John Cecil Watson Esq:re
with kind regards from
W. H. Cotton
14/XI/08.

FARBWERKE VORM. MEISTER LUCIUS & BRÜNING, HOECHST A. M.

THE COAL TAR COLOURS

OF

FARBWERKE VORM. MEISTER LUCIUS & BRÜNING
HOECHST ON MAIN, GERMANY

APPLIED IN

CALICO PRINTING.

PUBLISHED
BY FARBWERKE VORM. MEISTER LUCIUS & BRÜNING
HOECHST O/M.
1908

PREFACE.

In our „Pocket Manual“, published some time ago, we gave in a concise and convenient form directions for the application of our dyestuffs.

As this manual of recipes met with a very favourable reception and found an extensive use in practice, we determined to issue a more detailed description of the various ways in which our colours can be applied. The present volume on „Calico Printing“ treats of our dyestuffs suitable for that purpose and of the methods used for the fixation and production of colours on cotton fabrics.

Owing to the importance of the preparatory processes, to which the printed fabrics are subjected, we have, in this volume, described in general lines the bleaching and mercerising of cotton goods and have inserted sketches of some of the most important machinery used in calico printing. The patterns necessary for illustrating the text have been mostly produced in the printing department of our trial laboratory.

We trust that our esteemed clients will make ample use of this work as a book of reference and will accord it a friendly reception.

Hoechst o/M., 1908.

Farbwerke vorm. Meister Lucius & Brüning.

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GENERAL PART.

I.

THE BLEACHING OF COTTON FABRICS.

Bleaching is one of the most important preparatory operations in dyeing and printing. The object of bleaching is to destroy certain natural colouring matters of the cotton fibre and to remove from the fabric sizing and other matters, mechanically fixed on the fibre during the process of spinning and weaving.

The process of bleaching is varied according to the subsequent treatment the material has to undergo. In some cases a half-bleach will prove sufficient (f. i. for Aniline Black Resist and Indigo Resist styles), in other cases the cloth need only be steeped; for the Turkey Red-White styles, however, a perfect boiling and chemicking is essential. The use of too concentrated chlorine solutions for goods which are subsequently dyed with mordant colours, f. i. Turkey Red, impairs the beauty and the depth of shade.

The following processes are employed in preparing cloth for printing:

1. **Steeping.** This process removes the sizing used in the preparation of the material. The sizing consists generally of starch, or dextrine; less frequently of glue, fats, and magnesia salts. The goods are steeped in warm water, malt-liquors, soda solutions, or dilute acids, and are then well washed and dried. This preparation is especially suitable for dyeing dark shades.

2. **Half-Bleach.** According to this method the goods are first steeped, then boiled, and finally washed and soured. A treatment with chlorine may be dispensed with. Half-bleached cloth is used for dyeing medium shades, also for prints, whenever special clearness of the white parts is not required, and in cases where chlorine would influence the shade, f. i. Alizarine Red.

3. **Full-bleach.** If, in dyeing or printing, a perfectly clear white is required, the goods undergo thorough bleaching and chemicking processes.

(White cloths require an exceptionally thorough bleach, as they must not turn yellowish in being stored. It is, therefore, advisable to boil them twice, first with lime and then with soda. After chemicking and washing, they are usually blued with ultramarine.)

Previous to bleaching the goods are singed; this is especially important for printing.

The pieces are sewn together and pass a singeing machine at full width. All loose fibres are thus removed from the surface of the material. The singeing is effected either on plate, roller, or gas singeing machines. When working on the plate singeing machine, the cloth passes rapidly over two red hot copper or cast iron plates and then through a water trough to extinguish any sparks possibly remaining on the cloth. It is difficult to keep the plates always evenly heated, as the cloth in passing over cools them continually. In order to counteract this, a mechanical arrangement continually changes the position of the guide rollers to the plates.

The roller singeing machines contain red hot cast iron rollers over which the cloth passes in one direction, whilst the roller itself revolves in the opposite direction. Thus the material is continually brought into contact with different parts of the roller and is therefore more evenly singed.

When singeing with gas, the cloth passes one or more rows of gas jets. Coal or oil gas mixed with air is employed in order to produce a non-smoking flame. Where gas can not be obtained, so-called gasoline is succesfully employed; this is produced in specially constructed apparatus from volatile paraffine oil destillates. The flames of the gas singeing machines play on the surface of the cloth and remove the fluff.

F. Binder has constructed a machine, which effects the same results at a saving of gas and wages; in this construction the flame penetrates the fabrics by means of suction.

The operation of singeing should leave the fibre unimpaired. For heavy cloths the plate and roller machines are preferable; for light goods, however, the preference is given to the singeing with gas. Singeing on heated metal plates is certainly the most effective method, but gas singeing has the advantage, that each individual thread is singed by the flame. Occasionally both processes are combined.

After singeing, the pieces are run through porcelain rings in rope form into one of the following three steeping baths; they are then allowed to lie in suitable vessels until fermentation sets in, and are then thoroughly washed on a washing machine. After washing the material is entered into the kier.

The goods should not be boiled until they have been thoroughly scoured to remove as much of the sizing on the fibre as possible; this can be effected by mechanical or by chemical means, and consists in working on washing machines, or in fermentation by impregnating the cloth with alkaline or acid liquors. Starchy matter is thus rendered soluble and removed in the subsequent washing.

The material can be steeped:

1. in cold sulphuric acid of about 3° Tw., and allowed to lie for 6—12 hours. (In 1883, H. Koechlin proposed steeping in boiling sulphuric acid.)

2. in a solution of about $^3/_4$ % (of the weight of the material) dry caustic soda at boiling point and allowed to lie in wooden boxes for 24 hours. This method was proposed by Lauber, especially for thick cotton cloths.
3. in clear lye, previously used, at 140° F., until a sour smell indicates the commencement of fermentation.

The boiling process (boiling in alkali or bucking) is the most important operation in bleaching and the final results greatly depend on it.

Fifty years ago, the material was always boiled in open cisterns, but these have now been replaced by closed kiers which permit of boiling the material under pressure. The circulation of the liquor in closed kiers was originally effected by injectors; these sucked the liquid from the lower part of the kier and then showered it over the surface of the goods. By this method of working direct steam was continually entering which gradually condensed to water and thus diluted the alkaline liquid. To obviate this drawback, pumps were introduced (about the middle of the last century), which were driven from without the kier so that the liquid within was kept at a constant concentration. Up to 1882, suction and pressure pumps were used, but then Scheurer-Rott constructed the first rotary pumps, and at the same time invented appliances for superheating the lye. These superheaters make it possible to boil the lye without diluting it. The pumps on the other hand force the liquid through the tubular boiler. The system of pipes in this boiler is surrounded by a casing into which the steam is admitted. The condensed steam runs into a receiver at the base of the boiler.

This construction is typical for modern bleaching kiers.

Several innovations have been tried from time to time, such as perforated central pipes, perforated double casings inside the kier etc., but as they did not represent any real or vital improvement upon the first model they have been mostly dropped again.

The bottom of the kier is covered with a convex perforated false bottom, frequently weighted with granite pebbles, onto which the material is laid.

The material is packed in rope form into the kier by experienced workmen, and must fill the interior evenly; it is then covered over with clean canvas, and weighted with well galvanized iron rails. The lye is prepared in a separate vessel and is run into the kier together with water, whilst the pump is in action. The level of the liquid must be about 10—15 inches above the material. It is advisable to filter the whole liquid through a cotton cloth when entering the kier.

The contention that in this manner the alkaline liquid is 'salted out' by the goods, and that consequently the lower layers of the material come into contact with more dilute liquid than the upper layers has never been proved.

The lye which is already warm when entering the kier, is gradually heated to the boil; then, for reasons which will be explained below, some

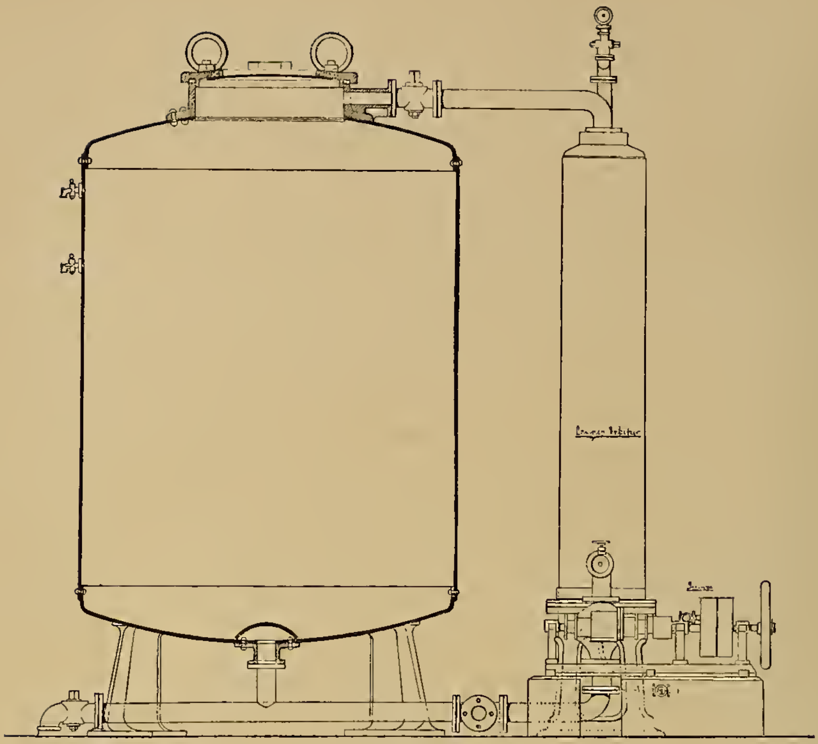


Fig. 1

bisulphite is added, the kier lid fastened, and the boiling continued under a pressure of about $2^1/_2$ atm.

Besides the upright kiers of the described or similar constructions, a horizontal kier built by Mather & Platt, Ltd., Manchester, is much employed, especially in large print works. This kier was originally intended by Horace Koechlin for a different method of boiling; it had, however, to be modified, so that the boiling in the so-called Mather kier is effected in practically the same manner as in the one described above. The difference lies in the manipulation. The goods are packed into waggons which are bodily run into the horizontal apparatus.

Fig. 2 shows a sectional elevation of the Mather kier.

The steeped and washed material passes through an impregnating machine (constructed like a washing machine), where it is saturated with soda lye (about $1^1/_2$ lbs. dry caustic soda for 100 lbs. of material); it is then carefully and tightly packed in the waggons. The waggons are run into the kier and on arriving in their proper position, a spring lever connects the kier with an opening in the bottom of the waggon, through which the liquid circulates as soon as the pump is set in motion. After closing the kier, a solution of rosin soap (4 gallons to 100 lbs. of material) is run in from a separate vessel. The soap solution contains 16 lbs. of rosin and 22 lbs. caustic soda lumps in 100 gallons.

When all the air is expelled from the kier by steam, the valve is closed, and the pump set in motion. For the first hour the goods are boiled under a pressure of $^2/_3$ atm.. and then for further 8 hours under a pressure of $1^1/_2$ atm. Then the steam is let out and the kier filled $^2/_3$ full of water; this is allowed to circulate for 1 hour, and then let off; this operation is then repeated twice.

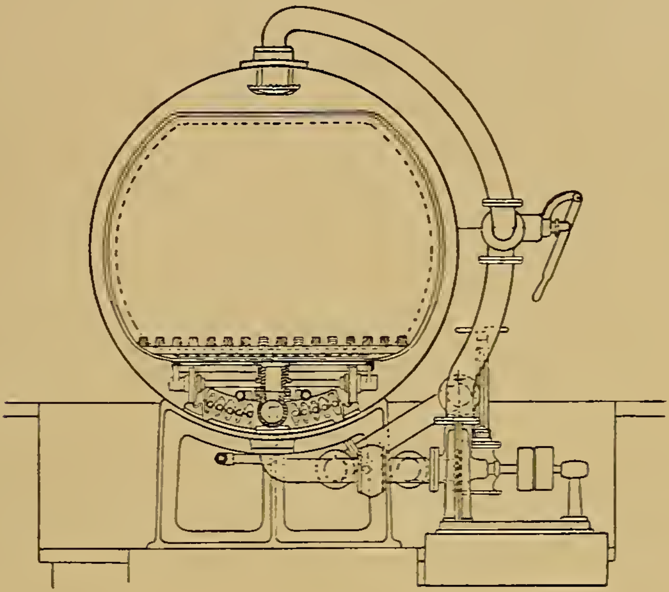


Fig. 2

A similar kier is that constructed by Thies and Herzig. The principle of this system is to operate in a kier which is free from air. Cotton, treated with caustic soda in the presence of air, is liable to become tender owing to the formation of oxycellulose, and for this reason, Horace Koechlin proposed to counteract the oxygen and to render it harmless by means of sodium sulphite. Thies and Herzig on the other hand applied mechanical means for the same purpose, viz. they connected the kier with a special air pump and a separate boiling pan besides the ordinary pump and the superheater. Although the operation of alkaline boiling becomes hereby distinctly more complicated, it assures the entire removal of oxygen, so that stronger lyes can be employed without impairing the strength of the fibre. Naturally, this process is more expensive than the ordinary method.

The previously steeped material is packed into the kier and the air at once drawn off by means of an air pump. Then old (previously used) lye is pressed into the kier through a valve in the bottom of the apparatus. The lye on entering is about 60° F. hot, but is at once heated up by means o the special heating appliance and circulated through the material for three hours. Then it is drawn off, and the goods are washed with the condensed water which has collected during these operations in the boiling pan. This vessel is now used for preparing a fresh alkaline solution of 6—9° Tw.; the amount of the lye is so regulated that it equals or slightly exceeds the weight of the goods in the kier. This lye is again heated up, the pump set in motion, and the liquid pumped into the kier, where it is worked for about 6 hours under a pressure of $2^1/_2$ atm. Finally the material is washed with water, heated to 100° F. in the boiling pan.

The duration of the boiling, the pressure under which it is effected, the composition and the concentration of the lye vary according to the nature of the material to be treated and according to the purpose for which the goods are intended.

The higher the pressure, the sooner the process of alkali-boiling is terminated; on the other hand the pressure ought never to exceed $2^1/_2$ atm., as the cotton fibre is tendered if the temperature rises above 265° F. The duration of the alkali boiling has also an effect upon the results of the bleaching process. On an average, a good circulation of the boiling liquid through the kier for 6 hours will be sufficient, and, if the goods are previously well scoured, the cloth so treated will be suitable for all branches of dyeing and printing.

The comparatively large amount of time, power and steam is in the first place due to the manner in which the material is laid in the kier. Being packed tightly in rope form, it offers a considerable resistance to the circulating liquid, and it is therefore evident that the operation must be continued longer than theoretically necessary, if each individual lot is to be acted upon evenly in the kier.

These circumstances have naturally also a bearing upon the quantity of the material in each individual lot. The greater the quantity of cloth, the more power will be required for boiling it evenly, and the greater will be the danger of being troubled by stains. For this reason it has been the aim of bleachers and constructors of bleaching machinery for many years to build some mechanical installations in which the material could be alkali-boiled at full width. The object of such a construction is, on the one hand, to reduce the length of the operation and, on the other hand, to keep the cloth opened out during the entire process and thus to overcome the difficulty of removing creases, which are often very obdurate in some materials when boiled in rope form.

Fig. 3 illustrates an installation by Endler-Welter (German Pat. 120447), which is suitable for alkali-boiling of light calicos at full width.

This arrangement consists of three connected chambers; the centre one, the steaming box, protrudes into the two adjoining chambers at either end and thus divides these each into two compartments. In the first chamber the cloth runs through the lye, and gets thoroughly saturated with it; it is then guided

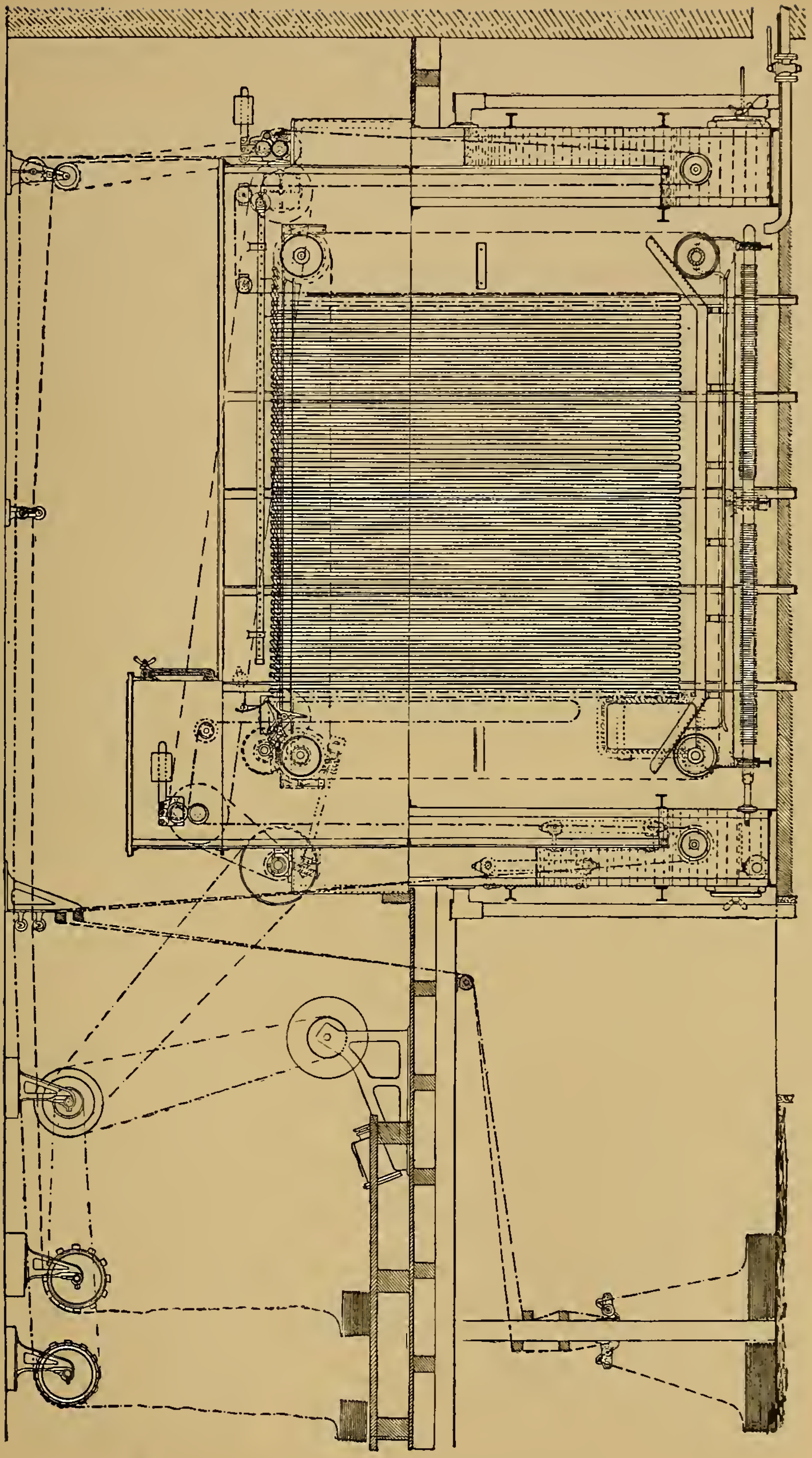


Fig. 3

into the steam box, which it passes in long hanging folds, and finally it is washed off in the third chamber. The liquids in the first and third chambers act as hydraulic valves for the central chamber in which a steam pressure of about $^1/_4$ atm. is maintained.

The actual process of boiling with alkali is here, therefore, replaced by steaming: the material which is impregnated with soda lye and bisulphite is steamed for varying lengths of time, the latter being regulated by the speed of the machine. The production can be increased by running two or three pieces simultaneously, viz. in double or treble layers, through the machine. For light calicos 1—$1^1/_2$ hours steaming will be sufficient, and the necessary amount of chemicals will be approximately $4^1/_2$ lbs. caustic soda lumps and 3 nog. bisulphite 52° Tw. per 112 lbs. of material.

After passing through the machine the cloth may be washed either open or in rope form in the ordinary manner.

Tagliani and Rigamonti improved this system by introducing the so-called collector. The pieces travel in the direction indicated by darts at full width through the vertical pit, until they arrive at the U-shaped collector in the second compartment, where they are plaited down by a self acting folding appliance. The collector itself consists of an endless chain, which is in constant motion. By this means the material also moves along: it is plaited down on the right arm of the collector, travels along the U-shaped space and arrives finally at the left arm of the collector, whence it passes out again through the vertical pit as shewn in sketch 4.

It is possible by means of a clever device to feed the collector quite regularly, and also to regulate automatically both the plaiting down of the cloth and the speed of the travelling chain.

The liquid is kept in circulation by means of a pump, and the goods remain $1^1/_2$—2 hours — according to quality — in the apparatus which holds from 2—10000 yards.

In both installations which we have described, the steam pressure is gauged by the height of the liquor in the vertical pits; it can never exceed 1 atm. However, this pressure is not sufficient to remove or to destroy all the impurities contained in cotton, and, therefore, kiers were built in which the cloth could be treated at full width, in a similar manner as in rope form in high pressure kiers.

Although the output of these kiers is rather small, still for some purposes they are almost indispensable.

The Jackson & Hunt bleaching kier (fig. 5) contains an arrangement by means of which the pieces are treated at full width, in a similar manner to jigger dyeing; they are wound on rollers: unwinding from the one, they are automatically rolled onto the other roller. In order to prevent creases from forming and the selvedges from doubling-up, a cylinder rests loosely upon these rollers and reverses the gear whenever necessary.

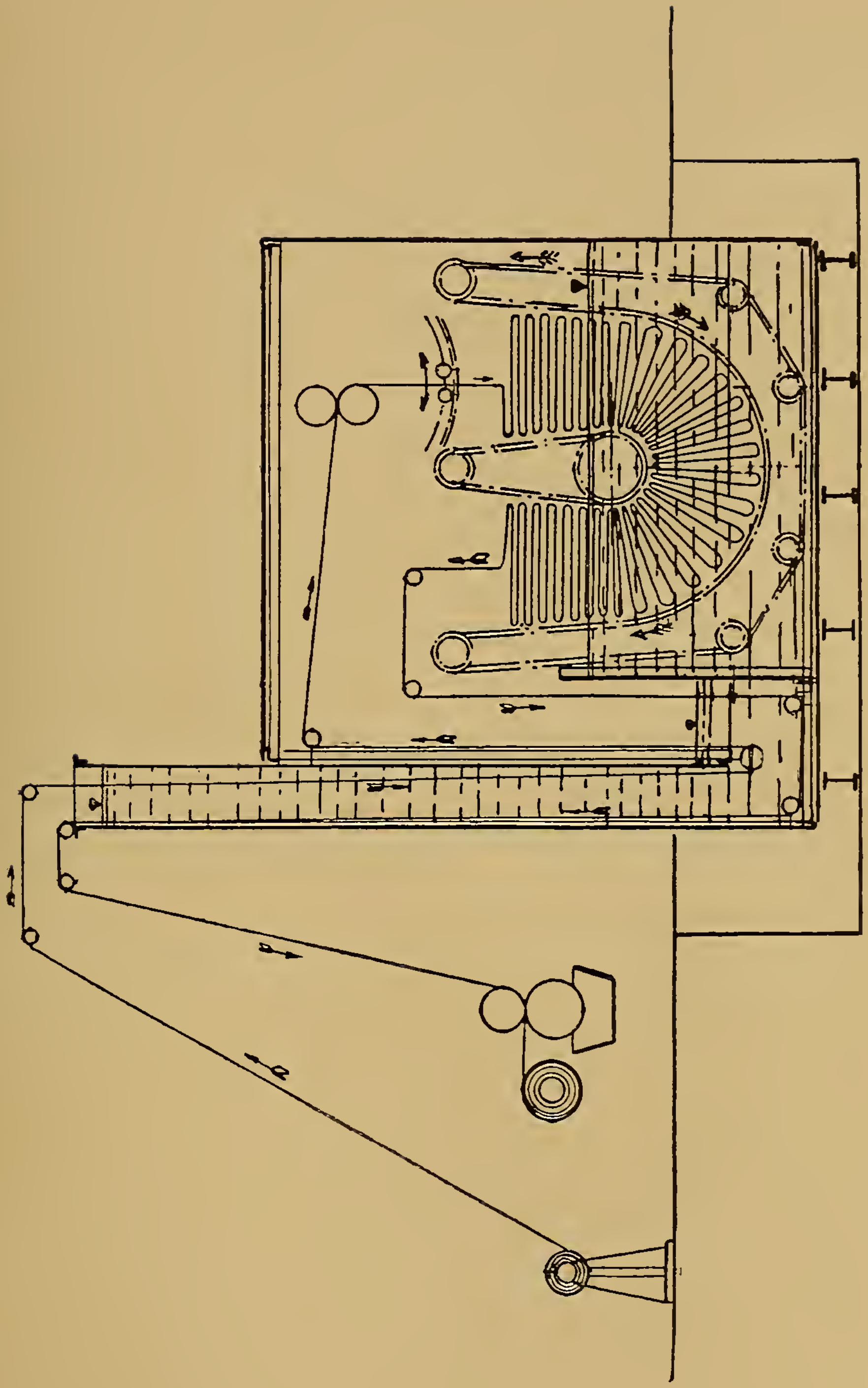


Fig. 4

The lye sprays over the pieces by means of a pump, whilst they are winding from one roller to the other. The length of this boiling process, also the steam pressure which is applied, can be varied at will. For ordinary cloths 2—3 hours boiling will suffice. The daily output of this kier is, therefore, 4 lots of 2 – 3000 yards each.

