, sulphite wood.
99 lb. = 15 ,, mechanical wood (pine).
85·8 lb. = 13 ,, china clay.
52·8 lb. = 8 ,, No. 24.
2 lb. 3 oz. aluminium sulphate.
$\frac{7}{8}$ oz. water blue 3 R.
Three-quarter-sized.



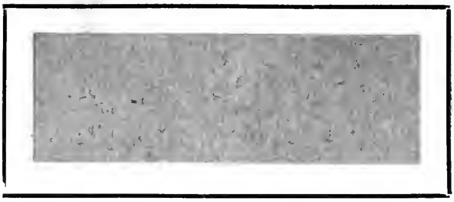
(Pattern No. 101.)

165 lb. = 25 per cent. No. 7 bleached.
66 lb. = 10 ,, No. 22 ,,
132 lb. = 20 ,, sulphite wood unbleached.
99 lb. = 15 ,, china clay.
132 lb. = 20 ,, No. 24.
Three-quarter-sized.



(Pattern No. 102.)

109·95 lb. = 16⅔ per cent. No. 7 bleached.
46·2 lb. = 7 ,, No. 22 ,,
132 lb. = 20 ,, sulphite wood unbleached.
219·98 lb. = 33⅓ ,, mechanical wood (pine).
99 lb. = 45 ,, china clay.
52·8 lb. = 8 ,, No. 24.
8¾ oz. ochre.
Three-quarter-sized.



(Pattern No. 103.)

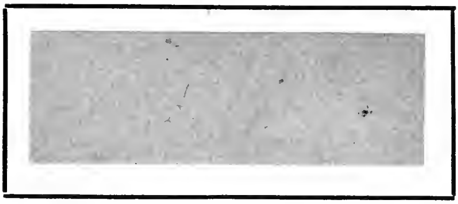
165 lb. = 25 per cent. No. 7 bleached.
99 lb. = 15 ,, No. 22 ,,
198 lb. = 30 ,, sulphite wood unbleached.
99 lb. = 15 ,, mechanical wood (pine).
66 lb. = 10 ,, china clay.
33 lb. = 15 ,, No. 24.
2 lb. 3 oz. aluminium sulphate.
$1\frac{3}{4}$ oz. diamond green G.
Three-quarter-sized.

MOTTLING WITH DARK-BLUE AND RED COTTON.

(Pattern No. 104.)

132 lb. = 20 per cent. No. 7 bleached.
99 lb. = 15 ,, No. 22 ,,
198 lb. = 30 ,, sulphite wood unbleached.
99 lb. = 15 ,, mechanical wood (pine).
105 lb. $9\frac{3}{5}$ oz. = 16 per cent. china clay.
13 lb. $3\frac{1}{5}$ oz. = 2 ,, No. 24.
13 lb. $3\frac{1}{5}$ oz. = 2 ,, No. 25.
Three-quarter-sized.

MOTTLING WITH DARK-RED COTTON.



(Pattern No. 105.)

165 lb. = 25 per cent. No. 7 bleached.
330 lb. = 50 ,, mechanical wood (pine).
66 lb. = 10 ,, china clay.
99 lb. = 15 ,, No. 25.
2 lb. 3 oz. aluminium sulphate.
1 oz. 6½ dr. eosine.
7 oz. ultramarine.
Half-sized.

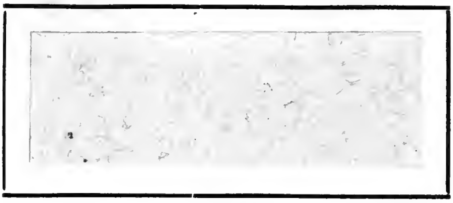
MOTTLING OF BLEACHED STUFF WITH 3 TO 4 PER CENT. OF DYED COTTON FIBRES.

(Pattern No. 106.)

The cotton fibres (bleached and well washed half-stuff) used for the mottling are dyed at the boil with—

3 per cent. oxamine blue B (Badische Anilin- und Soda-Fabrik),

with the addition of 10 per cent. of Glauber's salt (from the weight of fibres), kept boiling for three-quarters of an hour. The pulp is well washed after the dyeing, emptied, allowed to drain and dried.



(Pattern No. 107.)

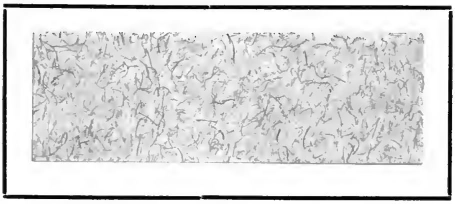
Dyed as for No. 106, but with—

3 per cent. oxamine red (Badische Anilin- und Soda-Fabrik).

(Pattern No. 108.)

Mottled with equal parts of blue and red cotton fibres dyed as above.

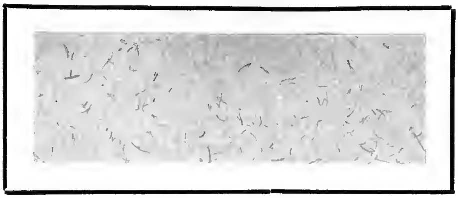
MOTTLING WITH DARK-BLUE UNION (LINEN AND WOOL OR COTTON WARP WITH WOOL WEFT).



(Pattern No. 109.)

220 lb. = 30 per cent. No. 7 bleached.
85 lb. 12$\frac{4}{5}$ oz. = 13 per cent. No. 22 bleached.
231 lb. = 35 per cent. unbleached sulphite wood.
99 lb. = 15 ,, china clay.
46 lb. 3$\frac{1}{5}$ oz. = 7 per cent. dark-blue union without seams, previously beaten into half-stuff.

Three-quarter-sized.



(Pattern No. 110.)

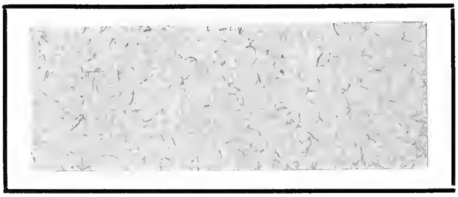
132 lb. = 20 per cent. No. 7 bleached.
99 lb. = 15 ,, No. 22 ,,
132 lb. = 20 ,, unbleached sulphite wood.
198 lb. = 30 ,, mechanical wood.
99 lb. = 15 ,, china clay.
1 lb. 1½ oz. aluminium sulphate.
1 oz. 6½ dr. diamond green G.
2 oz. 13 dr. auramine O.

Mottled with :

59 lb. 6⅖ oz. = 3 per cent. dark-blue union (cotton and wool).

Three-quarter-sized.

MOTTLING WITH BLUE STRIPED RED UNION.



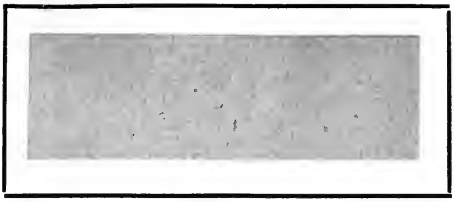
(Pattern No. 111.)

99 lb. = 15 per cent. No. 7 bleached.
132 lb. = 20 ,, No. 22 ,,
99 lb. = 15 ,, unbleached sulphite wood.
231 lb. = 35 ,, mechanical wood (pine).
99 lb. = 15 ,, china clay.
2 lb. 3 oz. aluminium sulphate.
1 oz. 6½ dr. diamond green G.
4 oz. 3⅕ dr. auramine O.

Mottled with :

79 lb. 3⅕ oz. = 4 per cent. blue striped red union, without seams.

Half-sized.



(Pattern No. 112.)

99 lb. = 15 per cent. No. 7 bleached.
66 lb. = 10 ,, No. 22 ,,
165 lb. = 25 ,, unbleached sulphite wood.
231 lb. = 35 ,, mechanical wood (pine).
99 lb. = 15 ,, china clay.
2 lb. 3 oz. aluminium sulphate.
4 oz. ½ dr. eosine.
1 oz. 6½ dr. ultramarine.

Mottled with:

79 lb. 3⅕ oz. = 4 per cent. blue striped red union without seams.

Half-sized.

MOTTLING OF BLEACHED STUFF WITH 3 TO 4 PER CENT. OF DYED WOOL FIBRES.

The colours used are products of the Badische Anilin- und Soda-Fabrik.

(Pattern No. 113.)

The wool fibres used for the mottling are dyed lukewarm with—

1½ per cent. of pure blue I.

2 per cent. of sulphuric acid, 168° Tw. (from the weight of fibres), is added in three portions, in intervals of ten

minutes; the bath is then heated to the boil and kept boiling for an hour.

If the colour is not completely exhausted after this time, 5 per cent. of Glauber's salt should be added.

A mordant which corresponds to the sulphuric acid and the Glauber's salt is sodium bisulphate, of which an addition of 6 to 7 per cent. will be found sufficient for the fixing of the colour.

After the dyeing is completed, it is necessary to wash well, drain and dry the fibres.

(Pattern No. 114.)

Dyed as above with—

3 per cent. fast red A.

(Pattern No. 115.)

Mottled with equal parts of blue and red wool fibres dyed as above.

MOTTLING OF BLEACHED STUFF WITH 3 TO 4 PER CENT. OF DYED JUTE FIBRES.

The colours used are products of the Badische Anilin- und Soda-Fabrik.

(Pattern No. 116.)

The fibres used for the mottling are dyed according to the following recipe :—

The solution in water of—

1 per cent. of marine blue BN.

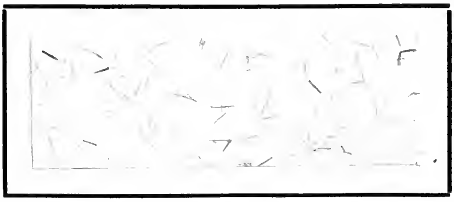
is gradually added, the bath heated to 158° to 168° F., and kept at this temperature for a quarter of an hour. A solution of 5 per cent. of tannic acid (from the weight of fibres) is then added and the steam shut off.

After cooling, wash, drain and dry.

(Pattern No. 117.)

Dyed as above with—

1 per cent. of saffranine TK.



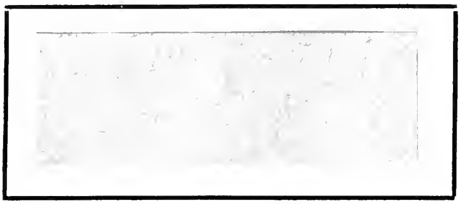
(Pattern No. 118.)

Mottled with equal parts of blue and red jute fibres, dyed as above.

MOTTLING OF BLEACHED STUFF WITH 3 TO 4 PER CENT. OF DYED SULPHITE WOOD FIBRES.

The colours used are products of the Badische Anilin- und Soda-Fabrik.

The unbleached sulphite wood used for mottling is dyed according to the recipe given for jute fibres.



(Pattern No. 119.)

$\frac{1}{2}$ per cent. indoine blue BB.

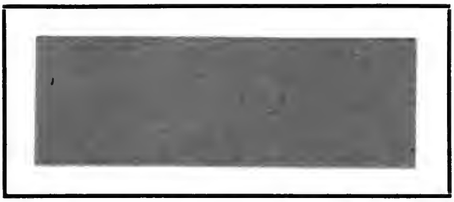
(Pattern No. 120.)