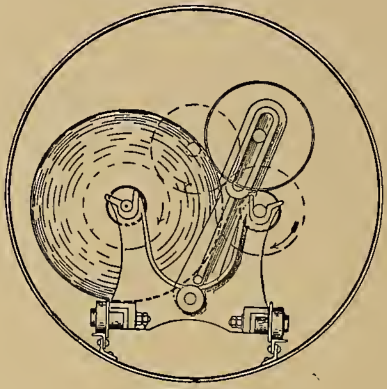


Fig. 5

As our sketch (fig. 5) illustrates, the interior of the Jackson & Hunt system is by no means fully occupied. To make use the whole of the available space and to increase the production a machine was built which consisted of two adjoining horizontal high pressure boilers, connected with each other by a slit. The pieces are again on rollers, but instead of winding and unwinding within the one boiler, they now unwind from a roller in the

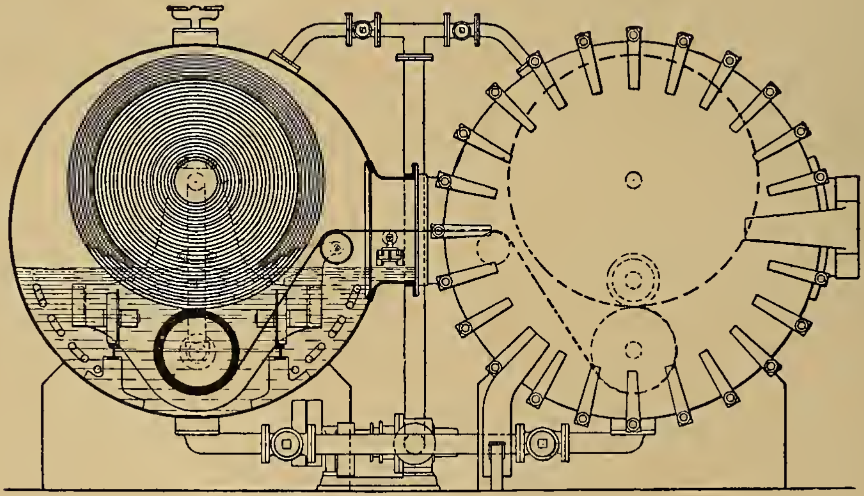


Fig. 6

one and, passing through the connecting slit, are wound onto the roller in the second boiler.

The pump sprays the lye onto and through the travelling fabric which, when thin enough, can be worked in double or more layers.

Whichever method of boiling is employed, the goods must subsequently be thoroughly washed, in order to remove all the substances rendered soluble by the boiling in alkali. After washing, the cloth is chemicked, in order to remove the yellowish tint; for this purpose it is passed through a dilute solution of chloride of lime, then left to lie in a heap for several hours, and is finally soured and washed. Sometimes the goods are soured before and after chemicking.

The chloride of lime solution must be absolutely free from all undissolved particles; it is, therefore, allowed to settle for some time and then the clear liquid drawn off. Chloride of soda instead of chloride of lime has the advantages of being more readily soluble and of acting more energetically than the latter, but it is also more expensive. Chloride of Soda, sodium hypochloride, is obtained by electrolysis of common salt, or by the interaction of soda and chloride of lime.

I. 100 lbs. Chloride of Lime 66° Tw. are finely ground with
40 gal. Water;
II. 60 lbs. Solvay Soda (98 %) dissolved with
20 gal. boiling Water. No. I and II are mixed and the whole diluted with water to
100 gallons.

The mixture is well stirred for $^1/_2$ hour and allowed to stand overnight. Thus 65 gallons of a clear solution of chloride of soda 11° Tw. are obtained.

The bleaching process terminates with a thorough washing, for all the mineral acid must be removed, as, in drying, this would concentrate and injure the fibre; it might also effect the shade when dyed.

E. Lauber gives the following practical methods for bleaching cloths intended for dyeing and printing.

I. HEAVY CLOTHS.

1. Singeing.
2. Passage through a sulphuric acid bath 3° Tw. (allowed to lie 4—5 hours, preferably overnight). Care must be taken not to let it dry.
3. Washing.
4. Boiling: 8—10 hours under $1^1/_2$ atm. pressure.

For 1000 lbs. material are required:

25 lbs.	Caustic Soda lumps,
10 lbs.	Solvay Soda,
4 lbs.	Castille Soap,
2 lbs.	Bisulphite 72° Tw.

5. Washing.
6. Chemicking with clear chloride of lime solution $^{1}/_{2}$—1° Tw.
7. Washing.
8. Souring with sulphuric acid $1^{1}/_{2}$—3° Tw.
9. Final washing.

II. LIGHT CLOTHS.

The bleaching process for light cloths is the same as for heavy cloths except that less alkali is used in boiling.

For 1000 lbs. of material are required:

22 lbs.	Caustic Soda lumps,
7 lbs.	Solvay Soda,
$3^{1}/_{2}$ lbs.	Castille Soap,
1 lb.	Bisulphite 72° Tw.

III. HEAVY FLANELETTES.

1. Impregnating with boiling soda lye (12 lbs. 76° Tw. per 1000 lbs. material). The goods are tightly packed in wooden boxes and kept there well covered for 24 hours.
2. Washing.
3. Boiling: 8—9 hours at $1^{1}/_{2}$ atm. pressure.

1000 lbs. material require:

70 lbs.	Soda Lya 76° Tw.,
8 lbs.	Solvay Soda,
4 lbs.	Soap,
$1^{1}/_{2}$ lbs.	Bisulphite 72° Tw.

The further operations are as described under I.

It is clear that the bleaching process does not always run smoothly, and it seems advisable, therefore, to refer briefly to some of the causes, the discovery and finally the avoidance of faults in bleaching.

These faults must be classified into: 1) clearly visible and properly defined spots or large undefined coloured blotches, and 2) invisible or scarcely visible stains. Both faults may occur simultaneously, therefore it is necessary, whenever difficulties arise, to ascertain their cause before attempting to remedy them. Attempts to remove stains by strong acid or chlorine are often liable to ruin the material entirely.

If the stains are visible, the bleacher will mostly recognise their origin quickly and treat them accordingly. Oil and grease spots, mostly noticeable in the raw material, are removed by a local treatment (rubbing with vegetable oil before bleaching); frequently, however, this treatment is only partially successful. Kier stains are light to dark brown, cloudy stains, caused by deposits, if the boiling liquid has circulated irregularly. These stains generally disappear in the supsequent souring and chemicking operations; however, if they are not removed by one operation, the boiling, souring and chemicking with dilute solutions must be repeated.

A further cause of stains is an insufficient washing of the material in the kier. The cloth touching the hot walls of the kier gets dried in parts and this causes stains, especially when lime is used as alkali in the boiling process.

Soap occasionally causes rosin stains which offer a stubborn resistance to saponification. Also lye stains are apt to occur by employing a too highly concentrated soda lye: local mercerization takes place which makes itself disagreeably apparent in dyeing (especially indigo).

Rust stains will appear if the wet material comes into contact with iron. To avoid this, the interior of the kier ought to be coated with lime-wash (thick milk of lime, mixed with albumen). This coat of lime must be perfectly dry before the kier is used.

Rust stains can be removed by a warm solution of oxalic acid and subsequent washing.

Special attention must be paid to the process of chemicking. As a general rule, the material is thoroughly cleansed and appears white before chemicking.

The stronger the chloride of lime solution, the greater is the danger of the oxidation spreading and forming oxycellulose on the fibre.

If cloth which is impregnated with chloride of lime solution is exposed to the action of direct sunlight, or to the air, also in drying, it is apt to be converted in some parts to oxycellulose. These facts must naturally be considered; it is, therefore, advisable to cover the chemicked material with clean packing sheets.

Oxycellulose is also formed when the goods come into contact with metallic iron in the presence of hypochloride solutions. Whilst the iron is converted into its hydroxide, oxygen is liberated and this, acting on the cellulose, forms oxycellulose.

Oxycellulose stains occur through uneven chemicking, especially if the solution contains undissolved particles which adhere to the cloth; these stains are very clearly to be seen in dyed materials, for they are dyed deeper owing to the greater affinity of the oxycellulose for the dyestuff. Oxycellulose is therefore easily detected by dyeing the material in a dilute solution of Methylene Blue. A further test for oxycellulose is found in its property of reducing 'Fehlings solution'. After freeing the cloth from all sizing ingredients,

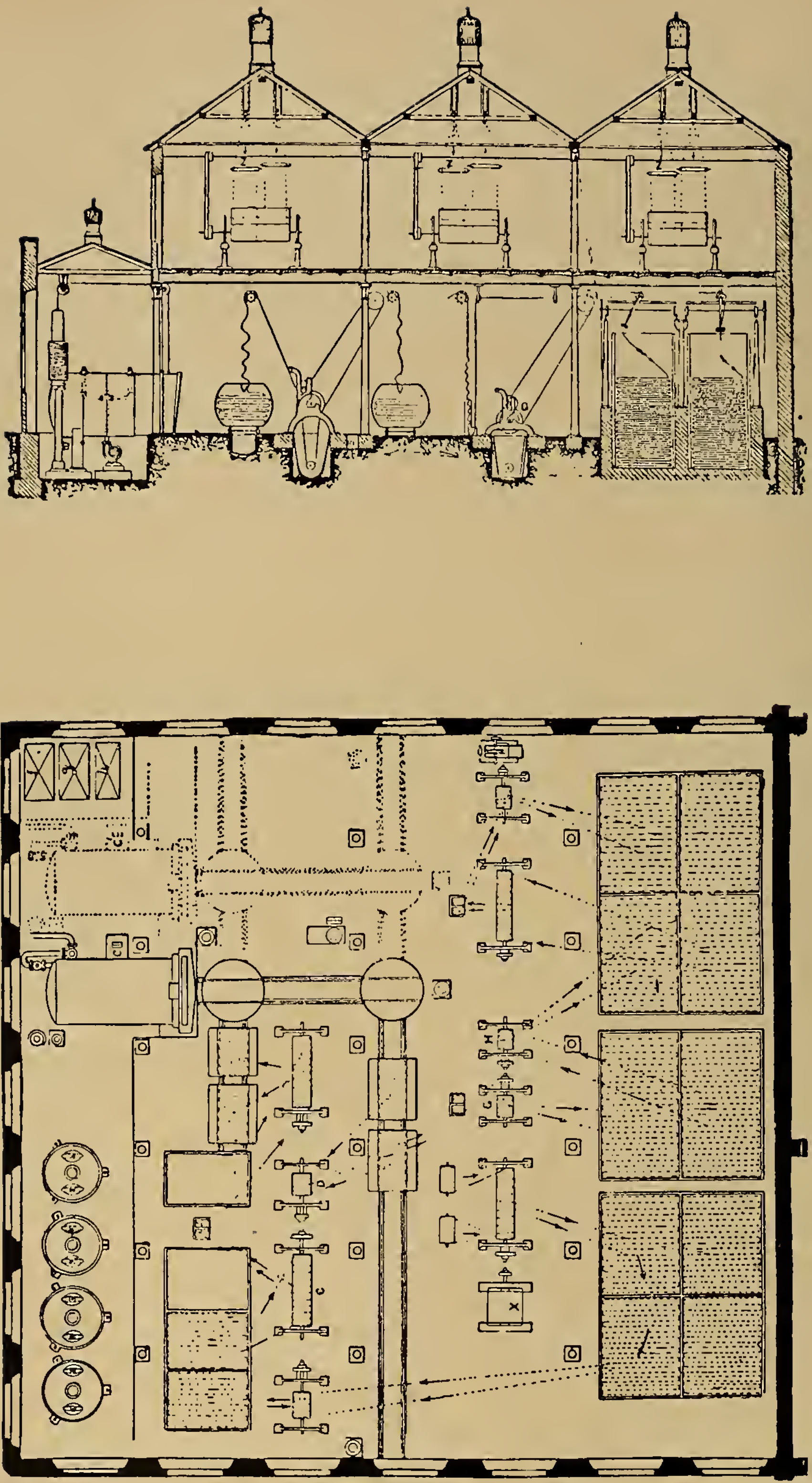


Fig. 7.
Bleaching Installation after Mather and Platt Ltd., Manchester.

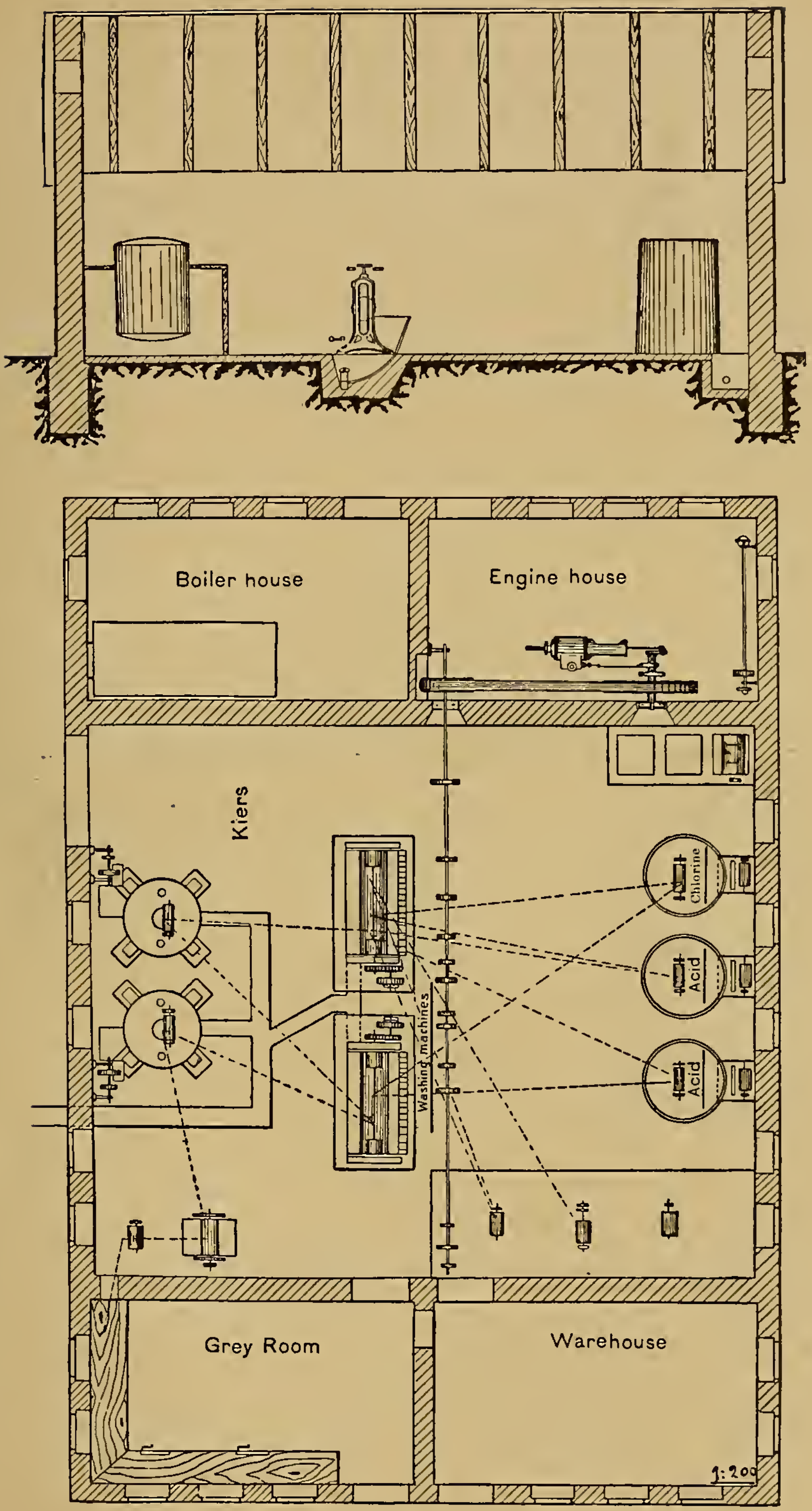


Fig. 8.
Bleaching Installation of the Zittauer Maschinenfabrik, Zittau in S.

it is boiled for $^1/_4$ hour on a water bath with 10 $^0/_0$ Fehling's solution; the presence of oxycellulose is shewn by a red colouring of the cloth, owing to the precipitation of cuprous oxide. Oxycellulose stains generally impair the strength of the cotton fibre; in many cases, however, this is not detected until the goods are treated with alkali.

Oxycellulose can not be removed from the fibre, as the cotton has undergone a chemical change. Great care must therefore be taken to avoid its formation.

Acid stains result if the pieces, after souring, are insufficiently washed; sometimes also the acid becomes more concentrated, if the wet goods dry in places, and thus the strength of the fibre is impaired. It is advisable to wash thoroughly after souring, and to test the acidity with congo solution before dyeing.

Before printing, the material is sheared and brushed. The shearing machines remove knots which have not been attacked by the singeing process, and also loose fluff which is raised in boiling and washing. Two kinds of machines are employed: longitudinal and transverse shearing machines. The shearing appliance of the latter runs over the stretched material in the direction of the weft. The production of this machine which shears only as much at a time, as corresponds to the size of the blade is much smaller than that of the logitudinal shearing machine which shears the continually moving cloth by means of a stationary, rotary shearing appliance.

After shearing, the material is brushed; the shearing and brushing operations may be combined on one machine.

II.

MERCERIZING OF COTTON FABRICS.

In 1844, John Mercer made the interesting and important discovery that cotton fabrics undergo both physical and chemical changes by the action of caustic solutions. Treated with caustic alkali and then well washed, the cotton fibres change considerably in appearance; they become plastic and show an increased affinity for metallic mordants and for a certain number of dyestuffs. This is due to a hydration of the cellulose. Examined under the microscope, the fibre appears cylindrical, thick, and transparent, whilst the ordinary cotton fibre appears flat and helicoid. Moreover, by this treatment the fabrics shrink considerably in length. Mainly for this reason Mercer's observation was not put to any practical use, but in 1890 Lowe, and in 1895 Thomas and Prevost showed that cotton cloth, stretched in the open and submitted to the action of soda lye, attains a silky lustre and does not shrink on leaving the stenter. This process which immediately found a practical application, was called mercerizing. It is of the greatest importance for the textile industry and is to-day employed in almost all print works. The method is simple and inexpensive; it increases the strength and the chemical affinity of the fibre, and produces a silk lustre which to a certain degree withstands repeated washing and soaping. The beneficial effect of mercerizing on the strength of the fibre is especially important when working with thin materials.

All sorts of cotton can be mercerized, the best effect, however, is obtained on Egyptian cotton, which has the longest staple.

For mercerizing, soda lye of 55—65° Tw. is generally employed. A caustic solution of 15° Tw. does not mercerize, a slight effect, however, can be seen when soda lye of 25° Tw. is used. The mercerizing effect increases with the strength of the alkaline liquid, the maximum being obtained with lye of 65° Tw.

The temperature of the lye has also a great bearing upon the mercerizing: as a rule, the lower the temperature, the better are the results. With dilute liquids the influence of the temperature is more marked than with concentrated lyes; f. i., a soda lye of 65° Tw. gives equal results at 32 and at 175° F., whilst a lye of 25—35° Tw. only yields a mercerizing effect when worked cold. The length of time the cloth is submitted to the action of the alkali is of little importance as to the result.

Paul Gardner tabulated the results as to the shrinking of makko yarn, treated at various temperatures and with soda lye of varying strength. In the following table the shrinking of the fibre is expressed in percentage, as compared to the original length:

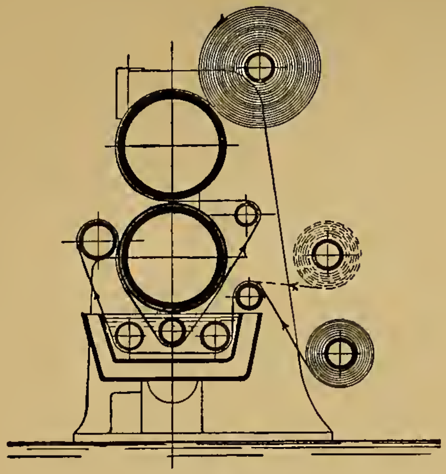
Soda Lye	7° Tw.			15° Tw.			23° Tw.			42° Tw.			52° Tw.			64° Tw.		
Minutes	1	10	30	1	10	30	1	10	30	1	10	30	1	10	30	1	10	30
Temperature																		
35° F.	0	0	0	1	1	1	12,2	15,2	15,8	19,2	19,8	21,5	22,7	22,7	22,7	24,2	24,5	24,7
65° F.	0	0	0	0	0	0	8	8,8	11,8	19,8	20,1	21,2	22,2	22,3	22,3	23,5	23,8	24,7
86° F.	0	0	0	0	0	0	4,6	4,6	6	19	19,5	19	18,5	19,5	19,8	20,7	21	21,1
176° F.	0	0	0	0	0	0	3,5	3,5	9,8	13,4	13,7	14,2	15	15	15,5	15	15,2	15,4

When mercerizing textures, these pass through concentrated and well cooled soda lye in a padding machine where they are squeezed by heavy cast-iron rollers; they are then wound on, allowed to lie for some time, and stretched on the frame, or sometimes are run onto the stentering machine directly after passing the rollers of the padding machine. Whilst on the stenter, the material is rinsed with hot water and then soured and washed in a cistern. The wash water is repeatedly used until it twaddles 6—8°, and is then used for other purposes f. i. for bleaching.

A large number of mercerizing machines have been constructed; fig. 9 illustrates a German mercerizing plant.

MERCERIZING PLANT

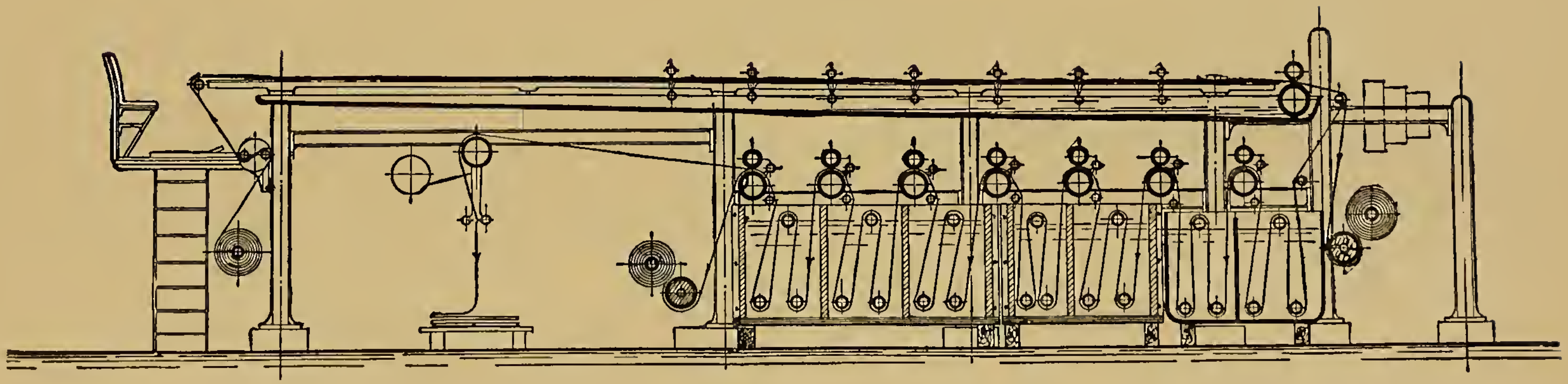
of the *Zittauer* Maschinenfabrik und Eisengiesserei A.-G., *Zittau* i. S.