1 per cent. saffranine TK.

(Pattern No. 121.)

Mottled with equal parts of blue and red unbleached sulphite wood, dyed as above.

WALL-PAPERS.

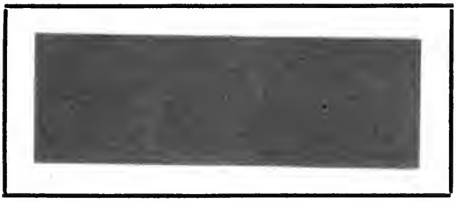


(Pattern No. 122.)

33 lb. = 5 per cent. No. 10 boiled.
33 lb. = 5 ,, No. 23 ,,
165 lb. = 25 ,, unbleached sulphite wood.
264 lb. = 40 ,, brown mechanical wood.
165 lb. = 25 ,, mechanical wood (pine).

Loaded and dyed with:

78 lb. 12 oz. ochre.
1 lb. 15½ oz. naphthol yellow S.
1 lb. 5 oz. auramine O.
5¼ oz. metanil yellow extra.
4 lb. 6 oz. aluminium sulphate.
12¼ oz. Prussian blue.
$\frac{1}{1}$ sized.



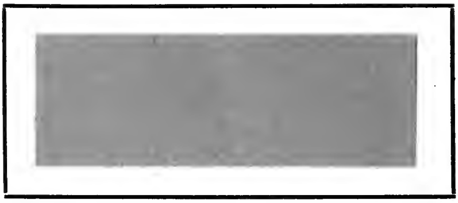
(Pattern No. 123.)

33 lb. = 5 per cent. No. 10 boiled.
52 lb. 12⅘ oz. = 8 per cent. No. 23 boiled.
138 lb. 9⅗ oz. = 21 ,, unbleached sulphite wood.
105 lb. 9⅗ oz. = 16 ,, mechanical wood (pine).
330 lb. = 50 per cent. brown mechanical wood.

Loaded and dyed with:

87 lb. 8 oz. ochre.
16 lb. 6½ oz. umber greenish.
15¾ oz. naphthol yellow S.
10½ oz. auramine O.
1 lb. 8½ oz. vesuvine BB.
7 oz. orange II.
4 lb. 6 oz. aluminium sulphate.
10½ oz. Prussian blue.

Half-sized.



(Pattern No. 124.)

79 lb. 3⅕ oz. = 12 per cent. No. 8 bleached.
39 lb. 9⅗ oz. = 6 ,, No. 23 ,,
132 lb. = 20 per cent. unbleached sulphite wood.
369 lb. 9⅗ oz. = 56 per cent. mechanical wood (pine).
39 lb. 9⅗ oz. = 6 ,, china clay.
4 lb. 6 oz. aluminium sulphate.
1 lb. 1½ oz. Prussian blue.
1¾ oz. diamond green G.
43 lb. 12 oz. ochre.

Half-sized.

(Pattern No. 125.)

52 lb. $12\frac{4}{5}$ oz. = 8 per cent. No. 10 boiled.
52 lb. $12\frac{4}{5}$ oz. = 8 ,, No. 23 unboiled.
145 lb. $3\frac{1}{5}$ oz. = 22 ,, unbleached sulphite wood.
356 lb. $6\frac{2}{5}$ oz. = 54 ,, mechanical wood (pine).
52 lb. $12\frac{4}{5}$ oz. = 8 ,, white clay.
14 oz. coal black.
$8\frac{3}{4}$ oz. brilliant black.
$5\frac{1}{4}$ oz. vesuvine BB.
$5\frac{1}{4}$ oz. vesuvine extra.
$5\frac{1}{4}$ oz. metanil yellow extra.

$\frac{1}{1}$ sized.

(Pattern No. 126.)

52 lb. $12\frac{4}{5}$ oz. = 8 per cent. No. 23 unbleached.
39 lb. $9\frac{3}{5}$ oz. = 6 ,, No. 10 boiled.
132 lb. = 20 per cent. unbleached sulphite wood.
396 lb. = 60 ,, mechanical wood (pine).
39 lb. $9\frac{3}{5}$ oz. = 6 per cent. china clay.
5 lb. $5\frac{3}{4}$ oz. vesuvine BB.
1 lb. 7 oz. 7 dr. malachite green.
8 lb. 1 oz. $2\frac{1}{2}$ dr. brilliant black B.
$2\frac{5}{8}$ oz. orange II.
43 lb. 12 oz. ochre.

$\frac{1}{1}$ sized.

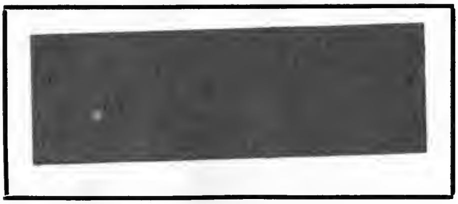
The following four patterns, Nos. 127-130, are produced by the Badische Anilin- und Soda-Fabrik on the following pulp mixture :—

33 parts unbleached sulphite wood.
67 ,, brown mechanical wood.
20 ,, china clay.

The quantities of colour are calculated on 220 lb. of dry stuff.

(Pattern No. 127.)

2 lb. 3 oz. vesuvine BB.
4 oz. 8$\frac{4}{5}$ dr. methyl violet B.
4 lb. 6 oz. orange II.



(Pattern No. 128.)

1 lb. 12 oz. vesuvine BL.
7 oz. vesuvine extra.

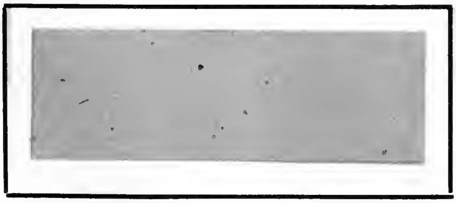
(Pattern No. 129.)

1 lb. 8½ oz. diamond green B.
1 lb. 8½ oz. vesuvine BL.
7 oz. metanil yellow.

(Pattern No. 130.)

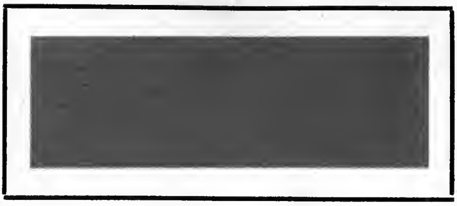
1 lb. 12 oz. magenta powder A.
2 oz. 15⅗ dr. methyl violet B.
4 lb. 6 oz. orange II.

PACKING PAPERS.



(Pattern No. 131.)

132 lb. No. 23 unbleached.
198 lb. unbleached sulphite wood.
220 lb. mechanical wood (pine).
44 lb. china clay.
55 lb. ochre.
6 oz. 4⅘ dr. logwood extract.
2 lb. 3 oz. aluminium sulphate.
⅞ oz. ultramarine.
Three-quarter-sized.

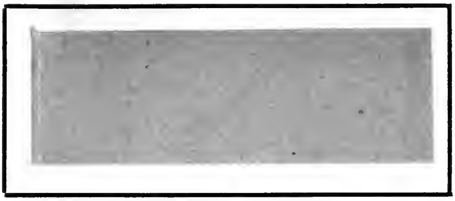


(Pattern No. 132.)

484 lb. No. 9 boiled.
66 lb. No. 23 unbleached.
330 lb. Venetian red C.
4 lb. 6 oz. aluminium sulphate.
3 lb. 8 oz. vesuvine extra.
3 lb. 8 oz. orange II.
1 oz. magenta.
Three-quarter-sized.

(Pattern No. 133.)

88 lb. No. 8 boiled.
154 lb. No. 23 unboiled.
220 lb. unbleached sulphite wood.
132 lb. mechanical wood (pine).
110 lb. china clay.
3 lb. 8 oz. logwood extract.
4 lb. 6 oz. aluminium sulphate.
2 lb. 10 oz. methyl violet 4 B.
1 lb. 8½ oz. diamond green B.
Half-sized.



(Pattern No. 134.)

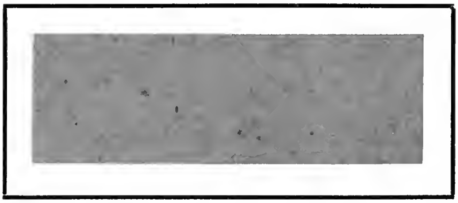
66 lb. No. 8 half-bleached.
88 lb. No. 23 ,,
264 lb. unbleached sulphite wood.
132 lb. mechanical wood (pine).
110 lb. china clay.
3 lb. 9 oz. ochre.
2 lb. 3 oz. aluminium sulphate.
1 oz. 3⅗ dr. metanil yellow extra.
Half-sized.

(Pattern No. 135.)

66 lb. No. 8 unbleached.
44 lb. No. 23 ,,
122 lb. unbleached sulphite wood.
264 lb. brown mechanical wood.
66 lb. mechanical wood (pine).
88 lb. white clay.
72 lb. 9 oz. ochre.
3 lb. 9 oz. logwood extract.
10½ oz. sodium bichromate.
3 lb. 6¼ oz. vesuvine extra.
4 lb. 6 oz. aluminium sulphate.
6 lb. 9 oz. orange II.
14 oz. metanil yellow extra.
Half-sized.

(Pattern No. 136.)

33 lb. No. 8 half-bleached.
55 lb. No. 23 ,,
55 lb. unbleached sulphite wood.
517 lb. mechanical wood (pine).
110 lb. clay.
6 lb. 9 oz. ochre.
1 lb. $10\frac{1}{4}$ oz. nigrosine W.
4 lb. 6 oz. aluminium sulphate.
7 oz. metanil yellow extra.
Half-sized.

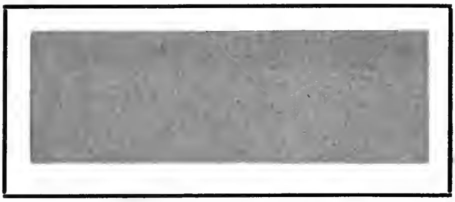


(Pattern No. 137.)

264 lb. No. 13 half-bleached.
154 lb. No. 9 ,,
132 lb. No. 23 ,,
110 lb. white clay.
6 lb. 9 oz. ferrous sulphate.
132 lb. golden ochre.
7 lb. $10\frac{1}{2}$ oz. red ochre.
Half-sized.

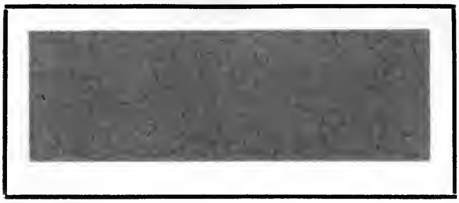
(Pattern No. 138.)

110 lb. No. 10 boiled.
176 lb. No. 23 unbleached.
164 lb. unbleached sulphite wood.
55 lb. ochre.
4 lb. 6 oz. logwood extract.
14 oz. sodium bichromate.
3 lb. $4\frac{1}{2}$ oz. vesuvine extra.
4 lb. 6 oz. aluminium sulphate.
1 lb. 5 oz. orange II.
1 lb. $10\frac{1}{4}$ oz. metanil yellow extra.
Three-quarter-sized.