A

A. Padding-machine with three cast-iron rollers, and moveable guide-rollers for a double immersion in one passage.

B Stentering and rinsing machine with open washing machine.



B

Fig. 9.

Raw material is very seldom mercerized, as the sizing prevents it from being evenly impregnated with the lye, therefore steeped and boiled goods are generally used and the chemicking operation carried out after mercerizing.

In order to ascertain whether a cloth is mercerized or not, it is examined under the microscope or dyed with Methylene Blue; in the latter case, the mercerized fibre yields a darker shade than unmercerized cotton. A very simple method of detection is recommended by H. Lange; according to this method, the fabrics are laid into a solution of zinc chloride and iodine in potassium iodide for 3 min., and then washed. If mercerized, the material turns blue whilst unmercerized material remains unchanged.

Solution A.	Solution B.
1 oz Iodine	30 oz Zinc Chloride, solid,
5 oz Potassium Iodide dissolved in	dissolved in
1 gill Water	1 gill Water.

Before use, solution A is stirred into solution B.

The silk lustre which the fibre attains by the process of mercerizing can be still further increased by mechanical means, f. i. by pressing minute rills which reflect light in a peculiar manner into the fabrics (Schreiner calander).

The Schreiner calander consists of two steel rollers which may be put under a pressure of about 200—300 atm.; one of the rollers is heated by gas and bears an extremely fine engraving. The pieces pass through these two rollers; it is clear that goods which in the course of the preceeding operations (printing, dyeing, or steaming) have been weakened, are often further impaired by the calandering process. They are occasionally even cut, and certain stains or any unevenness in the cloth is considerably brought into evidence by this treatment.

The Schreiner finish naturally yields more brilliant effects on mercerized than on ordinary cotton goods.

In a similar manner embossed effects can be produced by applying suitably engraved rollers. The following patterns illustrate effects obtained by mercerizing, calandering, and embossing.

Patterns No. 1, 2 and 3 show the effect of mercerizing and embossing; all three pieces were dyed together with Dianil Blue H6G. No. 1 is on bleached sateen, No. 2 on bleached mercerized sateen, and No. 3 shows the effect of the Schreiner calander on the material illustrated by Nr. 2.

No. 1. Dianil Blue H6G on bleached sateen.

No. 2. Dianil Blue H6G on bleached mercerized sateen.

No. 3. Dianil Blue H6G, dyed like No. 2, and finished on the Schreiner calander.

Methylene Grey BD.

Thiogene Cyanine G with Chlorate Discharge.

Diphenyl Black Base I pat.

EMBOSSED EFFECTS.

III.

CHEMICALS, MORDANTS AND THICKENINGS USED IN CALICO PRINTING.

1. SODIUM-COMPOUNDS.

Sodium Hydroxide or **Caustic Soda** $NaOH$, mol. weight 40, is a white, crystalline, brittle substance. easily soluble in water: 1 part of solid caustic soda dissolves in 2 parts of cold, and in $^1/_2$ part of warm water. Caustic soda is put upon the market in lumps or in the form of leaves, also as an aqueous solution under the name of soda-lye. Its use in the form of leaves is preferable on account of its dissolving more quickly. The quantity of caustic soda in soda-lye is determined either by degrees of Tw. or titrometrically. Soda-lye is used in bleaching and mercerizing; in calico printing it is employed for discharging tannin, neutralizing Azophor Red etc.; also for printing Indigo and Sulphur Colours, and for the production of alkaline aluminium and chrome mordants. Caustic soda must for most purposes be free from iron. 1 gr. mol. $NaOH$ is contained in 90,7 cc. resp. 123,1 gr. soda-lye $71^1/_2{}^0$ Tw. or in 212 cc. resp. 250,2 grs. soda-lye 36^0 Tw.

Sodium Peroxide Na_2O_2, mol. weight 78, is put upon the market in yellowish lumps or in powder; it must be kept well closed, as it easily absorbs moisture and carbonic acid. It dissolves in water and diluted acids, forming Peroxide of Hydrogen, which is a very efficacious bleaching substance.

Sodium Carbonate or **Soda** Na_2CO_3, mol. weight 106, soluble in 14 parts of cold and in about 2 parts of hot water, is commercially sold as calcined soda, Solvay soda, Na_2CO_3, or as crystal soda $Na_2CO_3 + 10\,H_2O$ (mol. weight 286). It is used as a resist under Aniline black, for neutralizing the acid in fixing basic colours with Antimony salts, for aftertreating chrome mordanted material and for the preparation of alumina and iron mordants.

Sodium Chloride or **Common salt** $NaCl$, mol. weight 58,5, soluble in $2^1/_2$ parts of water, forms regular crystals. and is used as addition in dyeing to the dye-baths of Direct Colours.

Sodium Hypochlorite $NaClO$, mol. weight 74,5 is obtained by the double decomposition of Chloride of lime and Soda. It is used for improving the white of printed goods and can be added direct to soap solutions. It is particularly efficient in cleansing the white of pieces dyed or printed with Ice Colours.

Sodium Chlorate $NaClO_3$, mol. weight 106,5 (soluble in 1 part of cold and $^1/_3$ part of hot water) is put upon the market in crystals, and is preferred to the corresponding potassium salt on account of its greater solubility. It is extensively used as oxidizing medium in Aniline Black and Diphenyl Black printing, and also in Chlorate discharges.

Sodium Bromide-Bromate (Discharge Salt II) is sometimes used for replacing the Chlorate in oxidizing discharges. The white obtained with it is however slightly yellow.

Sodium Sulphide $Na_2S + 9H_2O$, mol. weight 240, is put upon the market in crystals. In the melted state 50 parts correspond to 100 parts of Sodium Sulphide crystal. It is very soluble, hygroscopic, and is used as a solvent for Sulphur Colours; for the preparation of sulphide of copper etc.

Sodium Bisulphite $NaHSO_3$, mol. weight 104, forms small and easily soluble prisms, and is put upon the market as Bisulphite cryst. or in solutions of $66^1/_2{}^0$ Tw. It is used in bleaching, for Aniline Black resists, for preparing the hydrosulphite indigo vat, and for producing certain bisulphite compounds of dyestuffs as f. i. of Alizarine Blue and Ceruleine.

Sodium Hydrosulphite $Na_2S_2O_4$ mol. weight 174 is obtained by the reduction of bisulphite with zinc dust and is principally used for setting and working the Hydrosulphite Indigo vat.

Dissolved in water, Hydrosulphite is not stable; by adding caustic alkalies however the decomposition is retarded. Besides heat and moisture certain salts cause the hydrosulphite to decompose f. e. Thio-sulphates. Hydrosulphite is precipitated from its solutions by common salt, Glauber's salt etc.; this hydrosulphite contains water. Dry, properly desiccated sodium hydrosulphite does not decompose easily in the air. The hydrosulphite is tested with Indigocarmine solutions.

The Farbwerke have put on the market:

Hydrosulphite O
Hydrosulphite conc. powder.

Hydrosulphite O Hoechst is fairly stable, if kept in a cool place.

Hydrosulphite conc. powder is seven times as strong as Hydrosulphite O Hoechst and withstands the influence of air.

Hydrosulphite NF pat. consists of a molecular mixture of Formaldehyde Hydrosulphite and Formaldehyde Bisulfite ($NaHSO_2 \cdot CH_2O + 2H_2O + NaHSO_3 \cdot CH_2O + 2H_2O$) and contains about 44 % $NaHSO_2 \cdot CH_2O + 2H_2O$. It is obtained by the reaction of formaldehyde upon sodium hydrosulphite, and forms white solid bodies of fine crystalline structure. Protected from dampness and excessive heat, the substance keeps for months. In moist air it is apt to liquify; it melts in the water bath at 122° F, without losing its reducing properties. Only in its gaseous form viz. at the boil this hydrosulphite becomes efficient. Hydrosulphite NF has found extensive use: in printing with Indigo and Sulphur Colours, in discharging ice and direct dyeing colours, also for cleansing the white in goods printed with ice colours.

Hydrosulphite NFW pat. contains zinc white in addition to Hydrosulphite NF, and is used as a discharge on raised goods. The addition of zinc white prevents the sinking into the cloth of the easily soluble discharge, and embellishes the discharged white.

Hydrosulphite NFX pat. is similar to Hydrosulphite NFW, and contains lithopone instead of zinc white. The discharges prepared with Hydrosulphite NFX have the advantage of resisting acids better than those prepared with NFW, they also produce a better white.

Hydrosulphite NF conc. is a new compound of Formaldehyde Hydrosulphite, and contains 88% $NaHSO_2 \cdot CH_2O + 2H_2O$, mol. weight 154; consequently it has twice the discharging strength of Hydrosulphite NF. The special advantage of this substance, as compared with Hydrosulphite NF, is its stability and adaptability for very concentrated white and coloured discharges.

Sodium Sulphate Na_2SO_4, mol. weight 142 (soluble in 20 parts water 32° F and 2½ parts boiling water), is commercially known as Glauber's Salt, $Na_2SO_4 + 10H_2O$, mol. weight 322. It is chiefly used as addition to the dyebaths of the Direct Colours.

Sodium Nitrite $NaNO_2$, mol. weight 69, is put upon the market in crystals and is easily soluble. It is used in diazotising ice colours. It is necessary to make an analysis of the salt before use in order to determine the amount of nitrite required for diazotizing. The analysis is made by titration with Permanganate of potassium.

Sodium Phosphate. The common Sodium phosphate, $Na_2HPO_4 + 12H_2O$, mol. weight 358 (soluble in 35 parts of cold and 1 part of hot water), forms crystals which easily decompose and are efflorescent. It is used in dyeing and printing with direct colours, for fixing alumina mordants in Alizarine dying and for neutralizing Diazo solutions of insoluble Azo Colours produced on the fibre.

Sodium Pyrophosphate $Na_4P_2O_7 + 10H_2O$, mol. weight 446 (soluble in 20 parts of cold and 1 part of hot water), forms white crystals and is used in discharging Alpha Naphthylamine Claret with Hydrosulphite NF conc. and Rodogen MLB. It is also employed for the preparation of alkaline iron solutions.

Di-Sodium Ortho-Arsenate $Na_2HAsO_4 + 12H_2O$ mol. weight 402 (soluble in 3 parts of cold and very easily soluble in hot water) is used as an addition to the fixing baths for alumina or iron-mordanted material. It is very poisonous and therefore generally replaced by sodium phosphate.

Sodium Borate or Borax $Na_2B_4O_7 + 10H_2O$, mol. weight 382 (soluble in 15 parts of cold and $^1/_2$ part of hot water), forms large monoclinic prisms, and, owing to its slightly alkaline character, serves as a solvent for the Alizarine dyestuffs in padding, also as an addition to albumen solutions and as preservative against putrefaction.

Sodium Silicate or **Waterglass** $Na_2Si_4O_9$, mol. weight 302, is put upon the market as a thick liquid of $66^1/_2$—77° Tw. or in the solid state, and is used for dunging, also as an addition to white discharges on Turkey red, and for after-treating Aniline Black.

Sodium Acetate $NaC_2H_3O_2 + 3H_2O$, mol. weight 136 (soluble in 3 parts cold and in $^1/_2$ part hot water), is obtained by neutralizing acetic acid with caustic soda, and crystallizes in rhombic columns. It is used as an addition to the Diazo solutions in printing and dyeing with ice colours, for neutralizing mineral acids, as an addition to tin salt discharges and for Aniline Black resists.

Sodium Tartrate $C_4H_4O_6Na_2$, mol. weight 194 is obtained by neutralizing tartaric acid with caustic soda and is employed as an addition to oxidizing discharges.

Sodium Citrate $C_3H_4(OH)(COONa)_3$, mol. weight 258 is obtained by neutralizing citric acid with soda lye. It is used in solutions of $52^1/_2$ Tw., which ought always to react acid. It is employed for resists under Alizarine Steam Colours, for discharging chrome-mordants and as addition to oxidizing discharges.

2. POTASSIUM-COMPOUNDS.

Potassium Hydroxide or **Caustic Potash** KOH, mol. weight 56, forms a white crystalline substance, and is sometimes preferred to caustic soda in Indigo printing, owing to is greater solubility.

Potassium Carbonate or **Potash** $K_2CO_3 + 2H_2O$, mol. weight 174, is easily soluble in water and forms a white hygroscopic substance. It is a fairly strong alkali and is used in printing with Thiogene Colours.

Potassium Sulphite $K_2SO_3 + H_2O$, mol. weight 194 is usually sold in solutions of 90° Tw. and is employed for Sulphite discharges and resists. The dry powder is not stable when left open and must be kept in well closed vessels.

Potassium Pyrosulphite or **Potassium Metasulphite** $K_2S_2O_5$, mol. weight 222, is a stable preparation of sulphite in form of powder, which is used for dyeing Turkey Red, by a simplified method, patented by the Farbwerke Hoechst.

Potassium Persulphate $K_2S_2O_8$, mol. weight 270 is obtained from potassium bisulphate by electrolysis. It is a strong oxidizing agent. It does not dissolve easily in water and is therefore generally replaced by the soluble ammonia-salt. It is employed for the so-called Blue-Red style produced with Dianisidine Blue on Para Red.

Potassium Chlorate $KClO_3$, mol. weight 122,5 (soluble in 14 parts of cold and in 2 parts of hot water), forms transparent monoclinic tablets, and is used for oxidizing. Although little soluble, it is used instead of sodium chlorate on account of its lower price f. e. for Aniline Black padding liquids.

3. AMMONIUM-COMPOUNDS.

Ammonia or Spirits of Ammonia NH_3, mol. weight 17. The name of Ammonia is applied to a solution of gaseous ammonia in water. It is usually put upon the market as a solution of 25%. It is a fugitive base, and used f. e. in the so-called ammonia-chamber, in order to neutralize any acid vapours of Aniline Black and Alizarine Steam Colours.

Ammonium Chloride NH_4Cl, mol. weight 53,4 (soluble in 3 parts of cold and in $1\frac{1}{2}$ parts of hot water), is put upon the market in white crystals. The solutions of ammonium chloride in water dissociate when heated into the fugitive ammonia and hydrochloric acid. In printing use is made of this property of acting as an acid in its gaseous state.

Ammonium Bisulphite NH_4HSO_3, mol. weight 99 is sold in solutions of 64° Tw. and is used for preparing the bisulphite compounds of Alizarine Blue etc.

Ammonium Persulphate $(NH_4)_2S_2O_8$, mol. weight 228 (soluble in $\frac{1}{2}$ part of water) forms white crystals which are stable, as long as they are kept dry. When damp it generates oxygen at the ordinary temperature and acts therefore as a strong oxidizer. It is employed for the Blue-Red style produced with Dianisidine Blue on Para Red.

Ammonium Sulphocyanide NH_4SCN, mol. weight 76, forms colourless, easily soluble hygroscopic leaves. It is used as an addition to tin salt discharges, where it counteracts the hydrochloric acid formed, and thus prevents corrosion of the fibre. It may also be employed in resists under Aniline Black and other oxidizing colours.

Ammonium Tartrate $C_4H_4O_6(NH_4)_2$, mol. weight 184 is used as an addition to various discharge pastes. In steaming the ammonia volatilizes and the tartaric acid acts then as a discharge.

Ammonium Tartrate is prepared by dissolving 10 lbs of tartaric acid in 15 lbs hot water and neutralizing the solution at 30° C with 10—12 lbs ammonia. The solution must react alkaline. It is made up with water to $32\frac{1}{2}$° Tw.

Ammonium Citrate $C_3H_4OH\ (COONH_4)_3$, mol. weight 243 is obtained as a liquid of 52° Tw. by neutralizing citric acid with ammonia. It is used as an addition to oxidizing discharges and for resists under Alizarine Steam Colours.

4. MAGNESIUM-COMPOUNDS.

Magnesium Oxide or **Burnt Magnesia** MgO, mol. weight 40, forms a white amorphous powder which is used for producing the various magnesium mordants.

Magnesium Carbonate $MgCO_3$, mol. weight 84, is used in printing resists under Aniline Black.

Magnesium Chloride $MgCl_2 + 6H_2O$, mol. weight 203, is put upon the market either in crystals or calcined and dissolves easily in water. Owing to its hygroscopic character it is used as an addition to finishes, in order to retain moisture in finished goods.

Magnesium Sulphate or **Epsom salt** $MgSO_4 + 7H_2O$, mol. weight 246 (soluble in 4 parts of cold and in $1^1/_2$ parts of hot water), is chiefly used for finishing cotton goods.

Magnesium Acetate $Mg\ (C_2H_3O_2)_2 + 4H_2O$, mol. weight 214, is obtained by dissolving magnesium carbonate in acetic acid. It is used in solution of 40° Tw. as a resist for Aniline Black.

5. CALCIUM-COMPOUNDS.

Calcium Oxide, Caustic Lime, Quick Lime or **Burnt Lime** CaO, mol. weight 56, is obtained by calcining calcium carbonate. It forms a white amorphous and porous substance which in absorbing moisture develops heat. By the action of water upon quick lime calcium hydroxide (slaked lime), is generated which is employed in bleaching, vat dyeing, for producing calcium mordants etc. As Quick Lime absorbs moisture and carbonic acid from the atmosphere most readily, it must be stored in dry, closed places. Little water makes it „fall“ into a fine white (not gritty) powder; an excess of it yields the so-called milk of lime.

Calcium Carbonate or **Chalk** $CaCO_3$, mol. weight 100, serves for neutralizing, e. g. it neutralizes the acid which is liberated in fixing Basic Colours with tartar emetic and is used as an addition to Alizarine Red dyebaths and for the so called chalk-baths.

Chloride of Lime $CaOCl_2$, mol. weight 127 contains as its most efficient part hypochloric acid and is put upon the market as a smooth white powder, free from any hard lumps. In the open air it absorbs moisture and carbonic acid, and becomes soft and greasy. It dissolves in 20 parts of water. In dissolving it leaves an insoluble residue of caustic lime. Chloride of lime must be kept in well closed vessels and in a dry place. Its chief use is in bleaching and for cleansing the white of printed material. Chloride of lime should contain about 35 % effective chlorine. The analysis is made by titration with arsenous acid.

Calcium Acetate or Acetate of Lime $Ca(C_2H_3O_2)_2 + H_2O$, mol. weight 176, is produced from burnt lime and acetic acid:

35 lbs (3,5 k) pure burnt lime are slaked with
5 gall 5 l. water, and diluted with
7 „ 1 l. water, Then are added
20 „ 20 l. Acetic Acid 9° Tw. and the whole allowed to stand for 12—24 h.

The clear alkaline solution is drained off from the precipitate (containing iron), then acetic acid is added until a slight acid reaction sets in, and finally the solution reduced to 28½° Tw.

It is used as an addition to Alizarine steam Colours, especially to Alizarine. Red and Pink, for which purpose it must be perfectly free from iron.

Pyrolignate of Lime is put upon the market in brown lumps, and is produced by neutralization of pyroligneous acid by milk of lime. Owing to, its lower price it is used for the production of aluminium- and chrome mordants, instead of sugar of lead.

Oxalate of Lime C_2O_4Ca, mol. weight 128 is obtained by neutralizing oxalic acid with chalk. It is used as an addition to Chromate discharges upon Indigo. In that case no oxalic acid is required in the following passage through sulphuric acid.

6. BARIUM-COMPOUNDS.

Barium Chloride $BaCl_2 + 2H_2O$, mol. weight 244 (soluble in 3 parts of cold, or 2 parts of hot water is put on the market in rhombic tablets and is used for the preparation of barium chromate and iridescent effects with sodium tungstate.

Barium Chlorate $Ba(ClO_3)_2 + H_2O$, mol. weight 322 — soluble in 4 parts of cold and $^3/_4$ parts of hot water — is sold in monoclinic crystals and is principally used for the preparation of chlorate of alumina.

Barium Sulphocyanide $Ba(CNS)_2 + 2H_2O$, mol. weight 289 yields by double decomposition with alumina sulphate the often used sulphocyanide of alumina-mordant.

7. ALUMINIUM-COMPOUNDS.

Alumina Hydrate $Al_2(OH)_6$, mol. weight 155,8 is sold in pieces or as a paste and is obtained by precipitatnig aluminium sulphate solutions with soda. The hydrate, produced in this manner, always contains more or less sulphuric acid. In order to obtain hydrates, which are comparatively free from sulphuric acid the sulphate solutions are precipitated hot with ammonia and the precipitate then well washed. The aluminia hydrate is used for the preparation of various alumina-mordants.

Sodium Aluminate $Na_2Al_2O_4$, mol. weight 164 is obtained by dissolving freshly precipitated alumina hydrate in caustic soda. It is used as a mordant for Alizarine Red and as an addition to β-Naphthol preparations; also as a resist under Aniline Black in the production of red dyed styles.

Aluminium Chloride Al_2Cl_6, mol. weight 266,5 is used as a solution of 53° Tw. and on account of its easy dissociation it is frequently employed in printing colours produced on the fibre by oxidation.

Aluminium Chlorate $Al_2(ClO_3)_6$, mol. weight 554,9 is a very unstable compound, which is employed for producing oxidizing discharges. It is obtained by double decomposition of aluminium sulphate and chlorate of barium.

Aluminium Chlorate 42° Tw.

$$\text{I}\begin{cases}\text{200 parts aluminium sulphate}\\ \text{130 parts water}\end{cases}$$

$$\text{II}\begin{cases}\text{300 parts barium chlorate}\\ \text{350 parts water}\end{cases}$$

I and II are mixed together, cooled, filtered and the solution diluted to 42° Tw. In certain cases the aluminium chlorate is produced direct in the printing pastes by mixing aluminium sulphate with barium — or sodium chlorate.

Aluminium sulphate $Al_2(SO_4)_3 + 18H_2O$, mol. weight 664,8 (soluble in 10 parts of cold and $^1/_{10}$ parts of hot water), is a substitute for alum. It is used for the production of various aluminium mordants, and for that reason must be free from iron.

Potassium Aluminium Sulphate or **Potash Alum** $K_2SO_4 \cdot Al_2(SO_4)_3 + 24H_2O$, mol. weight 948 (soluble in 10 parts of cold and $^1/_4$ part of hot water), forms large colourless octahedra. Like sulphate of alumina it is used for the production of aluminium mordants.

Ammonium Aluminium Sulphate or **Ammonia Alum** $(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 + 24H_2O$, mol. weight 904,4 (soluble in 10 parts of cold water and very soluble in hot water), forms large colourless octahedra. It is used instead of potash alum for the production of aluminium mordants.

Kaoline or **China Clay** is a compound of alumina and silicic acid; it forms a fine white powder and serves as a mechanical addition to white discharges and resists.

Aluminium Sulphocyanide $Al_2(CNS)_6$, mol. weight 402, is produced from sulphate of alumina and sulphocyanide of barium. It is used as a mordant for Alizarine Red and Alizarine Pink, as it does not corrode the steel doctors in printing, and slight impurities of iron in the mordant are counteracted by it. It also acts as a resist for Aniline Black.

Sulphocyanide of Aluminium 18° Tw.

6300 parts sulphate of alumina, dissolved in
10000 parts water
8500 parts sulphocyanide of barium, dissolved in
10000 parts water

are mixed, decanted and filtered, and the filtered liquid is diluted to 18° Tw.

Aluminium Nitrate $Al_2(NO_3)_6 + 15 H_2O$, mol. weight 694,7, forms easily soluble crystals, and is obtained by dissolving aluminium hydrate in nitric acid, or by the double decomposition of sulphate of alumina with nitrate of lead. It dissociates neither by heating nor by dilution with water, and is used as a mordant for Alizarine Red Steam Colours.

Aluminium Acetate $Al_2(C_2H_3O_2)_6$, mol. weight 408, is obtained by dissolving aluminium hydrate in acetic acid, or by the double decomposition of aluminium sulphate or alum and sugar of lead or acetate of lime. Basic aluminium acetates are obtained by adding soda solutions to the normal aluminium acetate. The more basic they are, the more easily they dissociate when heated. The precipitates thus obtained do not dissolve again on cooling. Diluted with water the aluminium acetates do not dissociate. — In the presence of alkali sulphates, however, both the normal aluminium acetate and the basic aluminium acetates dissociate when diluted with water; they also dissociate more easily on heating, but the precipitates thereby obtained dissolve again on cooling. The basic aluminium acetates are usually obtained by the double decomposition of sulphate of alumina with sugar of lead and soda. In this case an alkalisulphate is present, and the product consequently dissociates easily. Acetate of alumina is used as a mordant in printing with Alizarine Red and for neutralizing the acid in Aniline Oxidation Black.

Aluminium Acetate 15° Tw.

I.

1500 parts alumina hydrate 12% are heated with
1000 parts acetic acid 9° Tw., filtered, and diluted with
water to 15° Tw.

II.

665 parts sulphate of alumina,
1000 parts water,
1137 parts sugar of lead,
1000 parts water

each to be separately dissolved hot, precipitated and diluted to 15° Tw.

Aluminium Sulpho-Acetate is obtained when a quantity of sugar of lead insufficient for completing the double decomposition is used. The normal sulpho-acetate does not dissociate on being diluted with water. When heated it forms a precipitate which dissolves again on cooling, whereas the basic sulpho-acetates dissociate both when diluted with water and when slightly heated. The precipitates thereby obtained do not dissolve again on cooling. The normal sulpho-acetate is used in printing, the basic aluminium acetates in dyeing with Alizarine Red.

1. Normal Sulpho-Acetate 15° Tw.

6650 parts sulphate of alumina,
6000 parts water,
9450 parts sugar of lead,
9000 parts water

each to be separately dissolved hot, precipitated and diluted to 15° Tw.

2. Basic Sulpho-Acetate 18° Tw.

1908 parts alum or 1336 parts sulphate of alumina,
2000 parts water,
1590 parts sugar of lead,
1600 parts water

each to be separately dissolved hot, and precipitated.

After cooling

150 parts crystal soda, are added

the whole left to stand for 24 hours, decanted and diluted to 18° Tw.

Aluminium Nitrate $Al_2(NO_3)_6 + 15H_2O$, mol. weight 694,7, forms easily soluble crystals, and is obtained by dissolving aluminium hydroxide in nitric acid, or by the double decomposition of sulphate of alumina with nitrate of lead. It dissociates neither on heating nor on dilution with water, and is used as a mordant for Alizarine Red Steam Colours.

Aluminium Nitro-Acetate, Nitrate Mordant, is obtained by the double decomposition of sulphate of alumina or alum with sugar of lead and nitrate of lead, or with acetate and nitrate of lime. It dissociates very slowly on steaming, it is therefore suitable as a mordant for Alizarine Red.

Nitrate Mordant.

667 parts sulphate of alumina are dissolved in
1000 parts water; then are added
786 parts acetate of lime 23° Tw. and
886 parts nitrate of lime 67° Tw.

the whole diluted to 3200 parts and filtered. Or

6 parts alum are mixed with
4 parts sugar of lead and
2 parts nitrate of lead.

8. CHROMIUM COMPOUNDS.

Chromium Hydrate $Cr_2(OH)_6$ mol. weight 207, is obtained by precipitating chrome alum with ammonia. Dissolved in acetic acid it is used for the production of acetate of chrome.

Chlorate of chrome $Cr_2(ClO_3)_6$ mol. weight 605, is obtained by the double decomposition of chrome alum and barium chlorate, and forms a green or violet solution, according to the temperature at which it was prepared. It smells strongly of chlorine, and, when heated, gives off large quantities of chlorine. Chlorate of chrome is a strong oxidising agent. Prud'homme proposed to use it as a means of preventing Aniline Black from turning green. Lauber recommends a basic chlorate of chrome as a mordant for Catechu Brown.

Bisulphite of chrome $Cr(HSO_3)_3$? is obtained by mixing chrome alum solution with bisulphite. It is decomposed by steaming, under formation of chrome hydroxide. It is used as a mordant for Chrome dyed styles, sometimes also as a chrome mordant for steam colours.

Chrome alum $K_2SO_4 \cdot Cr_2(SO_4)_3 + 24H_2O$, mol. weight 999, is put upon the market in dark violet octahedra. It serves as primary product for the production of chrome mordants.

Sulphocyanide of Chrome $Cr_2(CNS)_6$, mol. weight 452,6 is obtained by the double decomposition of chrome alum with sulphocyanide of barium. It is used as a mordant chiefly in printing with Logwood Black.

Acetate of Chrome $Cr_2(C_2H_3O_2)_6$, mol. weight 458,6, is obtained by dissolving chromium hydrate in acetic acid, by the double decomposition of chrome alum and sugar of lead or acetate of lime, or by the reduction of bichromate of potassium with glucose. Two modifications of acetate of chrome are sold: the green or normal acetate, $Cr_2(CH_3COO)_6$, and the violet or basic acetate, $Cr_2(CH_3COO_4)_4(OH)_2$. An addition of sodium acetate to acetate of chrome diminishes its faculty of being precipitated by alkalies. It is not easily decomposed. Basic chrome acetates are obtained by an addition of soda to normal acetate of chrome. Only very basic acetates dissociate on heating. Owing to their stability, acetates of chrome cannot be used in dyeing, but form the most important chrome mordants for printing.

Acetate of Chrome.

I. 1200 parts chromium hydrate and
1300 parts acetic acid 9° Tw. are heated on the water bath until completely dissolved, and diluted to 25° Tw.

II. $\left\{ \begin{array}{l} \text{1200 parts chrome alum} \\ \text{2400 parts water} \end{array} \right.$
$\left\{ \begin{array}{l} \text{1200 parts sugar of lead} \\ \text{1000 parts water} \end{array} \right.$

are precipitated, filtered and washed, and then diluted to 32° Tw.

III. 1200 parts sodium bichromate
1250 parts water
3000 parts acetic acid 9° Tw., to which are gradually added
756 parts glucose

are heated until the solution shows a green colour, and then diluted to 32° Tw.

Certain dyestuffs which require to be dissolved in alkalies, can only be used in combination with neutral acetate of chrome. This is produced as follows;

1000 parts acetate of chrome 32° Tw.
20 parts glycerine
8 parts soda
72 parts water.

Sulpho Acetate of Chrome is obtained like the corresponding aluminium salt, by employing an amount of sugar of lead insufficient for the complete decomposition of the chrome alum. Neither the normal nor the basic sulphoacetates are decomposed when diluted with water, and only the basic sulphoacetates dissociate on being heated.

Alkaline Chrome Mordants. I. Horace Köchlin prepared an easily fixable mordant for chrome colours, by mixing:

250 parts acetate of chrome 32° Tw.
320 parts caustic soda $71\,{}^1/_2$° Tw.
10 parts glycerine 53° Tw.
420 parts water
1000 parts.

II. According to Henri Schmid an alkaline mordant can be obtained direct by dissolving chromium hydrate in caustic soda:

1000 parts chrome alum are precipitated with
330 parts calc. soda, and the precipitate washed
and then dissolved in
5000 parts caustic soda 53° Tw.

The alkaline chrome mordants readily affix their chromoxide to the cotton fibre, and also give full shades in dyeing without the use of fixing mediums.

Chrome Mordant GA I, GA II, GA III, according to M. von Gallois, are obtained either by dissolving chromoxide hydrate in chromic acid alone or mixed with hydrochloric acid or acetic acid. They can also be obtained by double decomposition. The brand GA II, which contains acetic acid, is used specially in cotton dyeing. As it fixes its chromoxide to the fibre with readiness and gives even shades, it is well adapted for chrome dyed styles.

Chromate of Soda $Na_2CrO_4 + 10H_2O$, mol. weight 342,5, forms yellow monoclinic crystals and is obtained by neutralizing sodium bichromate with caustic soda or soda ash; it is used for discharges on Indigo.

Sodium Bichromate $Na_2Cr_2O_7 + 2H_2O$, mol. weight 299, forms deliquescent triclinic crystals, and is preferred to potassium bichromate, on account of its greater solubility, for the chromate discharges on Indigo, as also for chroming baths and for the production of various chrome mordants.

Potassium Chromate K_2CrO_4, mol. weight 194,5 (soluble in 2 parts water) forms yellow rhombic prisms, and is obtained, similarly to sodium chromate, from potassium bichromate with caustic potash or potash. It is sometimes used instead of potassium bichromate.

Potassium Bichromate, Red Chromate of Potash $K_2Cr_2O_7$, mol. weight 295 (soluble in 8 parts cold and 1 part hot water), forms orange red triclinic crystals. Like sodium bichromate, it is used for Indigo discharges, for the preparation of chrome mordants, and for chroming baths.

Barium chromate $BaCrO_4$, mol. weight 253, is obtained by precipitating sodium chromate or potassium chromate with barium chloride. It is insoluble in water and acetic acid, and is used in certain cases for discharges on Indigo.

Barium Chromate Paste 80 %.

200 parts potassium chromate
400 parts water
250 parts barium chloride
750 parts water.

Both solutions are mixed whilst being stirred. The precipitate is allowed to settle, decanted, filtered and pressed to 320 parts (80 % paste).

Chromate of Lead or **Chrome Yellow** $PbCrO_4$, mol. weight 323, is a bright yellow substance of high specific gravity and great covering power. It is obtained from potassium bichromate and sugar of lead.

Chrome Yellow.

300 parts potassium bichromate
80 parts soda calc.
3000 parts water
760 parts sugar of lead
6000 parts water.

Both solutions are poured simultaneously into 30000 parts water whilst being stirred, the precipitate is allowed to settle, decanted 3 times and filtered.

Chrome Yellow is fixed with albumen as a pigment colour, and is used as oxidising agent for Steam Aniline Black. In many cases Chrome Yellow is produced dirrect on the fibre, e. g. for Indigo resist styles. By treatment with hot milk of lime the neutral chromate of lead is transformed into basic chromate, or Chrome Orange.

9. IRON-COMPOUNDS.

Chloride of Iron Fe_2Cl_6, mol. weight 325, is put upon the market in easily deliquescent, yellow tablets and is used in an alkaline solution as an oxidising agent.

Ferrous Sulphate or **Iron Vitriol** $FeSO_4 + 7H_2O$, mol. weight 278 (soluble in 2 parts cold and $^1/_3$ part hot water), forms greenish blue, easily decomposing monoclinic crystals. It serves as primary product for the production of the various iron mordants.

Ferrous Acetate or **Acetate of Protoxide of Iron** $Fe(C_2H_3O_2)_2 + 4H_2O$, mol. weight 246, is obtained by dissolving iron in acetic acid, or by the double decomposition of iron vitriol with sugar of lead:

Ferrous Acetate $32^1/_2{}^0$ Tw.
680 parts sulphate of iron
360 parts sugar of lead
1350 parts water

are dissolved hot, allowed to stand, filtered, and diluted to $32^1/_2{}^0$ Tw.

It is mostly used for the production of Chamois shades. Of much greater importance as a mordant is:

Pyrolignate of Iron. It is obtained by dissolving iron in wood vinegar, or by the double decomposition of iron vitriol with pyrolignate of lime; it is extensively used as a mordant for dyed styles and for Steam Alizarine Violet.

Ferrocyanide of sodium $Na_4FeCy_6 + 10H_2O$, mol. weight 484,4, forms yellow monoclinic crystals, and is sometimes used instead of ferrocyanide of potassium, on account of its greater solubility and its lower price.

Ferrocyanide of Potassium or **yellow Prussiate** $K_4FeCy_6 + 3H_2O$, mol. weight 422 (soluble in 3 parts cold and 1 part hot water), forms lemon-coloured monoclinic tablets. It is used as a carrier of oxygen in printing and padding with Steam Aniline Black, and as an addition to oxidation discharges. Also as a mordant for Steam Alizarine Violet.

Ferricyanide of Potassium or **red Prussiate** $K_6Fe_2Cy_{12}$, mol. weight 658 (soluble in $2^1/_2$ parts cold and $1^1/_2$ parts hot water), forms dark red rhombic prisms. It is used, like yellow prussiate, as carrier of oxygen, and aftertreated with caustic soda, for Indigo discharges.

10. ZINC-COMPOUNDS.

Zinc dust is put upon the market as a grey powder; it consists of finely powdered zinc and some oxide of zinc, is a strongly reducing medium and is largely used in the preparation of Indigo vats, of hydrosulphite, bisulphite, zinc dust discharges etc. Zinc dust is tested titrometrically by means of potassium bichromate and iron ammonium sulphate.

Oxide of Zinc or **Zinc White**, ZnO, mol. weight 81, is sold as a very fine white powder; it possesses great covering power, and is much used as a resist under Aniline Black. It also serves for the production of Damask effects in printing. In order to produce smooth printing pastes it must be ground exceedingly fine.

Sulphide of Zinc ZnS, mol. weight 97, is put on the market in mixtures with barium sulphate, under the name of Lithopone, and is used with advantage as an addition to hydrosulphite white discharges on raised materials.

Bisulphite of Zinc $Zn(HSO_3)_2$, mol. weight 227,5, is sold as a yellow liquid of $32^1/_2{}^0$ Tw.; and is used as a mordant for Alizarine Blue.

Hydrosulphite of Zinc, is put on the market under the name of Hydrosulphite Z; formerly it was used for discharging α-Naphthylamine Claret and for printing with Indigo. Recently, however, it has been entirely superseded by the stable compounds of sodium-hydrosulphite-formaldehyde.

Hydrosulphite AZ is a basic compound of zinc-hydrosulphite-formaldehyde. It is white, insoluble in water, and is used as a stripping agent in dyeing.

Sulphate of Zinc $ZnSO_4 + 7H_2O$, mol. weight 287 (soluble in 1 part cold and $^1/_6$ part hot water) is put upon the market in white rhombic crystals which are very efflorescent. It is used for the production of the various zinc mordants.

Chromate of Zinc $ZnCrO_4 \cdot ZnO + 2H_2O$, mol. weight 298, is obtained by hot precipitation of zinc vitriol with potassium chromate or sodium chromate. It is used for the production of discharge pulps under Indigo.

Chromate of Zinc Paste 50 %.

$$\left\{\begin{array}{l}\text{200 parts potassium chromate}\\ \text{400 parts water}\end{array}\right.$$

$$\left\{\begin{array}{l}\text{290 parts sulphate of zinc}\\ \text{300 parts water}\end{array}\right.$$

are precipitated hot, filtered and pressed to 360 parts.

Acetate of Zinc $Zn(CH_3COO)_2 + 3H_2O$, mol. weight 237, forms easily soluble crystals, and is used as a resist for Aniline Black, and also as a mordant for Alizarine Blue S.

11. NICKEL-COMPOUNDS.

Bisulphite of Nickel is put upon the market as a green liquid $32^1/_2{}^0$ Tw. and is often used as a mordant instead of acetate of nickel.

Sulphate of Nickel $NiSO_4 + 7H_2O$, mol. weight 280,8 is put upon the market in green, very soluble crystals, and is used for the production of the various nickel mordants.

Acetate of Nickel $Ni(CH_3COO)_2$, mol. weight 176,8, is obtained by the double decomposition of sulphate of nickel with sugar of lead. It is used as a mordant for Alizarine Blue S.

12. MANGANESE-COMPOUNDS.

Peroxide of Manganese or **Manganese Ore,** MnO_2, mol. weight 87, is sometimes used as an oxidising medium.

Chloride of Manganese $MnCl_2 + 4H_2O$, mol. weight 198, is put upon the market as easily deliquescent pink crystals, or also as a liquid of 71$^1/_2$° Tw. It is used for the production of so-called Manganese Bistre.

Sulphate of Manganese, $MnSO_4$, mol. weight 151, is put upon the market in the form of pink crystals and is used for the production of Manganese Bistre.

Permanganate of Potash, mol. weight 158 (soluble in 15 parts cold and easily soluble in hot water with a reddish violet colour), forms almost black crystals with a steel blue gloss. It is a strong oxidising medium, both in acid and alkaline as well as in neutral solutions, and can also be used for the production of Manganese Bistre.

13. LEAD-COMPOUNDS.

Sulphate of Lead $PbSO_4$, mol. weight 302, is put upon the market mostly as a white paste, and is used as an addition to resists under Indigo Blue.

Nitrate of Lead $Pb(NO_3)_2$, mol. weight 330 (soluble in 2 parts cold and 1 part hot water), is put upon the market as white crystals, and is used for the production of nitrate mordants and of Chrome Yellow, also for Indigo resist styles.

Acetate of Lead or **Sugar of Lead** $Pb(CH_3COO)_2 + 3H_2O$, mol. weight 379 (soluble in 1$^1/_2$ parts cold and in $^1/_2$ part hot water), is put upon the market in white crystals. It is largely used for the production of Chrome Yellow and of various acetic acid mordants, also for Indigo resist styles.

Lead Vinegar is basic acetate of lead, and is obtained by boiling acetate of lead solutions with oxide of lead. It is used for the production of Chrome Orange.

14. COPPER-COMPOUNDS.

Chloride of Copper $CuCl_2 + 2H_2O$, mol. weight 170, is a most energetic carrier of oxygen, and is used in padding with Aniline- and Diphenyl Black, also for the production of Dianisidine Blue.

Sulphide of Copper CuS, mol. weight 95,5 is used as a carrier of oxygen for colours produced upon the fibre by oxidation.

It is prepared as follows:

I. 3750 parts copper vitriol, dissolved in
15000 parts water
3900 parts sodium sulphide cryst., dissolved in
10000 parts water.

Both solutions are poured simultaneously into 20000 parts cold water; then the precipitate is filtered, washed and pressed, to 5400 parts of paste.

Sulphide of copper can also be prepared as follows:

II. A. 500 parts sulphur
3500 parts caustic soda $66^{1}/_{2}{}^{0}$ Tw.
B. 2000 parts sulphate of copper, dissolved in
8000 parts water.

B is gradually mixed with A at 176^{0} F, allowed to stand, decanted twice and pressed to 2500 parts = 30 % paste.

On being exposed to air and still quicker to heat copper sulphide is converted into copper sulphate. It should therefore always be kept covered with wet cloths.

Sulphate of Copper or **Copper Vitriol** $CuSO_4 + 5H_2O$, mol. weight 249,5 (soluble in $2^{1}/_{2}$ parts cold and $^{1}/_{2}$ part hot water), is put upon the market in beautiful blue triclinic crystals, and is chiefly used for the production of sulphide of copper and for aftertreating colours which are to be made faster to light.

Nitrate of Copper, $Cu(NO_3)_2 + 6H_2O$, mol. weight 295,5, is put upon the market in easily soluble blue prisms, and is used as an addition to the resist pulps under Indigo.

Acetate of Copper $Cu(CH_3COO)_2 + H_2O$, mol. weight 199, forms blueish green monoclinic crystals, and is obtained by the double decomposition of copper vitriol and sugar of lead. It is used as an addition to the resist pulps under Indigo.

15. CADMIUM-COMPOUNDS.

Nitrate of Cadmium $Cd(NO_3)_2 + 4H_2O$, mol. weight 307,3, is obtained by dissolving metallic cadmium with nitric acid, and forms an easily soluble and deliquescent salt. It is used for the production of sulphide of cadmium which serves as a steam colour, and also as an addition to Chrome Yellow printing pastes, in order to prevent their turning brown through the action of sulphuretted hydrogen, yellow sulphide of cadmium being thereby formed.

16. ANTIMONY-COMPOUNDS.

Oxide of Antimony Sb_2O_3, mol. weight 287, is put upon the market as a white powder, and is used, dissolved in glycerine and caustic soda, as an addition to β-Naphthol prepare, in order to prevent the prepared material from turning brown.

Potassium Antimony Tartrate or Tartar Emetic $K(SbO)C_4H_4O_6 + \frac{1}{2}H_2O$, mol. weight 332,4 (soluble in 15 parts cold and 2 parts hot water), is put upon the market in colourless rhombic octahedra; it contains about 43 % oxide of antimony. The percentage is ascertained in the usual manner by titration with iodine. It is used in dyed styles for fixing tannin with which it forms an insoluble compound, and also largely for aftertreating tannin lakes of basic dyestuffs.

Sodium Tartar Emetic $Na(SbO)C_4H_4O_6 + \frac{1}{2}H_2O$, mol. weight 316,4, is put upon the market in colourless crystals, and is much more easily soluble than the corresponding potassium salt. It is therefore used in the production of tartar emetic resists, when very little solvent is available.

Antimony Sodium Fluoride or Double Salt of Antimony SbF_3NaF, is put upon the market in colourless triclinic prisms, and is very soluble. It contains about 66 % Sb_2O_3, and 6,6 parts Double Salt of Antimony are equivalent to 10 parts tartar emetic.

Salt of Antimony $SbF_3(NH_4)_2SO_4$, forms colourless, easily soluble crystals, and contains about 47 % Sb_2O_3. 9 parts Salt of Antimony are equivalent to 10 parts tartar emetic.

Antimony Potassium Oxalate $K_3Sb(C_2O_4)_3 + 4H_2O$, serves as a substitute for tartar emetic. It contains only about 25 % Sb_2O_3, nevertheless, in fixing, 10 parts of this salt are equivalent to 10 parts tartar emetic, because it dissociates more easily, and the bath does not become as acid with continued use as when tartar emetic is employed.

Lactate of Antimony or Antimonine is put upon the market as a yellowish moist substance, and contains only about 15 % Sb_2O_3. In fixing, 10 parts antimonine can be substituted for 10 parts tartar emetic, as the baths are completely exhausted. It is used with the addition of some acetic acid.

17. TIN-COMPOUNDS.

Stannous Hydrate $Sn(OH)_2$, mol. weight 152, is obtained by precipitating tin crystals with soda.

Stannous Hydrate 23 %.

$$\text{I.}\ \begin{cases} 695 \text{ parts tin crystals} \\ 1000 \text{ parts water.} \end{cases}$$

$$\text{II.}\ \begin{cases} 475 \text{ parts soda ash} \\ 1000 \text{ parts water.} \end{cases}$$

II is slowly stirred into I, allowed to settle, decanted, filtered and diluted to 2000 parts.

It is used as a discharge for direct dyeing colours, and for the production of acetate of tin.

Stannate of Soda is obtained by carefully dissolving stannous hydrate in soda lye at a moderate temperature, and is used in discharging Turkey red.

Stannic Hydrate $SnO(OH)_2$, mol. weight 168, is obtained by precipitating tetrachloride of tin with soda.

Stannic Hydrate $17^0/_0$.

2 lbs	I.	1000 parts	solid tetrachloride of tin = 66 % $SnCl_4$
5 gall.		25000 „	water
3 lbs $10^1/_2$ oz	II.	1830 „	soda cryst.
5 gall.		25000 „	water.

II is gradually added to I, allowed to settle, washed and filtered. The precipitate should weigh $5^1/_2$ lbs. It is used for the production of oxalate of tin, and as an auxiliary mordant for Alizarine Red Steam Colours.

Chloride of tin or **Tin crystals** $SnCl_2 + 2H_2O$, mol. weight 225, is put upon the market in colourless to yellowish crystals. Being hygroscopic and sensitive to light, it must be kept in well closed vessels. It dissolves well in a little water, whereas an excess of water causes a hydrolytic dissociation, for which reason tin crystals solutions must be acidified. Tin crystals are used for the production of various tin mordants, and also extensively as a reducing agent in discharging direct dyeing colours, and as a resist under ice colours.

Tetrachloride of Tin $SnCl_4$, mol. weight 260, is put upon the market in solid lumps and in solution of 106° Tw. It is used for the production of stannic hydrate by precipitation with soda.

Nitro-hydrochloride of tin 106° Tw, is obtained from tin crystals and nitric acid.

1000 parts tin crystals are mixed in small portions with
1000 „ nitric acid 62° Tw.

and the solution is heated on the water bath, in order to drive off the nitrous vapours. The liquid is then diluted with water to 106° Tw. It is used as an auxiliary mordant for Alizarine Red Steam Colours.

Acetate of Tin $Sn(CH_3COO)_2$, mol. weight 236, is obtained either by dissolving stannous oxide in ice vinegar or by the double decomposition of tin crystals and sugar of lead.

Acetate of Tin $32^1/_2{}^0/_0$.

1000 parts tin crystals are dissolved with
800 „ acetic acid 9° Tw.
1000 „ sugar of lead are dissolved with
800 „ acetic acid 9° Tw.

The tin crystals solution is mixed into the sugar of lead solution, left to cool, filtered, and diluted with acetic acid to $32^1/_2{}^0$ Tw. Its chief use is as a discharge for direct dyeing colours.

Oxalate of Tin $Sn(C_2O_4)_2$, mol. weight 294, is obtained by dissolving stannic hydrate in oxalic acid.

Oxalate of Tin 25° Tw.

2 lbs $3^1/_4$ oz 1000 parts stannic hydrate $17^0/_0$ are heated on the water bath with
$1^1/_2$ oz 40 parts oxalic acid, and diluted with water to 25° Tw.

The stannic hydrate must not dissolve completely. Oxalate of tin is used as an auxiliary mordant for Alizarine Red Steam Colours.

18. TUNGSTEN COMPOUNDS.

Tungstate of Soda $Na_2WO_4 + 2H_2O$, mol. weight 330 (soluble in 4 parts water) is put on the market in white rhombic tablets, and is used in finishing in order to prevent material from being inflammable. It is also employed for the production of opalescent effects by printing and subsequent passing through solutions of barium chloride. It has also been proposed for fixing insoluble Azo Colours produced upon the fibre.