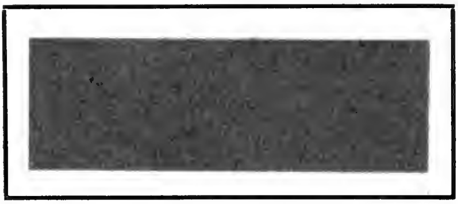
(Pattern No. 139.)

165 lb. No. 8 boiled.
198 lb. No. 23 unbleached.
517 lb. unbleached sulphite wood.
4 lb. 6 oz. aluminium sulphate.
$8\frac{3}{4}$ oz. logwood extract.
$8\frac{3}{4}$ oz. sodium bichromate.
1 lb. $10\frac{1}{4}$ oz. ferrous sulphate.
13 lb. 2 oz. ochre.
$12\frac{1}{4}$ oz. Prussian blue.
$\frac{1}{1}$ sized.



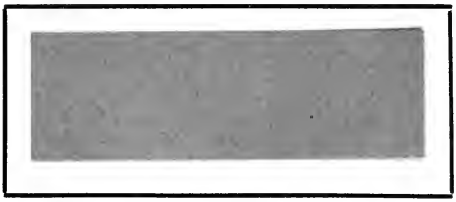
(Pattern No. 140.)

66 lb. No. 10 boiled.
66 lb. No. 23 unboiled.
110 lb. unbleached sulphite wood.
396 lb. brown mechanical wood.
33 lb. white clay.
88 lb. ochre.
2 lb. 3 oz. logwood extract.
5¼ oz. sodium bichromate.
4 lb. 6 oz. aluminium sulphate.
11⅜ oz. vesuvine extra.
Half-sized.



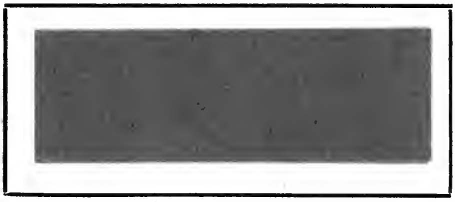
(Pattern No. 141.)

132 lb. No. 23 unbleached.
220 lb. unbleached sulphite wood.
164 lb. brown mechanical wood.
44 lb. white clay.
55 lb. ochre.
3 lb. 4½ oz. logwood extract.
7 oz. sodium bichromate.
1 lb. ⅝ oz. Bismarck brown.
5¼ oz. vesuvine BB.
2 lb. 3 oz. aluminium sulphate.
12¼ oz. metanil yellow extra.
2 oz. 13 dr. brilliant black B
Half-sized.



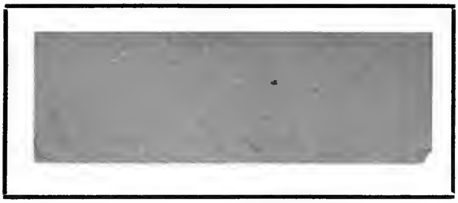
(Pattern No. 142.)

110 lb. No. 8 half bleached.
110 lb. ,, 23 ,,
88 lb. ,, 23 unbleached.
165 lb. unbleached sulphite wood.
143 lb. mechanical wood (pine).
110 lb. clay.
11 lb. ochre.
1¾ oz. brilliant black.
2 oz. 4⅘ dr. coal black.
4 lb. 6 oz. aluminium sulphate.
4 oz. 14½ dr. Prussian blue.
Half-sized



(Pattern No. 143.)

88 lb. No. 9 boiled.
110 lb. ,, 10 ,,
22 lb. ,, 23 unbleached.
440 lb. mechanical wood (pine).
33 lb. white clay.
1 lb. 5 oz. logwood extract.
2⅝ oz. sodium bichromate.
2 lb. 3 oz. aluminium sulphate.
1 lb. 3¼ oz. vesuvine extra.
30 lb. 12 oz. ochre.
Half-sized.



(Pattern No. 144.)

113 lb. No. 7 bleached.
22 lb. ,, 23 ,,
44 lb. unbleached sulphite wood.
484 lb. mechanical wood (pine).
4 lb. 6 oz. aluminium sulphate.
5¼ oz. imperial blue.
8¾ oz. sulphuric acid.
88 lb. china clay.
Three-quarter-sized.

(Pattern No. 145.)

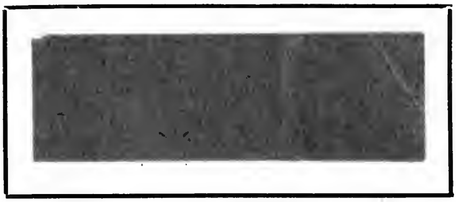
244 lb. No. 8 half-bleached.
66 lb. ,, 23 ,,
330 lb. unbleached sulphite wood.
6 lb. 9 oz. aluminium sulphate.
8 lb. 3¾ oz. brilliant orange R.
6 lb. 3¾ oz. cotton scarlet extra.
2 lb. 11¾ oz. sugar of lead.
10½ oz. magenta powder A.
1/1 sized.

Patterns Nos. 146-157 are papers manufactured in England. The coal tar colours used are products of the firm of Levinstein Limited.

The furnishes are for one beater, which makes 11 cwt. of finished paper.

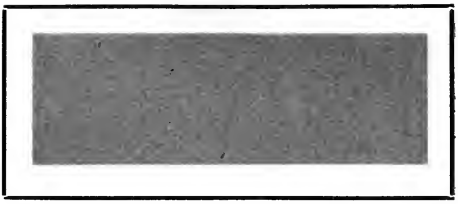
(Pattern No. 146.)