19. VANADIUM COMPOUNDS.

Vanadium Chloride VCl_2, mol. weight 122, is used as a blue solution (1 : 1000), and serves as a carrier of oxygen in printing and dyeing with Aniline Oxidation Black. It can be prepared in the following manner:

10 grs vanadate of ammonia are dissolved in 100 cc muriatic acid $34^1/_2$° Tw. and 400 cc water; to this solution are added 5 grs glycerine and heated until the yellowish green fluid has turned blue. The whole is then diluted to 10 litres.

Vanadate of Ammonia NH_4VO_3, mol. weight 117,2, is put upon the market as a yellowish white powder. It is used for the production of vanadium chloride, and also as a carrier of oxygen by being added to the printing pastes and in the prepares.

20. CERIUM COMPOUNDS.

Cerochloride $CeCl_3$, mol. weight 246,2, is put upon the market as a colourless solution of $20^0/_0$, and is used as a carrier of oxygen in printing with Diphenyl Black.

21. INORGANIC AND ORGANIC ACIDS.

Hydrochloric Acid or **Muriatic Acid** HCl, mol. weight 36,4, is put upon the market as a solution of 28,5—38° Tw. The percentage can be determined either by the specific gravity or by titration. It is extensively used, same as sulphuric acid, in souring, bleaching, in diazotizing of ice colours etc. 1 gr mol. HCl is contained in 97,3 cc, or in 113,2 grs hydrochloric acid $32^1/_2$° Tw.

Sulphuric Acid H_2SO_4, mol. weight 98, is put upon the market in highly concentrated form as acid of 168° Tw. Concentrated sulphuric acid forms hydrates with water under generation of heat. Consequently, in diluting concentrated sulphuric acid it must be gradually mixed into an excess of cold water. The percentage of the acid is determined by titration with normal alkali. Sulphuric acid is largely used in bleaching, for souring, in dyeing, in Indigo discharge printing and for diazotizing ice colours.

Nitric Acid HNO_3, mol. weight 63, is put upon the market as a liquid of 67—77° Tw. and is a very strong acid which dissolves most metals, converting them into nitrates. It is used in engraving the copper printing rollers.

Formic acid HCOOH, mol. weight 146, boiling point 210° F., has partly replaced acetic acid, owing to its lower price. It is put upon the market as a liquid of 80—96%, has a pungent smell, and produces blisters upon the skin. Formic acid is used for the preparation of various mordants, and instead of acetic acid for steam colours. It is more volatile than acetic acid, and is one of the strongest organic acids.

Acetic Acid CH_3COOH, mol. weight 60, boiling point 246° F. is put upon the market as Glacial Acetic Acid of 100%, or in solutions 30—50% of 9—12 or more degrees of Tw. It it impossible to determine the exact percentage by specific gravity, and therefore it is advisable to determine it by titration with normal alkali. Acetic acid is extensively used in printing as a solvent for dyestuffs, for preventing lake formation in printing colours, and for the production of acetic acid mordants.

Lactic Acid $CH_3CH(OH)COOH$, mol. weight 90, a monobasic organic acid, is put upon the market as a solution of 50%. It pardly impairs the cotton fibre, and is used for dissolving Diphenyl Black Base, and also in printing with steam colours.

Oxalic Acid $C_2O_4H_2 + 2H_2O$, mol. weight 126, is a di-basic fixed organic acid which is put upon the market in white monoclinic crystals, and dissolves in 9 parts of water. It is a very strong acid and impairs the vegetable fibre on steaming. Oxalic acid is used for the preparation of oxalate of tin, oxalate of lime, and as an addition to the acid bath in discharging Indigo with chromates.

Tartaric Acid $C_4O_6H_6$, mol. weight 150, is a di-basic fixed organic acid which is put upon the market in large white prisms, and dissolves in $^3/_4$ parts cold water. As it prevents lake formation, it is used in printing as an addition to steam colours, and also as a discharge for the various metallic mordants. Free tartaric acid or salts of tartaric acid greatly impair the vegetable fibre on steaming.

Ethyl tartaric Acid $C_4H_5O_6 \cdot C_2H_5$, is put upon the market as a solution of 22° Tw. and is used as an addition to basic printing colours, instead of tartaric acid or acetine. Commercial ethyl tartaric acid contains mono-ethyl tartaric acid and di-ethyl tartaric acid, sometimes also free acid and alcohol. It decomposes in steaming under regeneration of alcohol, and, therefore, does not impair the fibre as much as tartaric acid itself.

Citric Acid $C_6O_7H_8+H_2O$, mol. weight 210, is a tri-basic fixed organic acid. It forms beautiful colourless crystals, and dissolves in $^3/_4$ parts cold and $^1/_2$ part boiling water. Like tartaric acid, it is used as a discharge for metallic mordants, and, like tartaric and oxalic acid, impairs the vegetable fibre on steaming.

Tannin or Tannic Acid $C_{14}H_{10}O_9+2H_2O$, mol. weight 358, is put upon the market in the form of needles, also as a pale yellow to brown powder, or as a liquid. It is easily soluble in water, alcohol, acetic acid and glycerine, but insoluble in pure ether. It has an astringent taste, precipitates metal salts, and forms insoluble compounds with glue and albuminous substances. With iron solutions tannin produces blue black to black precipitates, with basic dyestuffs it gives lakes which are insoluble in water. Weak tannin solutions turn dark on being exposed to the air. Tannin is tested either by titration with permanganate of potash in presence of Indigo solution, or by comparative printing and dyeing, in which case the light shades of Magenta and Methylene Blue Tannin Lakes are especially adapted for determining the fixing power and purity of the tannin. Tannin is chiefly used as a mordant for basic dyestuffs, and for coloured resists under the insoluble Azo Colours produced upon the fibre.

22. SUNDRY ORGANIC COMPOUNDS.

Methyl Alcohol CH_3OH, mol. weight 32, is a colourless liquid of 0,789 specific gravity at 32° F., which boils at 151—153° F., and mixes with water in any proportion. The specific gravity is determined by means of the areometer. It serves as a solvent for dyestuffs.

Ethyl Alcohol or **Spirits of wine,** C_2H_5OH, mol. weight 46, is a colourless liquid of 0,8002 specific gravity at 32° F, which boils at 163,1° F, and mixes with water in any proportion. The specific gravity is determined by means of the areometer. It serves as a solvent for dyestuffs.

Formaldehyde or **Formaline** HCHO, mol. weight 30, is a very volatile, in water easily soluble compound of a pungent smell, and has great affinity to bisulphites, hydrosulphites, albuminous and gluey substances. By polymerisation it forms slightly soluble or insoluble substances. Formaldehyde is put upon the market as a solution of 40%, and is used for the preparation of stable hydrosulphite compounds, as also for fixing Albumen and Caseine Colours.

Carbolic Acid or **Phenol** C_6H_5OH, mol. weight 94, forms, in its pure state, a white crystalline substance, slightly soluble in water. It is poisonous and cauterizes the skin. Recently it is extensively used as an addition to coloured discharges produced with hydrosulphite NF conc., because, owing to its weak acid character, it prevents the lake formation of the Tannin Colours without destroying the hydrosulphite.

Solution Ether is Diaethylamine of high percentage, boils at 136° F. It is a colourless liquid of ammonia-like smell and basic properties, and is an excellent solvent for mordant dyestuffs.

Glycerine $C_3H_5(OH)_3$, mol. weight 92, boils at 554° F., and is put upon the market as a colourless or slightly yellowish tinted viscous liquid of sweet taste. The commercial brands show a strength of $32^1/_2$—48° Tw. Glycerine is an excellent solvent for many dyestuffs. Owing to its great hygroscopic nature it is largely used as an addition to printing pastes and finishes.

Acetine is formed by heating glycerine with glacial acetic acid, and represents a mixture of mono-, di-, and tri-acetine with some free acetic acid. On steaming it dissociates again into acetic acid and glycerine. It is an effective solvent for basic colours which dissolve with difficulty, such as Induline etc.

Benzine is a liquid of light weight, its specific gravity being 0,65—0,75, and it is used as an addition to printing colours which froth easily.

Turpentine, a colourless liquid of peculiar smell; specific gravity 0,68—0,89, is, like benzine, added to printing colours in order to prevent them from frothing. It is a singular property of turpentine to ozonise the oxygen of the air, upon which property is based its use in bleaching solutions of blood albumen.

Olive Oil, specific gravity 0,914 to 0,917, is added to printing colours, in order to make them work smoothly.

Castor Oil, specific gravity 0,960 to 0,964, is used for the preparation of Turkey red oil and chlor oil.

Chlor oil is obtained by mixing castor oil with chloride of lime solution. If added to the Alizarine Red printing colours, a more brilliant red is produced. Chlor oil is prepared in the following manner:

1 part castor oil and
1 part chloride of lime solution 3° Tw. are well mixed.

Para Soap PN is obtained by partial neutralization of ricinoleic acid with ammonia. It is extensively used as an addition to the naphthol prepares in dyeing and printing with Paranitraniline, on account of its particularly favourable effect upon the shade.

Turkey Red Oils are sulphonated castor oils which are used in the preparation of goods for printing with Alizarine Red Steam Colours and in Turkey Red dyeing. They can be prepared according to the following recipe:

200 lbs castor oil, I^a^ pressing, are slowly mixed with
50 lbs sulphuric acid 168,5° Tw., whilst being kept at a tem-

perature not exceeding 86° F. After 24 hours the mixture is washed three times with

50 gallons water in which
60 lbs Glauber's salt cryst. have been dissolved and after the wash water is entirely poured off, diluted with
5 gallons ammonia.

Instead of ammonia the corresponding quantity of soda lye may be used for neutralizing. The quantity of sulphuric acid used for sulphonating the oil may be varied.

Soap. As a rule soda soap is used, which must be neutral or only contain a trace of alkali. A good soda soap of 50% can be prepared in the following manner:

100 lbs oleic acid are boiled with
54 lbs water, then
46 lbs soda lye $67^1/_2$° Tw., are added and the whole boiled for 1 hour. Then diluted with water to
200 lbs.

A titration of the soap must always be made before use, in order to make sure that the oleic acid is completely neutralized and no excess of free alkali remains. If necessary, the soap can be corrected by a further addition of oleic acid or alkali and repeated boiling. The soap is used for cleaning the printed goods, and sometimes also as an addition when dyeing with direct dyeing colours.

Glucose or **Grape Sugar** is a carbon hydrate, its composition being $C_6H_{12}O_6$, and is put upon the market in yellowish lumps. It is mostly obtained from starch which is converted into sugar with acid. It is optically negative, and reduces Fehling's copper solution. It is a strong reducing agent when heated, with caustic alkalies. This reaction is utilized in Indigo printing, by Schlieper and Baum in their Indigo printing process. Glucose, is also used in finishing pieces and yarn, on account of its being hygroscopic.

Malt contains the ferment called Diastase, which is capable of converting starch into dextrine or sugar. Malt decoctions are used for removing starchy thickenings, sizings etc., from printed and steamed goods. As diastase loses its efficiency at a higher temperature than 140° F., the malt baths may only be used tepid.

Diastaphor. Under this name some highly concentrated, soluble preparations of diastase have recently been put upon the market which will most likely eventually replace malt.

Glue is a nitrogenous animal substance, prepared from bones, skin- or leather-clippings, and is put upon the market either in yellowish brown tablets or as a gelatinous paste. In solution it is added to dyebaths, in order to prevent the colours from bleeding into the white. It is also used as an addition.

to finishes and thickenings. In a purified, colourless and easily soluble form it is chiefly employed, as **Gelatine**, for finishing. When dissolved in water it hardens on cooling. An addition of acetic acid keeps it in a liquid state. Glue solutions easily become putrid. It is therefore advisable to add to them antiseptic substances, such as phenol, salicylic acid, boric acid etc.

Bees' Wax is, in its natural state, a yellowish plastic substance of specific gravity 0,965, insoluble in water and cold alcohol. It melts at 147° F., dissolves easily in bisulphide of carbon and oil of turpentine, and contains besides cerotic acid ethers of high molecular weight, fatty acids and a certain quantity of paraffin-like bodies. By melting and bleaching in open air and light (ozone bleach) the yellow wax is transformed into white wax. Additions of tallow, paraffin, ceresine are met with as adulterants. It is used as an addition to certain thickenings and for the production of the so-called wax resists.

Vegetable Wax is on the market as Japanese wax, Carnauba wax etc., and is a cheap surrogate of bees' wax. The composition and properties of vegetable wax are similar to those of bees' wax which it also much resembles in its use.

The following is a summary of all the chemicals and auxiliary substances which are used in the most important processes of calico printing.

1. ALKALIES AND SALTS WITH ALKALINE REACTION.

Sodium hydroxide, sodium carbonate, sodium phosphate, sodium pyrophosphate, sodium arseniate, sodium borate, sodium silicate, sodium acetate, potassium hydroxide, potassium carbonate, ammonia, magnesium oxide. magnesium carbonate, calcium oxide, calcium carbonate.

2. ACIDS AND SALTS WITH ACID REACTION.

Hydrochloric acid, sal ammoniac, aluminium chloride, sulphuric acid, nitric acid, formic acid, acetic acid, lactic acid, oxalic acid, tartaric acid, ethyl tartaric acid, citric acid, as also the ammonia salts of formic, acetic, oxalic, tartaric and citric acids.

3. SOLVENTS FOR DYESTUFFS.

a) For basic dyestuffs: Methyl alcohol, ethyl alcohol, formic acid, acetic acid, lactic acid, tartaric acid, ethyl tartaric acid, glycerine, acetine, phenol.

b) For mordant dyestuffs: sodium hydroxide, sodium carbonate, sodium phosphate, sodium pyrophosphate, sodium borate, potassium carbonate, ammonia. solution ether.

4. ADDITIONS TO DYEBATHS.

a) For basic dyestuffs: Formic acid, acetic acid, sulphuric acid, alum, aluminium sulphate, tartar emetic, glue, gelatine.

b) For mordant dyestuffs: Formic acid, acetic acid, calcium carbonate, calcium acetate, glue, gelatine, tannin, sumac.

c) For direct dyeing dyestuffs: sodium carbonate, sodium chloride, sodium sulphate, sodium phosphate, soap, turkey red oil.

d) For Sulphur dyestuffs: Sodium sulphide, sodium hydroxide, sodium carbonate, sodium chloride, sodium sulphate.

5. INORGANIC COMPOUNDS WHICH ARE EITHER PRINTED AS SELF COLOURS, OR ARE USED FOR THE PRODUCTION OF COLOURED INORGANIC COMPOUNDS EMPLOYED IN PRINTING OR DYEING.

Nitrate of lead, chromate of lead (chrome yellow, chrome orange), acetate of lead, lead vinegar, sodium chromate, sodium bichromate, potassium chromate, potassium bichromate, cadmium sulphide, cadmium nitrate, chloride of manganese, sulphate of manganese.

6. CHEMICALS FOR AFTERTREATMENT OF DYEINGS.

Clearing Turkey Red: Turkey red oil, soda and tin crystals.

Aftertreatment of dyeings with Dianil Colours: Sulphate of copper, potassium bichromate, chloride of lime, sodium nitrite, phenol, resorcine, β-naphthol, m-phenylene diamine, m-toluylene diamine, claret developer, Azophor Red PN, Solidogene O.

7. CHEMICALS FOR THE PRODUCTION OF INSOLUBLE AZO COLOURS.

Soda lye, Para soap PN, ricinoleate of ammonia, sodium aluminate, sodium antimonoxide, sodium nitrite, sodium acetate, sodium phosphate, chloride of copper.

8. MORDANTS AND CHEMICALS FOR THE PREPARATION OF MORDANTS.

Sodium hydroxide, sodium bisulphite, sodium pyrophosphate, sodium acetate, ammonia, acetate of magnesium, acetate of calcium, pyrolignate of lime, calcium sulphocyanide, barium sulphocyanide, aluminium hydroxide, potassium alum, sodium alum, ammonia alum, aluminium sulphate, aluminium sulphocyanide, aluminium nitrate, aluminium acetate, aluminium sulphoacetate, aluminium nitroacetate, chromhydroxide, chromium bisulphite, chrome alum, chromium sulphocyanide, chromium acetate, chromium sulphoacetate, alkaline chrome mordants, Chrome Mordant GA I, GA II, GA III, chromates and bichromates of soda and potash, ferrous sulphate, ferrous acetate, pyrolignate of iron, ferrocyanide of soda and potash, bisulphite of zinc, sulphate of zinc, acetate of zinc, bisulphite of nickel, sulphate of nickel, acetate of nickel, nitrate of lead, acetate of lead, chloride of copper, stannous hydrate, tin crystals, tetra chloride of tin, nitro-hydrochloride of tin, oxalate of tin, sulphuric acid, hydrochloric acid, nitric acid, formic acid, acetic acid, lactic acid, tartaric acid, oxalic acid, citric acid, tannin.

9. CHEMICALS FOR FIXING MORDANTS.

Sodium carbonate, sodium phosphate, sodium silicate, ammonia, calcium carbonate, turkey red oil, sodium and potassium tartar emetic, bifluoride of antimony, antimony salt, antimony oxalate of potash, antimonine etc.

10. CHEMICALS FOR DISCHARGING MORDANTS.

Tartaric acid, citric acid, oxalic acid, their sodium-, potassium-, and ammonium salts, sodium hydroxide, sodium bisulphate.

11. CHEMICALS FOR PROCESSES OF OXIDATION.

Sodium peroxide, sodium hypochloride, sodium chlorate, sodium bromate, sodium persulphate, potassium chlorate, potassium persulphate, ammonium persulphate, chloride of lime, barium chlorate, aluminium chlorate, chromium chlorate, sodium chromate, sodium bichromate, potassium chromate, potassium bichromate, barium chromate, chromate of lead, chromate of zinc, chloride of iron, ferricyanide of potash, peroxide of manganese, permanganate of potash.

12. CARRIERS OF OXYGEN.

Ferrocyanide of soda and potash, ferricyanide of soda and potash, chloride of copper, sulphide of copper, sulphate of copper, vanadium chloride, vanadate of ammonia, cerochloride.

13. CHEMICALS FOR RESISTING PROCESSES OF OXIDATION.

Sodium hydroxide, sodium carbonate, sodium sulphite, sodium bisulphite, sodium thiosulphate, sodium hydrosulphite, Hydrosulphite NF, NF conc., NFW, NFX, sodium phosphate, sodium silicate, sodium arseniate, sodium borate, sodium formiate, sodium acetate, sodium tartrate, sodium citrate, sodium lactate, potassium hydroxide, potassium carbonate, potassium sulphite, potassium metasulphite, ammonium sulphocyanide, magnesium oxide, magnesium carbonate, magnesium acetate, calcium sulphocyanide, calcium acetate, barium sulphocyanide, sodium aluminate, aluminium sulphocyanide, aluminium acetate, chromium bisulphite, chromium sulphocyanide, oxide of zinc, acetate of zinc, acetate of lead, chloride of tin, acetate of tin.

14. CHEMICALS FOR PROCESSES OF REDUCTION.

Sodium sulphide, sodium bisulphite, sodium sulphite, sodium metasulphite, sodium hydrosulphite, Hydrosulphite O, conc. powder, Hydrosulphite NF, NF conc., NFW, NFX, potassium sulphite, potassium metasulphite, ammonium bisulphite, ferrous sulphate, ferrous acetate, zinc dust, hydrosulphite of zinc, stannous hydrate, chloride of tin, stannous acetate.

15. CHEMICALS FOR RESISTING PROCESSES OF REDUCTION.

Sodium chlorate, sodium persulphate, potassium chlorate, potassium persulphate, ammonium persulphate, barium chlorate, aluminium chlorate, aluminium nitrate, sodium chromate, sodium bichromate, potassium chromate, potassium bichromate, barium chromate, chloride of iron, chromate of zinc, peroxide of manganese, chloride of copper, sulphate of copper, nitrate of copper, acetate of copper, chloride of tin, nitrate of tin, vanadium chloride, vanadate of ammonia, cerochloride, tartaric acid, citric acid, oxalic acid, lactic acid.

16. CHEMICALS AND AUXILIARY SUBSTANCES FOR THE TREATMENT OF PRINTED GOODS IN WASHING-, SOAPING- AND CLEARING OPERATIONS.

Sodium hydroxide, sodium peroxide, peroxide of hydrogen, sodium hypochloride, Hydrosulphite NF, NF conc., sodium silicate, ammonia, chloride of lime, calcium carbonate, sodium chromate, sodium bichromate, potassium chromate, potassium bichromate, hydrochloric acid, sulphuric acid, oxalic acid, soap, malt, diastaphor.

THICKENINGS.

Starch $(C_6H_{10}O_5)n$ is a carbon hydrate insoluble in cold water. On being heated with water, starch begins to swell at about 140° F. and as so-called starch paste forms an excellent thickening. In order to prevent the putrefaction of starch paste, small quantities of antiseptic substances, e. g. salicylic acid or boric acid are added. The different kinds of starch are distinguished by the aid of the microscope. Starch reacts with iodine which serves as a sure means of recognition. Strong heat, and acids convert starch into dextrine, and under suitable conditions it is converted into sugar by acids and certain ferments, e. g. diastase.

The following are the most important kinds of starch:

Wheat Starch is the kind of starch most used for the production of printing colours, as the starch paste obtained from it keeps well and does not easily become watery. Good wheat starch must not contain more than 15 % water; nor leave more than 0,5 % ash. The starch is stirred in water and gradually heated whilst being continually stirred. It swells and thickens till, at a certain moment, it begins to thin again. From that moment it must be allowed to cool. This thickening, acidified with acetic acid, is used for printing with basic dyestuffs in deep shades. In order to produce a thickening suitable for printing purposes, 12—20% starch are used. Besides testing for water and ash starch should be tested for stability. The starch paste, after standing for some days, is tested with litmus. The longer it keeps without becoming acid, the better it is in quality. Starch can also be made into a paste cold, by means of strong caustic soda. It is made into a paste with some water and then added to the soda. The starch swells and becomes transparent, forming the so-called apparatine which is used for finishes (the caustic soda has to be neutralized before use). Apparatine is also to be considered in preparing alkaline thickenings for printing with Indigo etc.

Rice Starch is little used for thickening, as the paste made from it easily breaks and becomes watery. It is, however, used in finishing.

Maize Starch is used but little in cotton printing, but sometimes in printing with alkaline dyestuffs and for insoluble Azocolours.

Potato Starch is only used in finishing. It contains up to 20% water.

Wheat Flour contains, besides starch, a nitrogenous substance, the so-called gluten, and is very suitable as thickening mixed with tragacanth or starch in printing certain colours, e. g. the ice colours and metal mordants. With Azophor Red, Azophor Black etc. wheat flour thickenings yield the darkest and most stable printing colours. The use of wheat flour thickening for discharges which are prepared with Hydrosulphite NF conc. offers also advantages compared to the use of gum thickenings. Good wheat flour must not contain more than 16% water and 4% ash.

Burnt Starch contains chiefly dextrine. It is obtained by roasting wheat starch, and is put upon the market as lighter or darker coloured powders, according to the degree of roasting. The lighter kinds are more advantageous as thickenings. In order to produce a good thickening, 25—50%, according to quality, are required. Well burnt starch contains less than 5% water. It is used for thickening metal mordants and strongly alkaline colours. In order to test burnt starch for its percentage of unchanged starch, a certain quantity is put on a filter of known weight, and well washed out with cold water. The residue is dried at 212° F. and weighed.

British Gum is a much used thickening, and is obtained by roasting maize starch. It is especially suitable for thickening discharges. In order to prepare the thickening, British gum is mixed with water, continually stirred whilst being heated till completely dissolved and then cooled. The thickening contains 30—50% British gum powder. Like burnt starch, it is put upon the market as lighter or darker coloured powders. The former are less roasted, and contain larger quantities of unchanged starch. They are more advantageous as thickenings, but the more roasted brands are preferable for printing with alkaline colours.

Dextrine is mostly obtained from potato flour, by suitable treatment with nitric acid at a warm temperature, and is put upon the market as a white or yellow product. It is occasionally used for thickenings and finishes.

Leiogomme is likewise obtained by roasting potato flour, and forms a pale yellow powder which is chiefly used for finishing.

Tragacanth, a dried vegetable sap, is put upon the market in shell-like or leafy pieces. It forms the most profitable thickening; with 60 parts per 1000 a good thickening is already obtained. It is largely used by itself and also in combination with wheat starch and wheat flour. Especially in printing with ice colours it is a very suitable thickening; for that purpose tragacanth is mixed with water and left to swell for 24 hours, whereupon it is heated for some time, if possible under pressure, till completely dissolved. The commercial kinds of tragacanth differ largely, wherefor it is necessary, before purchasing, to make a thickening test against a known sort.

Gums. Of these Senegal gum or gum Arabic are mostly used in printing. A good quality should be easily soluble in water, contain few insoluble parts, give a light coloured solution, and should not coagulate with mordants when allowed to stand. Senegal gum thickening is prepared by mixing it with water and heating it until completely dissolved. Some natural gums, especially those of India, have to be softened under pressure or with acids in order to be dissolved. Other sorts are easily soluble and may be added direct to the printing colours in form of powder. For certain dark colours and discharges the cheaper artificial commercial gum, crystal gum etc. can be employed. Colours which are thickened with gum turn out very even, but are lighter in shade than those thickened with starch. For printing purposes a gum solution of 50 $^0/_0$ is generally made.

Albumina are soluble in water, coagulating already by simple heating. We need here only consider animal albumina, i. e. egg albumen and blood albumen, which are used in printing as mechanically acting fixing media for pigment colours. Egg albumen, which forms transparent amber coloured tablets, is used for delicate shades. Good egg albumen must be soluble in water without a residue. As a rule a solution of 50 $^0/_0$ is prepared. Blood albumen is cheaper than egg albumen, but far less pure; consequently it can only be used for dark shades. In order to dissolve albumen, it is best to mix it with water of about 77° F. It gradually falls to the bottom, swells and dissolves. A perfect solution is obtained in 24 hours. The darker kinds of albumen possess great thickening properties. In order to bleach them, their solutions are treated with turpentine, by whose ozonising action the bleaching is effected. Additions of ammonia or borax act very favourably in the preparation of solutions of albumen. Egg albumen coagulates completely at 167° F., blood albumen at 162—174° F. By the reaction of mineral acids, especially at a warm temperature, albumen coagulates also completely. This property is made use of in Indigo discharge printing, in order to fix the mineral discharges. Albumina give insoluble compounds with formaldehyde, which fact is utilized for fixing albumen printing colours.

Caseine is an albuminous substance soluble in water which, unlike albumen, cannot be separated from its solution by simple boiling, but only by an addition of acid. It is put upon the market as a yellowish white granulated powder, and is but little used in printing, as the colours fixed with albumen are much more fast to washing than those fixed with caseine. With caustic soda caseine yields a compound easily soluble in water; in order to increase its solubility, borax is added to the caseine. Formaldehyde in solution or also as gas has a strongly coagulating effect upon caseine, while forming a compound insoluble in water; of this reaction use is now and then made in fixing pigment colours.

THICKENINGS.

In this connection we proceed to discuss the preparation of the most important thickenings used in printing.

These are mostly boiled, the time of boiling depending partly on the quantity, partly on the composition of the thickenings.

Acid Starch Thickening.

2100	parts	wheat starch
5700	„	water
2200	„	acetic acid 9° Tw.
10000	parts	

are boiled, then cooled.

Especially suitable for very dark shades printed with basic dyestuffs.

Wheat Starch Tragacanth Thickening.

700	parts	wheat starch
3000	„	water
6300	„	tragacanth (60 : 1000)
10000	parts	

are boiled, then cooled.

A good thickening for medium and light shades, to be recommended for ice colours etc.

Flour Tragacanth Thickening.

2100	parts	wheat flour
4300	„	water
3000	„	tragacanth (60 : 1000)
600	„	acetic acid 9° Tw.
10000	parts	

are boiled, then cooled.

The best thickening for ice colours, both as regards the beauty of the shades and the stability of the printing colours.

Thickening St. T.

1200	parts	wheat starch
6000	„	water
1800	„	tragacanth (60 : 1000)
1000	„	acetic acid 9° Tw.
10000	parts	

are boiled, then cooled.

Suitable for medium shades and for blotches which do not give sufficiently even results with acid starch.

Thickening for Red.

1000	parts	wheat starch
200	„	wheat flour
7150	„	water
350	„	tragacanth (60 : 1000)
650	„	acetic acid 9° Tw.
		are boiled, and when cooled
650	„	olive oil are added
10000	parts.	

Especially suitable for Alizarine colours which require oil.

Thickening T. N.

1550	parts	wheat starch
2200	„	water
4000	„	acetic acid 9° Tw.
1500	„	tragacanth (60 : 1000)
750	„	olive oil
10000	parts	

are boiled, then cooled.

Suitable for Alizarine Colours.

Thickening S. G.

700	parts	china clay
1000	„	water
1400	„	wheat starch
1950	„	water
3700	„	gum solution 1 : 1
150	„	wax
1100	„	olive oil
10 000	parts	

are boiled, then cooled.

Recommended as thickening for printing resists.

British Gum Thickening.

5000	parts	british gum powder
5000	„	water
10 000	parts	

are boiled, then cooled.

For resists and discharges.

Gum Solution 1:1.

5000	parts	senegal gum
5000	„	water
10 000	parts	

are allowed to stand and dissolved at the boil.

For light clean prints, as it gives even results.

Thickening St. B.

500	parts	wheat starch
2500	„	british gum powder
7000	„	water
10 000	parts	

are boiled, then cooled.

Is suitable for certain chrome colours which easily coagulate with tragacanth thickenings.

Alkaline Thickenings.

1000	parts	british gum powder
9000	„	caustic soda 77° Tw.
10 000	„	parts

are boiled for 1/4 hour.

For Indigo printing and tannin discharge styles.

Tragacanth (60:1000).

600	parts	tragacanth
9400	„	water
10 000	parts	

are allowed to stand for 24 hours; then boiled for 8 hours under pressure.

Is used by itself with ice colours, and in mixtures with starch thickenings.

Albumen 1:1.

5000	parts	egg albumen (or blood albumen)
5000	„	water
10 000	parts	

are left to stand till completely dissolved.

Is used for fixing pigment colours.

SPECIAL PART.

EXPLANATION OF THE SYSTEMATIC TABLES OF THE DYESTUFFS.

For each group of colours we give annexed a systematic table of the respective dyestuffs, showing:

1. The shade of the dyestuff,
2. The action of discharging agents on the dyestuff,
3. The most important properties of fastness,
4. The most important uses in calico printing.

The properties of fastness and the action of discharging agents are stated in figures denoting their degree, as explained below:

ACTION OF DISCHARGING AGENTS.

1. Discharged to a pure white, also in dark shades.
2. Discharged to a pure white only in light shades.
3. Not discharged white, but suitable for light bright coloured discharges.
4. Not discharged white, suitable only for dark coloured discharges.
5. Not discharged at all, but suitable as an addition to coloured discharges.

FASTNESS TO LIGHT.

1. Not changed, or only very slightly, after 1 month.
2. Appreciably changed after 1 month, little in 14 days.
3. Considerably changed in 14 days, little in 8 days.
4. Considerably changed in 8 days.
5. Already considerably changed in 1 day.

FASTNESS TO WASHING

was determined by treating the dyed cloth for $^1/_4$ hour without white, at 140° and 212° F, with a soap solution of 2 grs olive oil soap per litre. In calculating the degrees of fastness only the absolute decrease or alteration in shade has been taken into consideration. The bleeding of the colour on to white cloth and the dirtying of the soap baths have not been taken into account.

1. Stands washing at 212° F without loss.
2. Stands washing at 140° F without loss, loses slightly at 212° F.
3. Loses slightly at 140° F, considerably at 212° F.
4. Loses perceptibly already at 140° F.
5. Loses considerably already at 140° F, is completely stripped at 212° F.

FASTNESS TO CHLORINE

was determined by the alterations in shade caused by chemicking the prints with chloride of lime solutions of 1½° Tw, respectively ½° Tw.

1. Fast to chloride of lime 1½° Tw.
2. Slight alteration by chloride of lime 1½° Tw.
3. Considerable alteration by chloride of lime 1½° Tw., but fast to chloride of lime ½° Tw.
4. Slight alteration by chloride of lime ½° Tw.
5. Considerable alteration by chloride of lime ½° Tw.

I.

BASIC COLOURS.

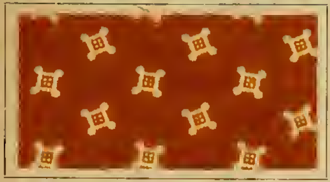
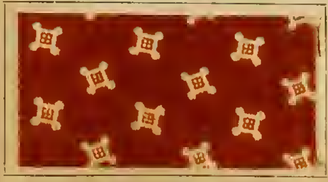
The Colours of this group are the salts or double salts of colour bases which form only slightly soluble or insoluble saltlike compounds with tannin. The fastness of these colour lakes is considerably increased by the entrance of antimony into the tannin compound.

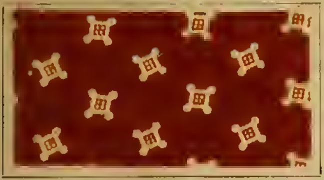
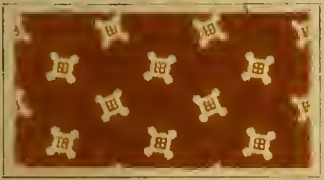
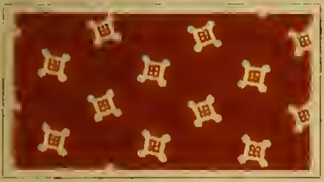
The acid combined with the colour bases is usually hydrochloric acid, less frequently acetic acid, sulphuric acid or oxalic acid. In many cases the basic colours form double salts with chloride of zinc. But as chloride of zinc is apt to weaken the cotton fibre in steaming, the use of the simple hydrochlorides, which are free from zinc, or else, of the isolated colour bases is preferable for printing purposes. In preparing printing colours, the colour bases must be dissolved by adding organic acids.

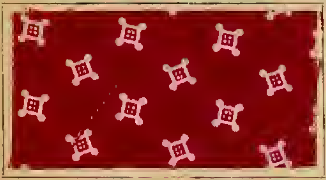
As shown further on, ethyl tartaric acid and acetine are good solvents for basic colours insoluble in water.

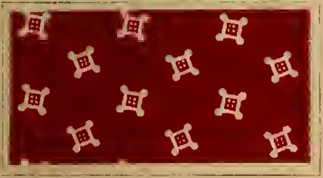
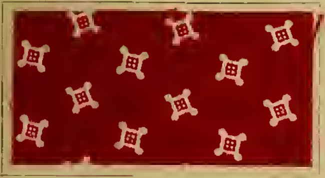
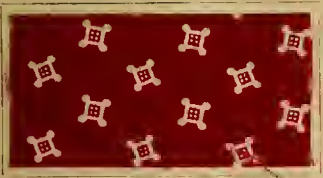
A. SYSTEMATIC TABLES OF THE BASIC COLOURS.

FOR EXPLANATION OF THE FIGURES SEE PAGE 60.

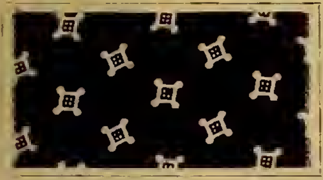
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Methylene Yellow H 	1	5	5	5	3	2—3	2	Is used for steam colour printing and in discharges with reducing agents. Is fast to acids and to steaming.
Auramine conc. 	1	5	4—5	4—5	2	2—3	2—3	Is affected by acids and steaming. Is used in steam colours and in discharges with reducing agents. Suitable also for the production of yellow and green shades which are to be discharged with chlorates.
Flavophosphine 4 G conc. new 	2	5	5	5	2—3	3	2	Are used for steam colour printing, by themselves or in combination with other basic colours, for the production of yellow, orange, brown, olive etc. shades. Can be very suitably employed, on account of being stable to reducing agents, in hydrosulphite and tin discharges.
Flavophosphine GG conc. new 	2	5	5	5	2—3	3	2—1	
Flavophosphine G conc. new 	2	5	5	5	2—3	3—4	2	
Flavophosphine R conc. new 	2	5	5	5	3	3—4	2	
Phosphine O 	1—2	5	4—5	4	3	3—4	3—2	Is used as a self colour and in mixtures for the production of drab and leather shades; also as an addition to tin discharges.

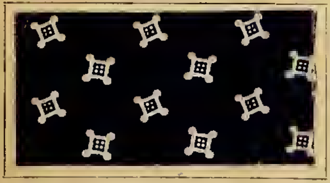
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Phosphine extra 	1—2	5	4—5	4	3	3—4	3—2	Is used as a self colour and in mixtures for the production of drab and leather shades; also as an addition to tin discharges.
Azophosphine GO pat. 	1	2	3—4	2	3—2	4	2	Are used in direct printing, by themselves and in mixtures. Suitable also for discharged tannin styles.
Azophosphine BRO pat. 	1	2—3	3—4	2	3—4	4—5	2	
Leather Yellow Base 3G 	1—2	5	4—5	4—5	3	3—4	2	Are used as steam colours for the production of Cachou and brown shades. Specially suitable for dark shades, since the absence of mineral acid prevents any corrosion of the fibre.
Leather Yellow Base O 	2—1	5	4—5	4—5	3	3—4	2	
Leather Yellow Base OB 	2	5	4—5	4—5	3	3—4	2	
Vesuvine conc. 	2	2—3	4	2	4	4—5	3	Vesuvines are not very suitable for steam colour printing, as they are apt to sublimate. They can, however, be fixed sufficiently fast by ageing for a short time in the Mather-Platt.

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Vesuvine 2R 	2	2—3	4	2	4	4—5	3	Vesuvines are not very suitable for steam colour printing, as they are apt to sublimate. They can, however, be fixed sufficiently fast by ageing for a short time in the Mather-Platt.
Vesuvine 4BG conc. 	2	2—3	4	2	4	4—5	3	
Rosazeine B 	2	5	5	5—4	3—4	4	3—4	Rosazeines are used in direct printing as tannin lakes, either by themselves or in combination with yellow dyestuffs, e. g. Auramine or Methylene Yellow H, for the production of pink and red shades. Suitable as resists on Aniline Black and Nitroso Blue; also as coloured discharges on Dianil and insoluble Azo Colours. They are rarely used fixed with acetate of chrome.
Rosazeine G 	2	5	5	5—4	3—4	4	3—4	
Rosazeine B extra 	2	5	5	5—4	3—4	4	3—4	
Rosazeine G extra 	2	5	5	5—4	3—4	4	3—4	
Rosazeine 4G extra 	2	5	5	5—4	3—4	4	2—3	

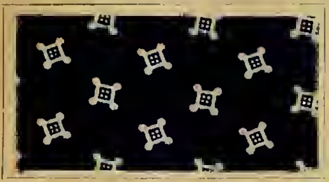
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Rosazeine Scarlet G extra 	1—2	4—5	4—5	1—2	3—4	3—4	2—3	Is used in steam colour printing, and in resists on Aniline Black and Nitroso Blue.
Safranine GGS 	2—1	5	5	3—4	3	3	2—3	Are used in steam colour printing for red, pink and claret shades, also in tannin discharged and Aniline Black resist styles and in tin resists.
Safranine AN extra 	2—1	5	5	3—4	3	3	2—3	
Safranine O 	2—1	5	5	3—4	3	3	2—3	
Safranine B conc. 	2—1	5	5	3—4	3	3	2—3	
Safranine conc. 	2—1	5	5	3—4	3	3	2—3	
Safranine B conc. blueish 	2—1	5	5	3—4	3	3	2—3	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
New Magenta O 	1	5	4	2—3	4	3	2—3	Are not often used by themselves in steam colour printing, but mostly in combination with other basic colours. Suitable for the production of shades to be discharged with chlorate.
Magenta small crystals 	1	5	4	2—3	4	3	2	
Grenadine RR 	2 - 3	5	4—5	3—4	4	3—4	2	Are used in the same styles as the Magentas.
Cerise G 	2 – 3	5	4—5	3 – 4	4	3—4	2	
Methylene Violet 3RA extra 	2—1	5	5	4—5	3	3 4	2	The Methylene Violet brands are used in direct printing and in tannin discharged styles either by themselves on in combination with other basic colours, especially blue, yellow and green ones. They are also suitable for coloured discharges with tin crystals.
Methylene Violet RRA powder 	2—1	5	5	4—5	3	3—4	2	
Methylene Violet RRN powder 	2—1	5	5	4—5	3	3—4	2	

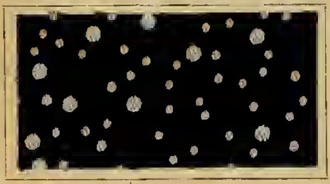
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Methylene Violet BN powder 	2—1	5	5	4—5	3	3—4	2—3	As above.
Methylene Heliotrope O 	2—1	5	5	4—5	2—3	3	2	Suitable for steam colour printing and for tannin discharged styles for the production of Blue, Violet and Heliotrope shades which are fast to light.
Methyl Violet 5R 	1	5	4—5	4—5	4—5	3	2	Methyl Violets are extensively used, as steam colours on account of their very bright shades and cheapness. They are used either by themselves or in combination with blue and green dyestuffs, for the production of various navy and dark blue shades. They are also frequently used for printing on Naphthol prepare, for tin resists, in Azo colour styles as also in Aniline Black styles fixed either with tannin or zinc salts. As the Methyl Violets give a good white they are much used in tannin discharged styles. Crystal Violet O is especially adaptable for this purpose as it is fast to chlorine.
Methyl Violet 4R 	1	5	4—5	4—5	4—5	3	2	
Methyl Violet 3R 	1	5	4—5	4	4—5	3	2	
Methyl Violet 2R 	1	5	5—4	4	4—5	3	2	
Methyl Violet R 	1	5	5—4	4	4—5	3	2	

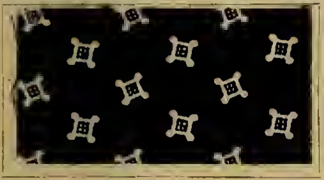
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Methyl Violet B 	1	5	5	3—4	4—5	3	2	Methyl Violets are extensively used, as steam colours on account of their very bright shades and cheapness. They are used either by themselves or in combination with blue and green dyestuffs, for the production of various navy and dark blue shades. They are also frequently used for printing on Naphthol prepare, for tin resists, in Azo colour styles as also in Aniline Black styles fixed either with tannin or zinc salts. As the Methyl Violets give a good white they are much used in tannin discharged styles. Crystal Violet O is especially adaptable for theis purpose as it is fast to chlorine.
Methyl Violet BB 	1	5	5	3—4	4—5	3	2	
Methyl Violet 3B 	1	5	5	3—4	4—5	3	2	
Methyl Violet 4B 	1	5	5	3—4	4—5	3	2	
Methyl Violet 5B 	1	5	5	3—4	4—5	3	2	
Methyl Violet 6B 	1	5	5	3—4	4—5	3	2	
Methyl Violet 7B superior 	1—2	5	5	3—4	4—5	3	2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Methyl Violet 8B superior 	1	5	5	3—4	4—5	3	2	As above.
Violet crystals O 	1	5	5	3—4	4	3	2	Violet crystals O are chiefly used in tannin discharged styles.
Marine Blue D5R conc. 	2	5	5	3—4	4—3	3	2	Marine Blues are largely used as steam colours, in tannin discharged styles and owing to their bright shades as tannin resists on naphthol prepare. On account of being stable to reducing agents they are also suitable for tin and Aniline Black resists. The D brands are especially adapted for steam colour printing.
Marine Blue D3R 	2	5	5—4	3—4	4—3	3	2	
Marine Blue DRX 	2	5	5—4	3—4	3	3	2	
Marine Blue RI 	2	5	5	3—4	4—3	3	2	
Marine Blue BI 	2	5	5—4	3—4	4—3	3	2	

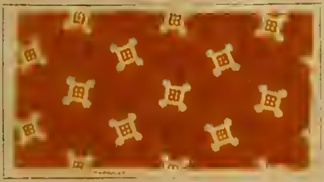
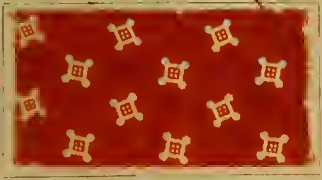
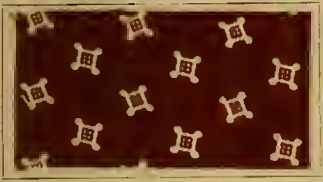
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Discharge Marine Blue S extra conc. 	4	5	4—5	5	3	3	3 – 4	Special brand for coloured hydrosulphite discharges.
Victoria Blue 4 R 	1	5	5	3—2	4—5	3	2	Chiefly used as self colours in steam colour printing, suitable also for tin resists, in Aniline Black styles and for printing with Azocolours on naphthol prepare. Are discharged easily with chlorates.
Victoria Blue R 	1	5	5	3—2	4—5	3	2	
Victoria Blue B 	1	5	5	3—2	4—5	3	2	
Methylene Blue D2R 	2—3	5—4	2 – 3	4 – 5	2	3	2	The D brands, being free from chloride of zinc, are especially suitable for steam colour printing, for obtaining bright blues, for shading dark blues etc. They are also used in tannin discharged and Aniline Black styles and are suitable for printing with Azo colours on naphthol prepare. Are largely employed for tin resists and in hydrosulphite discharges.
Methylene Blue DBB conc. 	2—3	5—4	2—3	5—4	2	3	2	
Methylene Blue DBB extra conc. 	2—3	5—4	2—3	5—4	2	3	2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
New Methylene Blue N 	2—3	5—4	2—3	5—4	2	3	2	The D brands, being free from chloride of zinc, are especially suitable for steam colour printing, for obtaining bright blues, for shading dark blues etc. They are alſo used in tannin discharged and Aniline Black styles and are suitable for printing with Azo colours on naphthol prepare. Are largely employed for tin resists and in hydrosulphite discharges.
Methylene Blue R conc. 	2—3	5—4	2—3	5—4	2	3	2	
Methylene Blue B conc. 	2—3	5—4	2—3	5—4	2	3	2	
Thionine Blue GO 	2—3	5—4	2—3	5—4	2	3	2	Is the most stable Methylene Blue brand as regards reducing agents, which makes it particularly suitable for coloured hydrosulphite dicharges. Fixed with acetate of zinc it is largely used in Prud'homme Black styles.
Ethyl Blue RD 	2	5	5	5—4	2	3	2	The Ethyl Blue and New Ethyl Blue brands are much used for the production of dark blue grounds; they have a great advantage over the Indulines which are insoluble in water. The S brands are the hydrochloric acid salts of colour bases, while the other brands are colour bases which are soluble in acetic acid, and which have the advantage in dark blotches of not weakening the fibre.
Ethyl Blue BD 	2	5	5	5—4	2	3	2	
New Ethyl Blue RS 	2—3	5	5	5—4	2	3	2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
New Ethyl Blue BS 	2—3	5	5	5—4	2	3	2	The Ethyl Blue and New Ethyl Blue brands are much used for the production of dark blue grounds; they have a great advantage over the Indulines which are insoluble in water. The S brands are the hydrochloric acid salts of colour bases, while the other brands are colour bases which are soluble in acetic acid, and which have the advantage in dark blotches of not weakening the fibre.
New Ethyl Blue R 	2—3	5	5	5—4	2	3	2	
New Ethyl Blue B 	2—3	5	5	5—4	2	3	2	
Diphene Blue R conc. 	2—3	5	5	5—4	2	3	2	
Fast Cotton Blue 3R 	2—3	4—5	4	4	2	3	2—3	Are not very suitable as steam colours for direct printing as they are affected by steam. They are, however, extensively used in dyeing.
Fast Cotton Blue R extra 	2—3	4—5	4	4	2	3	2—3	
Fast Cotton Blue TAI 	2—3	4—5	4	4	2	3	2—3	Is extensively used in tannin discharged styles as it does not stain the white.