36½ per cent. sulphite wood.
63½ ,, mechanical wood.
300 lb. china clay.
45 lb. cotton scarlet extra.
3 lb. saffranine 5220.
1½ lb. orange II.
70 lb. alumina ferric.
18 gals. size.



(Pattern No. 147.)

32 per cent. sulphite wood.
68 ,, mechanical wood.
240 lb. china clay.
3¾ lb. Blackley blue I special.
2 oz. paper yellow A.
¼ lb. prussiate of potash.
60 lb. alumina ferric.
15 gals. size.

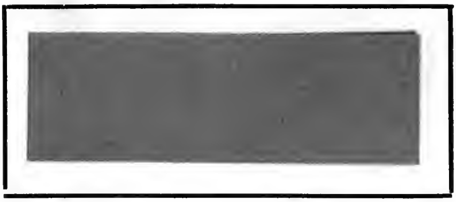


(Pattern No. 148.)

36½	per cent.	sulphite wood.
63½	,,	mechanical wood.
366	lb.	china clay.
10	lb.	ochre.
6½	lb.	paste blue.
7	oz.	mineral black.
½	oz.	paper yellow A.
¼	lb.	prussiate of potash.
30	lb.	alum.
15	gals.	size.

(Pattern No. 149.)

30	per cent.	sulphite wood.
70	,,	mechanical wood.
340	lb.	china clay.
¾	lb.	Blackley blue II.
¼	oz.	brilliant green.
¼	lb.	prussiate of potash.
30	lb.	alum.
15	gals.	size.

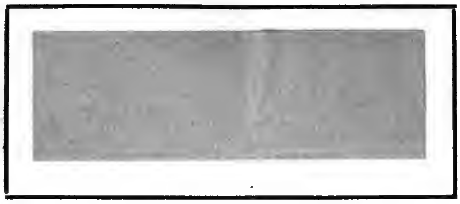


(Pattern No. 150.)

36½ per cent. sulphite wood.
63½ ,, mechanical wood.
392 lb. china clay.
67½ lb. ochre.
11 lb. paste blue.
4 oz. paper yellow A.
6 oz. mineral black.
15 gals. size.

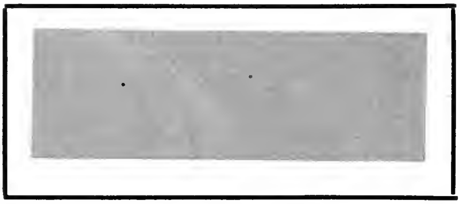
(Pattern No. 151.)

43 per cent. sulphite wood.
57 ,, mechanical wood.
10½ lb. Blackley blue extra.
1¾ lb. saffranine 5220.
½ lb. prussiate of potash.
292 lb. china clay.
60 lb. alum.
12 gals. size.



(Pattern No. 152.)

40 per cent. sulphite wood.
60 ,, mechanical wood.
280 lb. china clay.
¾ lb. saffranine 5220.
1 oz. mineral black.
30 lb. alum.
15 gals. size.



(Pattern No. 153.)

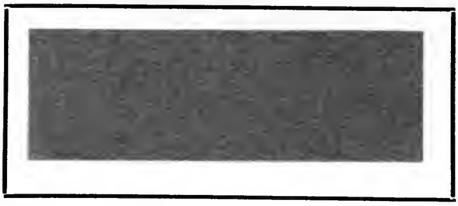
40 per cent. sulphite wood.
60 ,, mechanical wood.
240 lb. china clay.
3½ oz. saffranine 5220.
2½ oz. methyl violet 1713.
30 lb. alum.
15 gals. size.

(Pattern No. 154.)

40 per cent. sulphite wood.
60 ,, mechanical wood.
1¼ oz. orange II.
¼ oz. saffranine 5220.
332 lb. china clay.
30 lb. alum.
15 gals. size.

(Pattern No. 155.)

40 per cent. sulphite wood.
60 ,, mechanical wood.
220 lb. china clay.
3 oz. paper yellow A.
25 lb. alum.
15 gals. size.



(Pattern No. 156.)

100 per cent. sulphite wood.
240 lb. satinite.
45 lb. ochre.
20 lb. Turkey red.
3 oz. paper yellow A.
30 lb. alum.
6 lb. glue.
24 gals. size.

(Pattern No. 157.)

36½ per cent. sulphite wood.
63½ ,, mechanical wood.
332 lb. china clay.
6 lb. Blackley blue III.
1 lb. saffranine 5220.
½ lb. mineral black.
½ lb. prussiate of potash.
60 lb. alum.
12 gals. size.

VIII. DYEING TO SHADE.

The dyeing of full subdued shades to pattern is a difficult operation, firstly, on account of the great variety of fibres, loading materials and colouring matters used in the manufacture of papers, and secondly, on account of the often varying behaviour of the latter during the processes by which the water is extracted, and during the drying operation on the paper machine.

To avoid stoppages of the paper machine, and to avoid the necessity of correcting mistakes which may occur, one beater charge is dyed first to shade.

During the operation samples are repeatedly taken out by hand, the excess of water squeezed out, and the sample is then compared with the well-moistened pattern.

It is best to judge shades in diffused daylight, as in glaring sunlight the shade is reflected whitish, whilst in the dusk the shades appear less deep.

A north light is best suited for the comparison of shades. The comparison should be made both by reflected and in direct light, placing oneself first with the back against the light and afterwards towards it. The first impression should be decisive, as by prolonged looking at the shade the sensitiveness of the eye is affected on account of the natural complementary colour appearing.