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Fast Cotton Blue TA II 	2—3	4—5	4—5	4—5	3	3	2—3	Is largely used in tannin discharged styles.
New Fast Blue 3R cryst. 	4—5	4—5	4—5	4—5	3	3	2—3	Very well adapted for tannin discharged styles.
Acetinduline R solution new 	—	—	—	—	2	3	2—1	Acetinduline R solution new and the Indulines for printing, which latter must be dissolved with acetine or ethyl tartaric acid, are used in steam colour printing alone or shaded, for the production of dark blue blotches. Mixed with Auramine or Methylene Yellow H they give full dark green shades.
Induline for printing R powder 	—	—	—	—	2	3	2—1	
Induline for printing B powder 	—	—	—	—	2	3	2—1	
Methylene Grey BD 	1—2	5	4—5	4—5	4—5	3	2	The Methylene Grey brands are mostly used for direct printing, in tannin discharged styles and as resists for Prud'homme Black.
Methylene Grey ND 	1—2	5	4—5	4—5	4—5	3	2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Methylene Grey O 	1—2	5	4—5	4—5	4—5	3	2	The Methylene Grey brands are mostly used for direct printing, in tannin discharged styles and as resists for Prud'homme Black.
Brilliant Green cryst. extra 	1	5	2—3	2—1	4	4	2—3	Are used, alone or mixed, in steam colour printing, in tannin- and chlorate discharged styles, as tannin and tin resists and for printing with Azo colours on naphthol prepare.
Malachite Green cryst. extra 	1	5	2—3	2	4	4	2—3	
Methylene Green GG 	2	4—5	2—3	3—4	2—1	3	2	Are used alone and mixed with other basic dyestuffs in steam colour printing and tannin discharged styles. The D brand is free from chloride of zinc and therefore especially adapted for dark steam colours. Suitable for half discharge effects with potassium sulphite.
Methylene Green extra yellow D 	2	4—5	2—3	3—4	2—1	3	2	
Methylene Green extra yellow conc. 	2	4—5	2—3	3—4	2—1	3	2	
Methylene Green extra yellow DG 	2	4—5	2—3	3—4	2—1	3	2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Janus Yellow G pat. 	2	4—3	5—4	4—5	3	3	1—2	The Janus Colours can be used in direct printing as well as for padding and dyeing.
Janus Yellow R pat. 	2—3	3	5—4	4—5	2	3—4	1—2	
Janus Red B pat. 	2	2	5—4	2—3	3—4	3	2	
Janus Brown R pat. 	2	4—3	5—4	1—2	4	4	2	
Janus Blue G 	1—2	4	4	5	3	3—4	2	The Janus Blue and Indophene Blue brands are chiefly used for dicharged styles. With tin crystals a red or red violet discharge is obtained which can be used for the production of red, or red violet effects on a blue ground. Indophene Blue AE can be especially recommended for tannin discharged styles on account of its great fastness to chlorine.
Janus Blue B 	2—1	4	4	5	3	4—5	3—2	
Indophene Blue AE 	1—2	4	4	4	3	4—5	2	

B. DIRECT OR STEAM PRINTING OF BASIC COLOURS.

The printing pastes contain dyestuff, thickening, the quantity of tannin required for fixing, and substances serving as solvents and preventing the premature formation of lakes which render the printing pastes useless. Such solvents are acetic acid, formic acid, lactic acid, tartaric acid, ethyl tartaric acid, acetine and glycerine. Latterly the now easily procurable and cheaper formic acid has in many cases taken the place of the much used acetic acid. Since fixed acids are liable to weaken the cotton fibre during the steaming process, tartaric acid has been advantageously replaced by ethyl tartaric acid whose action is slower and milder, and only dissociates on steaming. Acetine, which is an excellent solvent for dyestuffs insoluble in water (e. g. Indulines for Printing) is also not injurious to the fibre. Glycerine and acetine which forms glycerine on steaming, act most favourably as hygroscopic substances.

A preparatory treatment of goods with oil mordants is not required for the direct printing with basic colours.

The quantity of tannin necessary for fixing depends on the quantity of dyestuff used, and must be proportionately increased for light shades.

By the action of steam the lake is formed and the dyestuff is fixed upon the fibre.

The Steaming Apparatus are either steaming boxes with intermittant filling or so-called continuous steamers. The most important continuous steamer is the Mather-Platt ager for short steaming and the large continuous steamer in which the goods can be steamed for 1—2 hours. These steaming apparatus are very suitable for working on a large scale, and are most successfully employed in many printworks. The advantages of continuous steaming consist in a larger production, saving of steam, doing away with the greys, reduction of the number of hands etc.

The temperature and the degree of moisture of the steam are most essential for fixing the steam colours. It is therefore advisable to fit up some controlling and registering apparatus for temperature and moisture, the use of which greatly facilitates the precision of the steaming operation. In many cases the printed goods are passed, before steaming in a closed or continuous steamer, through the Mather-Platt ager, in order to remove the acid vapours formed in steaming which might injure the printed colours or tender the goods. In most cases steaming for 1—1$^1/_2$ hours, but generally without pressure, is required.

The steamed goods are then subjected to certain aftertreatments, in order to complete the fixing of the colours, the removal of the thickening or superfluous colouring matter, and the production of a pure white. In working on a large scale, these aftertreatments are frequently carried out in an open soaper. The different divisions of these machines contain the fixing, washing and soaping baths. The basic colours fixed with tannin are first passed through a tartar emetic bath, containing 5—10 grs tartar emetic per litre, and some soda or chalk for neutralizing the liberated acid. The passage through tartar emetic is mostly done tepid at 86—122° F. for about $^1/_2$ minute, or the goods are padded with a concentrated solution of tartar emetic, allowed to lie for some time and then thoroughly washed. Other antimony compounds are also used as substitutes for tartar emetic, e. g. antimony oxalate, antimony salt, double antimony fluoride, and antimonine (see page 42). These compounds give up their antimony oxide more readily than tartar emetic, and, consequently, offer economical advantages. Antimonine must be used with the addition of some acetic acid, and permits of the antimony oxides contained in the fixing bath being quantitatively used up. The other above named antimony compounds require, like tartar emetic, neutralizing additions to the fixing baths, in order to counteract the injurious effect of the liberated acids upon the colours.

Sometimes the goods are malted for the complete removal of thickenings containing starch, which has not been transformed to dextrine through steaming; that is, starch which is insoluble in water, is converted, by means of diastase, into easily soluble kinds of sugar. For that purpose extracts from fresh malt, or commercial preparations containing diastase are used, e. g. Diastaphor. The malting is mostly carried out in the rope for $^1/_4$ to $^1/_2$ hour at 86°—122° F, with 20—50 grs malt per litre bath, or with 3—5 % diastaphor of the weight of the goods.

In most cases the printed goods are further subjected, after passing through tartar emetic and subsequent washing to soaping operations, which are carried out either in the rope or in the open. The soap used must be a good olive oil soap (Marseilles soap). The temperature varies, according to the fastness of the articles, from tepid to boiling, likewise the amount of soap from 1—5 grs per litre. It is sometimes advisable, in order to keep the white cleaner, to add some Tannate of Antimony to the soap bath.

In order to obtain a good white, the goods are finally chemicked and eventually also blued, which two operations can be united. The chemicking is effected with solutions of chloride of lime, either alone or with an addition of soda, alum etc. One distinguishes according to the apparatus employed between steam, dry and cylinder chemicking.

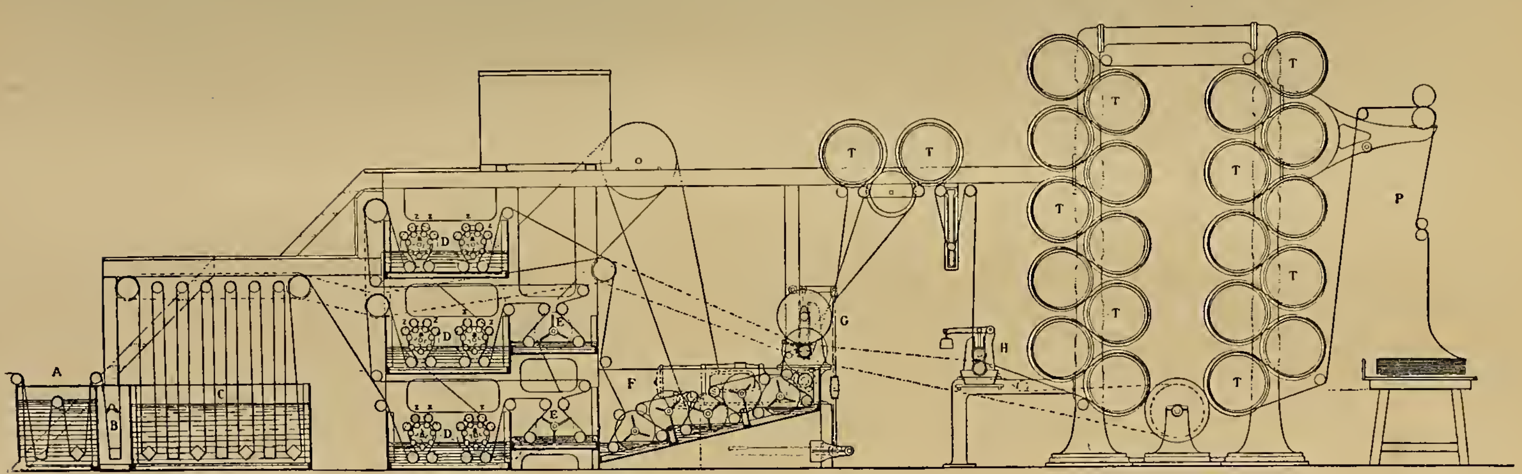


Fig. 10.
Open soaping machine of the Elsässische Maschinenbau-Gesellschaft, Mülhausen.

Continuous Soaping, System Remy.

Explanation of the sketch.

A Cistern for tartar emetic, soda etc.
B Rinsing cistern with squirting pipes.
C First soaping cistern.
D Patented apparatus for automatic beating of the cloth.
E Washing cisterns.
F Washing machine with three divisions and rinsing apparatus.
G Squeezing apparatus.
H Padding machine.
T Cylinder drying machine with mechanical plating down apparatus.

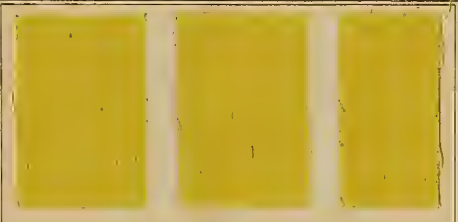
In steam chemicking the goods are passed through a solution of chloride of lime of 0,2—1$^1/_2$° Tw., then through a small steaming box, and are afterwards washed by means of squirting pipes and dried on the drying cylinder. Dry chemicking is employed more frequently than steam chemicking. It is carried out in the following manner: the goods are padded on a padding machine with a chloride of lime solution of 0,2—1° Tw., and dried direct on the drying cylinder without being washed. It is often more advantageous, in order to obtain a pure white, to pass the goods twice through a weaker, than once through a stronger chloride of lime solution, as the colours are less affected in that way.

Annexed is a sketch and description of a Continuous Soaping and Washing Machine which is being used in printworks with good results.

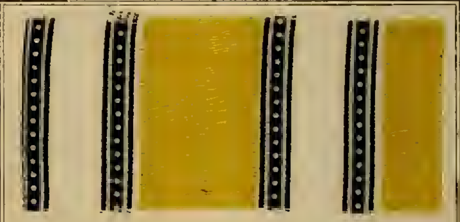
METHYLENE YELLOW H.

Methylene Yellow H is a Thiobenzenyl dyestuff, and is put upon the market as a yellow, crystalline powder. It is easily soluble in water with a yellow colour. On account of its bright shade it is often used in printing either by itself or in combination with other dyestuffs for the production of green and olive effects. It is fast to acids, steaming and chlorine, is very stable to reducing agents, and is therefore extensively used as an addition to hydrosulphite and tin discharges, as well as for resists under Prud'homme Aniline Black.

For tables of fastness and discharge effects see page 64.



0,5 % Methylene Yellow H



2 % Methylene Yellow H
3½ % Diphenyl Black Base I

Yellow Printing Colour:

5 parts	**Methylene Yellow H**
20 parts	acetic acid 9° Tw.
329 parts	water
5 parts	acetine
600 parts	thickening St. T.
10 parts	glycerine
1 part	tataric acid
30 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Yellow Printing Colour:

20 parts	**Methylene Yellow H**
70 parts	acetic acid 9° Tw.
158 parts	water
20 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

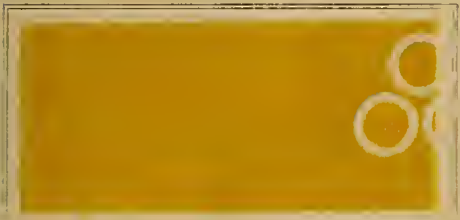
Black Printing Colour: 3½ % **Diphenyl Black Base I.**

Reactions upon the Fibre: conc. H_2SO_4 — browner; 10% H_2SO_4 — brighter; conc. HCl — almost decolorised; 10% HCl — brighter; 10% NaOH — darker; 25% NH_3 — no change; $SnCl_2 + HCl$ — decolorised; 10 % hydrosulphite NF conc. — no change.

AURAMINE.

Auramine, is a Diphenylmethane dyestuff, and forms a sulphur-yellow powder, which is slightly soluble in cold, and very soluble in warm water. The following brands are put upon the market: conc., O, I and II. Continued heating of weak and especially of acid solutions above 140^0 F causes decomposition of the dyestuff which has to be taken into consideration when preparing the printing colours. Equally detrimental is too long and continued steaming under pressure, whereby the intensity of the colour is also greatly diminished. Auramine is much used in steam colour printing, either alone or in combinations for the production of green and olive shades. It is fast to chlorine, washing, and fairly fast to light; very stable to reducing agents, and can be added to the sulphite, hydrosulphite and tin discharges; on the other hand it is easily destroyed by oxidising agents. Owing to is beautiful deep shade it is also often used for coloured resists under Aniline Black.

For tables of fastness and discharge effects see page 64.



0,5 % Auramine conc.

1 % Auramine conc. 2 % Marine Blue D3R

Yellow Printing Colour:

5 parts	Auramine conc.
20 parts	acetic acid 9^0 Tw.
329 parts	water
5 parts	acetine
600 parts	thickening St. T.
10 parts	glycerine
1 part	tartaric acid
30 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Yellow Printing Colour:

10 parts	Auramine conc.
35 parts	acetic acid 9^0 Tw.
263 parts	water
10 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
50 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Blue Printing Colour: 2 % Marine Blue D3R.

Reactions upon the Fibre: conc. H_2SO_4 — duller; 10 % H_2SO_4 — brighter; conc. HCl — almost decolorised; 10 % HCl — brighter; 10 % NaOH — almost decolorised (reddish); 25 % NH_3 — little change; $SnCl_2 + HCl$ — decolorised; 10 % hydrosulphite NF conc. — no change.

FLAVOPHOSPHINES.

Flavophosphines are Acridine dyestuffs, which furnish a series of shades from a gold yellow to a bright orange. They are all easily soluble in water. The patterns below illustrate the direct printing of the extreme yellow and red brands. Flavophosphines are put upon the market in the following brands: 4G conc. new, GG conc. new, G conc. new, and R conc. new, as well as in the diluted brands under the designation O new. On account of their bright shades they are used in printing alone as also in mixtures, in order to obtain fine olives, browns etc. They are very fast to soap, light and chlorine, and withstand all reducing agents, which makes them particularly valuable for discharge printing with hydrosulphite, potassium sulphite and tin crystals. They are also used in tannin discharged styles as they leave the white clean.

For scale of shades, tables of fastness and discharge effects see page 64.


2 % Flavophosphine 4G conc. new


2 % Flavophosphine R conc. new

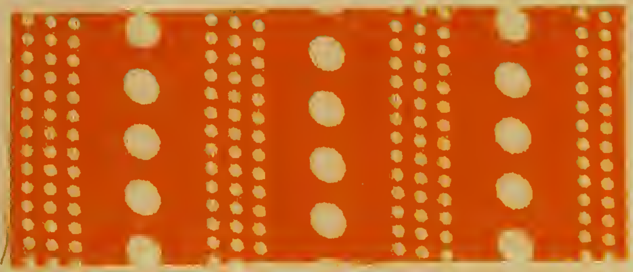
Orange Printing Colour:

20 parts	dyestuff
70 parts	acetic acid 9° Tw.
158 parts	water
20 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — yellower; 10 % H_2SO_4 — brighter; conc. HCl — yellow orange; 10 % HCl — brighter; 10 % NaOH — duller; 25 % NH_3 — browner; $SNCl_2 + HCl$ — lighter; 10 % hydrosulphite NF conc. — no change.

AUROFLAVINE KR.

Auroflavine KR is a similar dyestuff to the Flavophosphines and is put upon the market as an orange powder. It is easily soluble in water and is used owing to its bright shade as a substitute for the tin lake of Persian Berries in steam colour printing. It is considerably faster than the latter to soaping, light and chlorine. Auroflavine KR is stable to tin crystals with which it can be used in coloured discharges. Hydrosulphites turn thes hade yellower. It is almost entirely destroyed by oxidising agents, but is very suitable for bright orange resists under Prud'homme Aniline Black.



2 % Auroflavine KR

Orange Printing Colour:

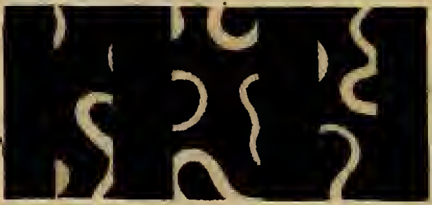
20 parts	**Auroflavine KR**
148 parts	water
30 parts	glycerine
100 parts	starch-tragacanth thickening
20 parts	acetine
70 parts	acetic acid 9° Tw.
500 parts	acid starch Thickening
2 parts	tartaric acid
80 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — yellower; 10 % H_2SO_4 — redder; conc. HCl — nearly decolorised; 10 % HCl — redder; 10 % $NaOH$ — little change; 25 % NH_3 — little change; $SnCl_2 + HCl$ — decolorised on heating; 10 % Hydrosulphite NF conc. — little change.

LEATHER YELLOWS.

Leather Yellows are Acridine dyestuffs, and are put upon the market as hydrochlorides and as bases. Leather Yellow O is the hydrochloric acid salt of the dyestuff and is easily soluble in water. Owing to is stability to reducing agents it can be used as a coloured discharge with hydrosulphite NF conc. etc. The Leather Yellow Bases are insoluble in water, but very soluble with orange red colour in acetic acid, acetine etc. They are mostly employed in steam colour printing, either alone or mixed with other dyestuffs, in order to obtain brown shades. As these dyestuffs do not contain any mineral acids, there is no fear even in dark shades of their tendering the cotton fibre. They are very fast to washing, chlorine and light. The are destroyed by oxidising agents, but are very stable to reducing agents, so that they can be used as tin discharges and resists. The following brands are put upon the market: 3G, O and OB, the most yellow being the 3G brand, the most red the O brand, and the darkest the OB brand.

For tables of fastness and discharge effects see page 65.

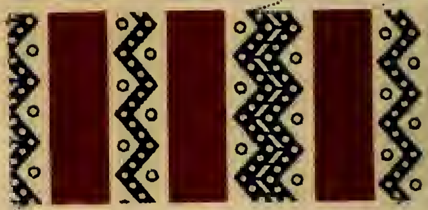


4 % Leather Yellow Base OB
Cover: 6 % Diphenyl Black Oil DO

Brown Printing Colour:

40 parts	**Leather Yellow Base OB**
134 parts	acetic acid 9° Tw.
30 parts	acetine
6 parts	tartaric acid
30 parts	glycerine
600 parts	thickening St. T.
160 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Black Printing Colour:
6 % **Diphenyl Black Oil DO.**



4 % Leather Yellow Base 3G
$3^1/_2$ % Diphenyl Black Base I

Brown Printing Colour:

40 parts	**Leather Yellow Base 3G**
134 parts	acetic acid 9° Tw.
30 parts	acetine
6 parts	tartaric acid
30 parts	glycerine
600 parts	thickening St. T.
160 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Black Printing Colour:
$3^1/_2$ % **Diphenyl Black Base I.**

Reactions upon the Fibre: conc. H_2SO_4 — yellower; 10 % H_2SO_4 — little change; conc. HCl — lighter; 10 % HCl — yellower; 10 % $NaOH$ — lighter; 25 % NH_3 — lighter; $SnCl_2 + HCl$ — lighter, orange solution; 10 % hydrosulphite NF conc. — no change.

PHOSPHINES.

These Acridine dyestuffs are put upon the market as a red brown powder, and are easily soluble in water, with a reddish yellow colour. They are used in steam colour printing, mostly for the production of wood- and drab colours, as well as for shading. They are fast to washing and chlorine, and fairly fast to light, but are destroyed by oxidizing agents. They are very stable to tin crystals, but are affected by hydrosulphite NF conc. There are two brands on the market: the Extra- and the O brand.

For tables of fastness and discharge effects see pages 64 and 65.

2 % Phosphine O

Drab Printing Colour:

20 parts	**Phosphine O**
70 parts	acetic acid 9° Tw.
158 parts	water
20 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — yellowish brown; 10 % H_2SO_4 — brighter; conc. HCl — yellowish brown; 10 % HCl — brighter; 10 % NaOH — lighter; 25 % NH_3 — brighter; $SnCl_2 + HCl$ — lighter; 10 % hydrosulphite NF conc. — little change.

AZOPHOSPHINES.

Azophosphines are basic dyestuffs which are put upon the market as a brown powder, and are very soluble in water, with a yellowish red colour. They are brighter than the Phosphines, and are mostly used for shading other dyestuffs. Compared to the Phosphines, they are faster to washing, but less fast to chlorine and light. They are destroyed both by oxidising and by reducing agents. For tannin discharged styles they are very suitable, as they give a pure white.

For tables of fastness and discharges effects see page 65.

2 % Azophosphine GO

Drab Printing Colour:

20 parts	**Azophosphine GO**
70 parts	acetic acid 9° Tw.
158 parts	water
20 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — red brown; 10 % H_2SO_4 — brighter; conc. HCl — red brown; 10 % HCl — brighter; 10 % NaOH — red; 25 % NH_3 — duller; $SnCl_2 + HCl$ — almost decolorised; 10 % hydrosulphite NF conc. — lighter.

CHRYSOIDINES AND VESUVINES.

Chrysoidines and Vesuvines are Azo Colours, containing free Amido groups, and are put upon the market either as a red brown crystalline powder or as large black crystals. They are easily soluble in water with an orange brown colour. For steam colour printing they are not very suitable, as they easily sublimate on steaming and stain the white. It is, however, possible to fix them sufficiently fast by steaming for a short time in the Mather-Platt ager. They are not very fast to washing, chlorine and light, and are easily destroyed both by oxidising and reducing agents.

For tables of fastness and discharge effects see pages 65 and 66.

2 % Vesuvine conc.

Brown Printing Colour:

20 parts	**Vesuvine conc.**
70 parts	acetic acid 9° Tw.
108 parts	water
20 parts	acetine
650 parts	senegal gum thickening
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

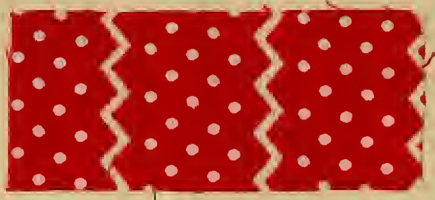
Reactions upon the Fibre: conc. H_2SO_4 — darker; 10 % H_2SO_4 — brighter; conc. HCl — red brown; 10 % HCl — brighter; 10 % NaOH — lighter; 25 % NH_3 — little change; $SnCl_2 + HCl$ — almost decolorised; 10 % hydrosulphite NF conc. — almost decolorised.

ROSAZEINES.

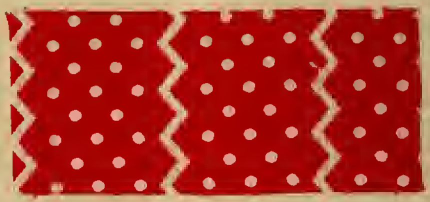
Rosazeines belong to the group of Pyronine dyestuffs, and form green crystals or reddish violet powders. They are easily soluble in water, with a blueish red colour, and the solutions fluoresce strongly. The following brands are put on the market: Rosazeine B extra, G extra, 4G extra, 6G extra and 6GD extra besides the diluted brands B, G, 4G, 6G and 6GD. For steam colour printing only the following brands can be used, as the tannin lakes produced by the other brands are not very fast to washing: 4G, 6G, 6GD, 4G extra, 6G extra and 6GD extra. Fixed with chrome, the Rosazeines give extremely bright shades of a blueish tinge which, however, do not equal the tannin lakes for fastness. The Rosazeines are fast to chlorine, the 4G and 6G brands are fairly fast to washing, but none of them excel in fastness to light. They are destroyed by oxidising agents, but are stable to reducing agents, and especially Rosazeine 6G extra and 6GD extra may be used in coloured discharges with hydrosulphite and tin crystals. They are also used for the production of red and pink resists under Prud'homme Aniline Black.

The most extreme yellow brand of the Rosazeine series is Rosazeine Scarlet which is put upon the market as the G and G extra brands. The scarlet shades obtained by it are distinguished for their fastness to washing. It is further employed in steam colour printing, both alone and mixed with other Rosazeines. It is very stable to tin crystals, but is destroyed by hydrosulphite NF conc. Moreover it gives bright resists under Prud'homme Aniline Black.