If the shade is apparently correct a larger sample is taken out, reduced with water, sized, and run on the free space outside the deckel straps on the wire of the paper machine. It may be run along with the paper over the drying cylinders.

A well-dyed paper should have a level appearance, free from blotches and specks. It should be taken into consideration that some colours—for instance, eosine, Prussian blue, logwood colours on iron and chromium mordants—will subsequently slightly darken.

New matchings of shades should whenever possible be done in the forenoon, so that, especially in the dull, short winter days, the paper will be on the machine in daylight. It will then still be possible to correct an off-shade.

In the selection of colours, the price at which the finished article is sold, the purpose for which it is intended, and the fastness which the shade is required to possess, are points which have to be considered. (It would be utterly wrong, for instance, to use acid iron mordants for a black cartridge paper, as needles or articles made of polished steel wrapped in such a paper would go rusty.)

By calling the shade of a paper "perfectly fast" its resistance to the destructive action of the sunlight is not all that the term includes, but often resistance to acid or alkaline agencies, as well as steam and rubbing are required.

In manuals of dyeing and in current literature the reactions of the various colours are given in tables, by means of which any separate colour in an unfixed state may be readily classified.

With a dyed sized paper made from various kinds of fibres it is, however, uncertain and extremely difficult to find out what colours have been used for dyeing the same, especially if more than one colour has been employed for the production of the shade.

Coal tar colours, which have been made by simple mixing of various brands, may be easily detected by blowing a small quantity on wet blotting paper; the individual colours will appear separately.

The simplest way to compare the strength of standard colours of various makers is to dissolve equal quantities of the colours in equal quantities of water; pour the solutions into glass cylinders of equal diameter, and compare the shades by looking through.

The fullest shades are obtained by dyeing first with a colour which covers well, such as mineral colours, for instance, and by topping with a coal tar colour afterwards.

A great number of shades, especially for wall-papers, wrapping papers, etc., can only be obtained by using a combination of various colours.

A thorough knowledge of the results obtained by mixing various colours will greatly facilitate the working method.

The simple or primary colours—red, yellow, blue—appear in the spectrum of sunlight in an absolutely pure state.

These, with the shades between, in their natural successions, red, orange, yellow, green, blue, violet, give in their totality the impression of white light.

The technical result is, however, directly opposite to the physical one. By mixing red, blue and yellow colours in equal colour strengths, not white but black will be the result.

Next to the primary colours are the secondary colours obtained by mixing two of the primary ones:—

Orange from red and yellow.
Green ,, yellow and blue.
Violet ,, blue and red.

According as one of the two components predominates, medium shades inclining towards either red, yellow or blue will be the result.

By mixing a primary with a secondary colour, in which the primary colour does not form one of the two components, tertiary colours are obtained. For example:—

Brown from red-orange and blue.

The secondary colour is, in this case, the natural complementary colour to the primary one.

By mixing two secondary colours shades are obtained very similar to the primary colours:—

Blue from blue-violet and bluish green.
Yellow from yellowish green and yellowish orange.
Red from red-orange and red-violet.

It is, however, impossible to obtain shades of the purity possessed by the primary colours.

The colouring matters used in practice possess the ability of imparting to other substances their appearance in light and their properties.

White represents the light, black the darkness; yellow comes next to white, violet next to black, red lies between yellow and blue.

As regards clearness—

Orange lies between yellow and red.
Red ,, ,, orange and green.
Green ,, ,, red and blue.
Blue ,, ,, green and violet.

Colours, when reduced, look faded and lighter, whilst in the opposite direction their typical appearance will be the more pronounced.

Shades, the specific character of which is very distinctly expressed, are called full shades.

The yellow rays of artificial light influence the appearance of shades considerably. White appears with a yellow tone, whilst yellow appears lighter. The red shades appear more pronounced, whilst blue and violet appear greener and darker; light blue appears greener and yellowish.

Colours are either warm and glaring, as, for instance, yellow, orange, red, red-violet, brown, yellowish green, or cold and subdued, like blue, bluish green, blue-violet. Grey and green display no definite character.

Generally speaking, shades appear warmer when mixed with yellowish red, and colder when mixed with blue or violet. Reddish orange is, according to its nature, the warmest and most glaring colour mixture. Usually all the lighter colours, and especially yellow, stand out against the darker ones, so that even a warmer but darker shade will appear less striking in presence of a comparatively colder but lighter one.

Yellow appears only pure on a perfectly white ground. Shades are saddened with neutral black and grey, by means of which their light reflecting power is reduced, whilst white influences their natural brilliancy.

Neutral black is for this reason often used with ochre, umber, English red, and other colouring matters for the production of mode shades (drawing, wall and wrapping papers). It is, indeed, for these purposes the safest colour to use. It produces browns if mixed with orange, olive greens or stone greens with ochre, silver greys with blue, chestnut or mahogany browns with red, and pale yellowish greys with yellow.

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Books on Textile and Dyeing Subjects.

THE TECHNICAL TESTING OF YARNS AND TEXTILE FABRICS. With Reference to Official Specifications. Translated from the German of Dr. J. HERZFELD. Sixty-nine Illustrations. 200 pp. 1898. Price 10s. 6d.; Abroad, 11s.; strictly net, post free.

Contents.

Yarn Testing. III., **Determining the Yarn Number.**—IV., **Testing the Length of Yarns.**—V., **Examination of the External Appearance of Yarn.**—VI., **Determining the Twist of Yarn and Twist.**—VII., **Determination of Tensile Strength and Elasticity.**—VIII., **Estimating the Percentage of Fat in Yarn.**—IX., **Determination of Moisture** (Conditioning).—**Appendix.**

Press Opinions.

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DECORATIVE AND FANCY TEXTILE FABRICS. With Designs and Illustrations. By R. T. LORD. A Valuable Book for Manufacturers and Designers of Carpets, Damask, Dress and all Textile Fabrics. 200 pp. 1898. 132 Designs and Illustrations. Price 7s. 6d.; Abroad, 8s.; strictly net, post free.

Contents.

Chapters I., A Few Hints on Designing Ornamental Textile Fabrics.—II., A Few Hints on Designing Ornamental Textile Fabrics (continued).—III., A Few Hints on Designing Ornamental Textile Fabrics (continued).—IV., A Few Hints on Designing Ornamental Textile Fabrics (continued).—V., Hints for Ruled-paper Draughtsmen.—VI., The Jacquard Machine.—VII., Brussels and Wilton Carpets.—VIII., Tapestry Carpets.—IX., Ingrain Carpets.—X., Axminster Carpets.—XI., Damask and Tapestry Fabrics.—XII., Scarf Silks and Ribbons.—XIII., Silk Handkerchiefs.—XIV., Dress Fabrics.—XV., Mantle Cloths.—XVI., Figured Plush.—XVII., Bed Quilts.—XVIII., Calico Printing.

Press Opinions.

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According to Various Systems, with Conversion Tables. An Auxiliary and Text-book for Pupils of Weaving Schools, as well as for Self-Instruction and for General Use by those engaged in the Weaving Industry. Translated from the German of ANTHON GRUNER. With Twenty-two Diagrams in Colours. 150 pp. 1900. Price 7s. 6d.; Abroad, 8s.; strictly net, post free.

Contents.

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"The book under notice is intended as an instructor to those engaged in power-loom weaving, and, judging by its compilation, the author is a thorough master of the craft. It is not overloaded with details, and he manages to compress in a book of some 150 pages all that one can possibly wish to know about the different parts of the machinery, whether of English or foreign make, and for whatever kind of cloth required. A comprehensive summary is also included of the various yarns and methods of numbering them, as well as a few useful hints and a number of coloured diagrams for mandarin weavings. The book is printed in bold, legible type, on good paper, has a copious index, and is well and strongly bound."—*Ashton-under-Lyne Herald.*

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COLOUR: A HANDBOOK OF THE THEORY OF COLOUR.

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Press Opinions.

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THE COLOUR PRINTING OF CARPET YARNS. A Useful Manual for Colour Chemists and Textile Printers. By David Paterson, F.C.S. Seventeen Illustrations. 132 pp. 1900. Price 7s. 6d.; Abroad, 8s.; strictly net, post free.

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Chapters I., Structure and Constitution of Wool Fibre.—II., Yarn Scouring.—III., Scouring Materials.—IV., Water for Scouring.—V., Bleaching Carpet Yarns.—VI., Colour Making for Yarn Printing.—VII., Colour Printing Pastes.—VIII., Colour Recipes for Yarn Printing.—IX., Science of Colour Mixing.—X., Matching of Colours.—XI., "Hank" Printing.—XII., Printing Tapestry Carpet Yarns.—XIII., Yarn Printing.—XIV., Steaming Printed Yarns.—XV., Washing of Steamed Yarns.—XVI., Aniline Colours Suitable for Yarn Printing.—XVII., Glossary of Dyes and Dye-wares used in Wood Yarn Printing.—Appendix.

Press Opinions.

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By L. Tailfer, Chemical and Mechanical Engineer. Translated from the French by John Geddes McIntosh, Lecturer on Chemical Technology, London. Price 12s. 6d.; Abroad, 13s.; strictly net, post free.

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THE SCIENCE OF COLOUR MIXING.

A Manual intended for the use of Dyers, Calico Printers and Colour Chemists. By David Paterson, F.C.S. Forty-one Illustrations, Five Coloured Plates, and Four Plates showing Eleven Dyed Specimens of Fabrics. 1900. Price 7s. 6d.; Abroad, 8s.; strictly net, post free.

Contents.

Chapters I., Colour a Sensation; Colours of Illuminated Bodies; Colours of Opaque and Transparent Bodies; Surface Colour.—II., Analysis of Light; Spectrum; Homogeneous Colours; Ready Method of Obtaining a Spectrum.—III., Examination of Solar Spectrum; The Spectroscope and Its Construction; Colourists' Use of the Spectroscope.—IV., Colour by Absorption; Solutions and Dyed Fabrics; Dichroic Coloured Fabrics in Gaslight.—V., Colour Primaries of the Scientist *versus* the Dyer and Artist; Colour Mixing by Rotation and Lye Dyeing; Hue, Purity, Brightness; Tints; Shades, Scales, Tones, Sad and Sombre Colours.—VI., Colour Mixing; Pure and Impure Greens, Orange and Violets; Large Variety of Shades from few Colours; Consideration of the Practical Primaries: Red, Yellow and Blue.—VII., Secondary Colours; Nomenclature of Violet and Purple Group; Tints and Shades of Violet; Changes in Artificial Light.—VIII., Tertiary Shades; Broken Hues; Absorption Spectra of Tertiary Shades.—Appendix: Four Plates with Dyed Specimens Illustrating Text.—Index.

Press Opinions.

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GAS AND COAL DUST FIRING. A Critical Review of the Various Appliances Patented in Germany for this purpose since 1885. By ALBERT PÜTSCH. 130 pp. Translated from the German. With 103 Illustrations. Price 7s. 6d.; Abroad, 8s.; strictly net, post free.

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Books on Plumbing, Decorating, Metal Work, etc., etc.

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