For tables of fastness and discharge effects see pages 66 and 67.



2 % Rosazeine 6G extra.



2 % Rosazeine 6GD extra

Red Printing Colour:

20 parts	dyestuff
70 parts	acetic acid 9° Tw.
158 parts	water
20 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — orange; 10% H_2SO_4 — brighter; conc. HCl — orange; 10% HCl — brighter; 10% NaOH — lighter; 25% NH_3 — little change; $SnCl_2 + HCl$ — lighter and brighter; 10 % hydrosulphite NF conc. — little change.

SAFRANINES.

Safranines are the hydrochloric acid salts of Azine dyestuffs. They are red brown powders, easily soluble in water, with a red colour. They are much used in calico printing either by themselves or in combination with other dyestuffs for the production of red and claret shades. They are fast to chlorine, and sufficiently fast to washing and light. Oxidising agents destroy them, but they are very stable to tin crystals, and, mixed with Auramine, are used for the production of red and pink coloured discharges. Hydrosulphite changes them into blue. Safranines are also used for the production of red resists under Prud'homme Aniline Black. Safranine GGS is the most yellow, and Safranine B conc. blue shade, is the most blue brand, but Safranine AN extra is used mostly for printing purposes.

For tables of fastness and discharge effects see page 67.

2 % Safranine AN extra

Dark Blue. Pale Blue
Green. Claret

Red Printing Colour:

20 parts	**Safranine AN extra**
70 parts	acetic acid 9° Tw.
158 parts	water
20 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Dark Blue Printing Colour: 1.6 % **Methylene Blue DBB extra conc.**
0,4 % **Marine Blue B**

Pale Blue Printing Colour: Dark Blue Printing Colour, reduced 1 : 5

Green Printing Colour: 0.175 % **Brilliant Green cryst. extra**
0.325 % **Auramine conc.**

Claret Printing Colour: 2 % **Safranine AN extra**
0.5 % **Azophosphine GO**
0.15 % **Grenadine RR**

Reactions upon the Fibre: conc. H_2SO_4 — dark green; 10 % H_2SO_4 — dark violet; conc. HCl — dark blue; 10 % HCl — more violet; 10 % NaOH — browner, 25 % NH_3 — little change; $SnCl_2 + HCl$ — decolorised on heating; 10 % hydrosulphite NF conc. — decolorised.

MAGENTAS.

Magentas are Triphenylmethane dyestuffs, and are put upon the market as brilliant green crystals or as a powder, and dissolve in water with a red colour. The New Magenta O brand is distinguished for its great solubility in water. In steam colour printing Magentas are frequently used alone as well as in combination with other dyestuffs, in order to obtain claret and cachou shades. They are fast to chlorine, fairly fast to washing, but only in a moderate degree to light. Oxidising agents destroy them easily. They are very stable to tin crystals, and can be used as additions to tin discharges and resists. Hydrosulphite NF conc. also destroys them easily. They are furthermore largely made use of in tannin discharged styles as they give a good white. The pure dyestuffs are on the market under the name of Magenta cryst. or New Magenta O, and the impure ones, the so-called Magenta wastes, as Cerise, Grenadine, Marroon etc. The latter are mostly used for shading dark colours.

For scale of shades, tables of fastness and discharge effects see page 68.

1 % New Magenta O

Claret Printing Colour:

10 parts	**New Magenta O**
35 parts	acetic acid 9° Tw.
263 parts	water
10 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
50 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — yellowish brown; 10 % H_2SO_4 — darker and bluer; conc. HCl — yellowish brown; 10 % HCl — darker and bluer; 10 % NaOH — redder and lighter; 25 % NH_3 — lighter; $SnCl_2$ + HCl — slowly decolorised; 10 % hydrosulphite NF conc. — slowly decolorised.

METHYL VIOLETS.

Methyl Violets are alkylated Rosanilines which are put upon the market as green metallic lustrous lumps with shell-like fracture or as a powder. They easily dissolve in water with a violet colour. Owing to their brightness they are much used alone and also for shading of Marine Blues in steam colour printing. They are fairly fast to chlorine and washing. Their fastness to light is only moderate. They are easily discharged by oxidising agents. Being very stable to tin crystals, they are used for the production of tin discharges and resists. They are destroyed by hydrosulphite NF conc. An important application of Methyl Violets is as resists under Aniline Black and for the production of tannin discharged styles, as they give a good white. The Methyl Violets on the market furnish tannin lakes, varying in shades from red violet to navy blue. The red violet brands are much less stable to sulphite discharges than the bluer brands. The most extreme red brand is 5R, the bluest is 8R superfine. Methyl Violet BB is the brand which is used mostly.

For scale of shades, tables of fastness and discharge effects see pages 69 and 70.

2 % Methyl Violet 5R

Violet Printing Colour:

20 parts	**Methyl Violet 5R**
70 parts	acetic acid 9° Tw.
158 parts	water
20 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

1 % Methyl Violet BB

Violet Printing Colour:

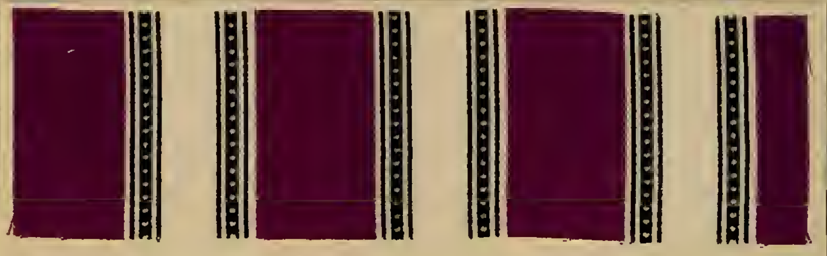
10 parts	**Methyl Violet BB**
35 parts	acetic acid 9° Tw.
263 parts	water
10 parts	acetine
600 parts	thickening St. T.
30 parts	glycerine
2 parts	tartaric acid
50 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — yellowish brown; 10 % H_2SO_4 — dark green; conc. HCl — orange; 10 % HCl — dark green; 10 % $NaOH$ — browner; 25 % NH_3 — litte change; $SnCl_2 + HCl$ — almost decolorised; 10 % hydrosulphite NF conc. — lighter.

METHYLENE VIOLETS.

Methylene Violets are alkylated Safranines; they form brown to black powders, and are easily soluble in water with a violet colour. Although producing less bright shades than Methyl Violets, they are much used in steam colour and discharge printing, owing to their greater fastness. They are destroyed by oxidising agents and by hydrosulphite NF conc., but are very stable to tin crystals. As they give a very pure white, they are also much used in tannin discharged styles. The following brands of Methylene Violets are on the market: 3RA extra, RRA powder, RRN powder and BN powder. 3RA extra gives the most red, and BN the most blue tannin lake.

For scale of shades, tables of fastness and discharge effects see pages 68 and 69.



0,5 % Methylene Violet 3RA extra, $3^1/_2$ % Diphenyl Black Base I

Violet Printing Colour:

5 parts	**Methylene Violet 3RA extra**
20 parts	acetic acid 9° Tw.
329 parts	water
5 parts	acetine
600 parts	thickening St. T.
10 parts	glycerine
1 part	tartaric acid
30 parts	acetic acid tannin sol. 1 : 1
1000 parts.	

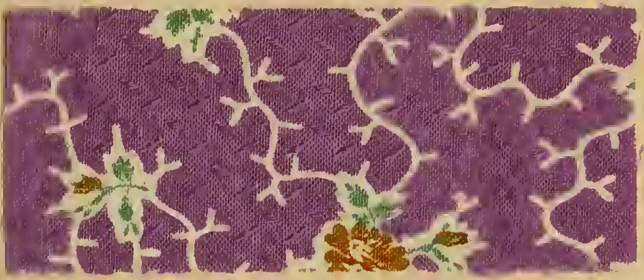
Black Printing Colour: $3^1/_2$ % **Diphenyl Black Base I.**

Reactions upon the Fibre: conc. H_2SO_4 — green; 10 % H_2SO_4 — bluer; conc. HCl — blue; 10 % HCl — bluer; 10 % NaOH — lighter; 25 % NH_3 — little change; $SnCl_2 + HCl$ — decolorised; 10 % hydrosulphite NF conc. — decolorised.

METHYLENE HELIOTROPE O.

Methylene Heliotrope O is a similar dyestuff to the Safranines and is put upon the market as a brown powder. It does not very readily dissolve in water, but easily in acetic acid. It is very fast to chlorine, washing and light, and is extensively used on account of its beautiful shade, either alone or shaded with blue dyestuffs in steam colour printing. For the production of steam colours the complete solution of the dyestuff is essential. This is best carried out, without an addition of water, by means of acetic acid, tartaric acid, acetine and glycerine. Methylene Heliotrope is destroyed by oxidising agents and by hydrosulphite NF conc., it is, however, very stable to tin crystals. It is also much used for tannin discharged styles, as it gives a pure white.

For tables of fastness and discharge effects see page 69.



Dark Orange Pale Orange Green Heliotrope

Dark Orange Printing Colour: 3 % **Flavophosphine G conc. new.**

Pale Orange Printing Colour: 0,65 % **Flavophosphine 4G conc. new.**

Green Printing Colour: 0,1 % **Brilliant Green cryst. extra.**
0,15 % **Auramine conc.**

Heliotrope Printing Colour:

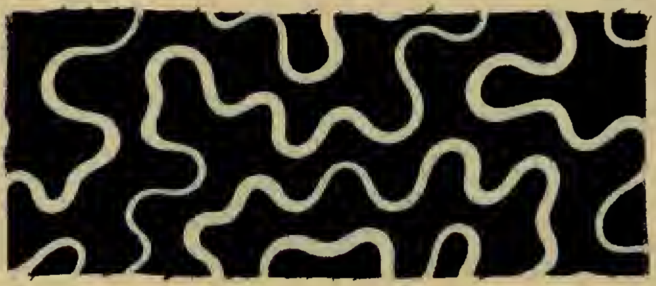
2 parts	**Methylene Heliotrope O,**
20 parts	acetic acid 9° Tw.,
8 parts	acetine,
12 parts	glycerine,
4 parts	tartaric acid,
238 parts	water
700 parts	senegal gum thickening 1 : 1,
16 parts	acetic acid tannin sol. 1 : 1,
1000 parts	

Reactions upon the Fibre: conc. H_2SO_4 — olive; 10 % H_2SO_4 — bluer: conc. HCl — blue; 10 % HCl — bluer; 10 % $NaOH$ — browner; 25 % NH_3 — little change; $SnCl_2 + HCl$ — almost decolorised; 10 % hydrosulphite NF conc. — decolorised.

MARINE BLUES.

Marine Blues are mixtures of Methylene Blue and Methyl Violet. They are put upon the market as brown crystalline powders, and are easily soluble in water with a blue colour. They are much used in steam colour printing, either alone or for shading Methylene Blue. They are fast to chlorine, sufficiently fast to washing, and fairly fast to light, stable to tin crystals, but are nearly completely destroyed by oxidising agents and by hydrosulphite NF conc. Their further use is for Azo Colour styles as tin and tannin resists, as well as for the production of tannin discharged styles and as resists under Prud'homme Aniline Black. The most important brands are Marine Blue D5R, D3R, DRX, RI and BI, of which the »D« brands may be especially recommended for steam colour printing, being free from chloride of zinc.

For scale of shades, tables of fastnes and discharge effects see page 71.



2% Marine Blue D3R

Blue Printing Colour:

20 parts	**Marine Blue D3R,**
70 parts	acetic acid 9° Tw.,
158 parts	water,
20 parts	acetine,
600 parts	thickening St. T.,
30 parts	glycerine,
2 parts	tartaric acid
100 parts	acetic acid tannin sol. 1 : 1.
1000 parts	

Reactions upon the Fibre: conc. H_2SO_4 — yellowish green; 10% H_2SO_4 — blue green; conc. HCl — green; 10% HCl — blueish green; 10% $NaOH$ — more violet; 25% $NaOH$ — brighter; $SnCl_2 + HCl$ — gradually orange; 10% hydrosulphite NF conc. — lighter.

VICTORIA BLUES.

Victoria Blues are Diphenylnaphthylmethan dyestuffs, and are put upon the market in the form of powder. They dissolve much more easily in warm than in cold water, are fairly fast to soaping and chlorine, but not very fast to light. Owing to their very pure blue shade they are much used in steam colour printing, and for printing on naphthol prepare. They can also be fixed with chrome, by an addition of Turkey red oil. They are easily discharged by oxidising agents, but are very stable to tin crystals, and are therefore much used as additions to the tin discharges and resists. Hydrosulphite destroys them. They are moreover suitable for tannin discharged styles as they give a very pure white. The following brands are on the market: B, R and 4 R; of these B represents the most blue and 4 R the most red brand.

For tables of fastness and discharge effects see page 72.

2% Victoria Blue R.

Blue Printing Colour:

20 parts **Victoria Blue R,**
70 parts acetic acid 9° Tw.,
158 parts water,
20 parts acetine,
600 parts thickening St. T.,
30 parts glycerine,
2 parts tartaric acid,
100 parts acetic acid tannin sol. 1 : 1

1000 parts.

Reactions upon the Fibre: conc. H_2SO_4 — red brown; 10% H_2SO_4 — blueish green; HCl — red brown; 10% HCl — blueish green; 10% NaOH — dark red brown; 25% NH_3 — little change; $SnCl_2 + HCl$ — red brown; 10% hydrosulphite NF conc. — lighter.

METHYLENE BLUES.

Methylene Blues are Thiazine dyestuffs which are put upon the market as hydrochlorides, in the form of brown powders, or as double salts with zinc chloride in the form of greenish powders with a bronze metallic lustre. They are easily soluble in water with a blue colour. Owing to the beauty of their shades and their great fastness to chlorine, washing and light they belong to the most used basic dyestuffs. In steam colour printing it is particularly the »D« brands, which are free from zinc chloride, that are used by themselves or in combination with Marine Blue, Methyl Violet, Acetinduline R solution, Ethyl Blue and New Ethyl Blue. They are entirely destroyed by oxidising agents, and partially destroyed by sulphites (half discharges). To tin crystals and Hydrosulphite NF conc. they are very stable (Thionine Blue GO). For tannin discharged styles and Prud'homme Black they are largely used, Thionine Blue GO printed with acetate of zinc being especially suitable for the latter.

For tables of fastness and discharge effects see page 72 and 73.

Dark Blue Pale Blue

Red Pink Green Blue

Dark Blue Printing Colour:

2% **Methylene Blue DBB extra conc.**

Pale Blue Printing Colour:

Dark Blue Printing Colour, reduced 1:3 with Senegal gum thickening.

Red Printing Colour:

1,1 % **Safranine AN extra,**
0,175% **Auramine conc.**

Pink Printing Colour:

Red Printing Colour, reduced 1:3

Green Printing Colour:

0,1 % **Brilliant Green cryst. extra,**
0,15% **Auramine conc.**

Blue Printing Colour:

0,2% Methylene Blue DBB extra conc. with Senegal gum thickening.

Reactions upon the Fibre: conc. H_2SO_4 — green; 10% H_2SO_4 — little change; conc. HCl — more greenish; 10% HCl — little change; 10% $NaOH$ — redder; 25% NH_3 — little change; $SnCl_2 + HCl$ — decolorised; 10% hydrosulphite NF conc. — decolorised.

INDULINES FOR PRINTING AND ACETINDULINES.

Indulines for printing are Indulines that are insoluble in water, and are put upon the market as dark green, brownish green or black green powders. In order to dissolve them, acetine or ethyl tartaric acid are mostly used. Acetindulines are solutions of Indulines for printing in acetine, and can be added direct to the thickening. Both are very fast to light, chlorine and soaping, and are largely used in steam colour printing for the production of very dark indigo and navy blue shades, as they give a very full and even colour, and are very inexpensive. Owing to the insolubility and great fastness to washing of the tannin lakes of these dyestuffs, the white and accompanying colours remain very clean. They are mostly used in combination with other embellishing colours such as Methylene Blue, Methyl Violet, and Brilliant Green. For dyeing and discharging purposes these dyestuffs are not very suitable.

For tables of fastness and discharge effects see page 75.

Red Printing Colour: { 1,1 % **Safranine AN extra,**
{ 0,175 % **Auramine conc.**

Pink Printing Colour: Red Printing colour, reduced 1 : 5.

Green Printing Colour: { 0,1 % **Brilliant Green cryst. etxra,**
{ 0,15 % **Auramine conc.**

Blue Printing Colour:

80 parts **Acetinduline R solution new,**
600 parts acid starch thickening,
100 parts acetic acid 9° Tw.
{ 5 parts **Methylene Blue DBB extra conc.**
{ 85 parts water
50 parts tragacanth (60 : 1000),
80 parts acetic acid-tannin sol. 1 : 1.
1000 parts.

Reactions upon the fibre: conc. H_2SO_4 — dark violet; 10% H_2SO_4 — darker; conc. HCl — darker violet; 10% HCl — darker; 10% NaOH — dark brown; 25% NH_3 — rather darker; $SnCl_2$ + HCl — only on heating gradually decolorised; 10 % hydrosulphite NF conc. — gradually brown.

ETHYL BLUES, NEW ETHYL BLUES, AND DIPHENE BLUE.

Ethyl Blues, New Ethyl Blues and Diphene Blue are put upon the market either as hydrochlorides, or as bases. Their tannin lakes are distinguished for great fastness to washing, chlorine and light. Owing to the fulness of their shades they can be used in steam colour printing, in place of the insoluble Indulines, for the production of dark blue shades. For very concentrated printing colours it is advisable to use the colour bases of these dyestuffs, which are easily soluble in acetic acid with the addition of some acetine.

The dyestuff bases are:

Ethyl Blue BD,
Ethyl Blue RD,
New Ethyl Blue B,
New Ethyl Blue R and
Diphene Blue R conc.

whereas New Ethyl Blue BS and RS represent the hydrochlorides. These blues are shaded in the same way as the Indulines for printing, Methylene Blues, Methyl Violets etc. being added. New Ethyl Blue BS and RS can also be used for dyeing, on account of their great solubility in water.

For tables of fastness and discharge effects see page 73 and 74.

2 % Ethyl Blue RD

2 % New Ethyl Blue BS

Blue Printing Colour:

20 parts	**Ethyl Blue RD**,
100 parts	acetic acid 9° Tw.,
20 parts	acetine,
6 parts	tartaric acid,
30 parts	glycerine,
600 parts	thickening St. T.,
124 parts	water,
100 parts	acetic acid-tannin sol 1 : 1,
1000 parts.	

Blue Printing Colour:

20 parts	**New Ethyl Blue BS**,
70 parts	acetic acid 9° Tw.,
158 parts	water,
20 parts	acetine,
600 parts	thickening St. T.,
30 parts	glycerine,
2 parts	tartaric acid,
100 parts	acetic acid-tannin sol 1 : 1.
1000 parts.	

Reactions upon the Fibre: (Ethyl Blue RD) conc. H_2SO_4 — green; 10 % H_2SO_4 — little change; conc. HCl — green; 10 % HCl — little change; 10 % NaOH — more violet; 25 % NH_3 — little change; $SnCl_2 + HCl$ — lighter; 10 % hydrosulphite NF conc. — slowly brown.

FAST BLUES FOR COTTON.

Cotton Fast Blues are dyestuffs of the Meldola Blue group, and are put upon the market as dark violet powders with bronze metallic lustre. In water they dissolve easily with a blueish violet colour. They are fast to light, chlorine and washing, but not very fast to alkalies and steam. Although they are unsuitable for steam colour printing, they possess great advantages for dyeing purposes. Their great fastness and cheapness, as also the circumstance that they scarcely colour the white at all, renders their employment in tannin discharged styles most valuable.

The most important brands of this group of dyestuffs are:

New Fast Blue 3R cryst.
Fast Blue for Cotton 3R and R extra

as also the special brands for tannin discharged styles

Fast Blue for Cotton TAI, TAII and TAIV.

A peculiarity of these dyestuffs is that their dust irritates the mucous membranes and produces coughing and sneezing. In order to obviate this inconvenience, the above dyestuffs are also sold in brands marked free from dust.

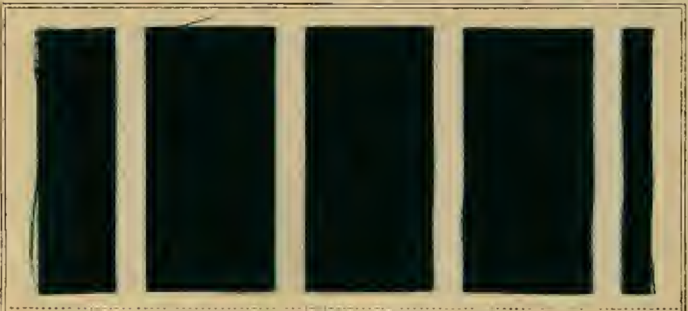
For tables of fastness and discharge effects see page 74 and 75.

Reactions upon the Fibre: conc. H_2SO_4 — yellowish green; 10% H_2SO_4 — darker; conc. HCl — brown; 10% HCl — darker; 10% NaOH — more violet; 25% NH_3 — little change; $SnCl_2$ + HCl — orange; 10% hydrosulphite NF conc. — almost decolorised.

BRILLIANT GREENS AND MALACHITE GREENS.

These Diamidotriphenylmethane dyestuffs are put upon the market as crystals with bronze metallic lustre or in the form of powder, and are easily soluble in water with a green colour. Owing to their beautiful bright shades they are largely used, alone or mixed with other basic dyestuffs, for the production of green and olive colours, as also for shading in dark effects. They are fairly fast to chlorine, and even more so to washing and acid, but only moderately to light. Oxidising agents and hydrosulphite easily destroy them. The white obtained by means of hydrosulphite discharges is, however, not quite stable. They show great stability to tin crystals, which causes them to be much used as additions to tin discharges and resists. They also serve as resists under Prud'homme Aniline Black, and can likewise be used for shading in tannin discharged styles. Brilliant Green is somewhat yellower than Malachite Green.

For tables of fastness and discharge effects see page 76.



1% Brilliant Green cryst. extra

Green Printing Colour:

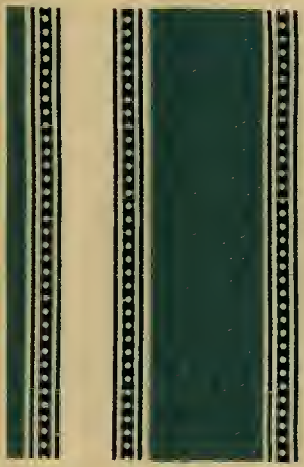
10 parts	**Brilliant Green cryst. extra,**
35 parts	acetic acid 9° Tw.,
273 parts	water,
10 parts	acetine,
600 parts	thickening St. T.,
20 parts	glycerine,
2 parts	tartaric acid,
50 parts	acetic acid tannin sol 1 : 1.
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — orange; 10% H_2SO_4 — olive; HCl — orange; 10% HCl — olive; 10% NaOH — slowly decolorised; 25% NH_3 — lighter; $SnCl_2 + HCl$ — orange; 10% hydrosulphite NF conc. — slowly decolorised.

METHYLENE GREEN.

Methylene Green, a Nitro compound of Methylene Blue, forms a dark brown powder which dissolves in water with a greenish blue colour. Owing to its excellent fastness to light, chlorine and washing (it may be designated as the fastest basic dyestuff), it is extensively used in steam colour printing, either alone or for shading other colours. Since it gives a clean white it can likewise be used for the production of tannin discharged styles. By printing over with potassium sulphite and subsequent steaming in the Mather-Platt ager good half discharges are abtained. The most important brands for printing are: Methylene Green extra yellow conc., Methylene Green extra yellow D and Methylene Green extra yellow DG. The two latter brands are free from zinc chloride, and consequently most suitable for very dark steam colours.

For tables of fastness and discharge effects see page 76.



Dark Green Pale Green

Dark Violet Pale Violet
Pale Green Dark Green

Dark Green Printing Colour:

20 parts	**Methylene Green extra yellow D,**
70 parts	acetic acid 9° Tw.
158 parts	water,
20 parts	acetine,
600 parts	thickening St. T.,
30 parts	glycerine,
2 parts	tartaric acid,
100 parts	acetic acid-tannin sol 1 : 1.
1000 parts.	

Pale Green Printing Colour:

Darkgreen Printing Colour, reduced 1 : 5.

Dark Violet Printing Colour:

1,4% **Methyl Violet R**

Pale Violet Printing Colour:

Dark Violet Printing Colour, reduced 1 : 6.

Pale Green Printing Colour:

0,1 % **Brilliant Green cryst. extra**
0,15 % **Auramine conc.**

Dark Green Printing Colour:

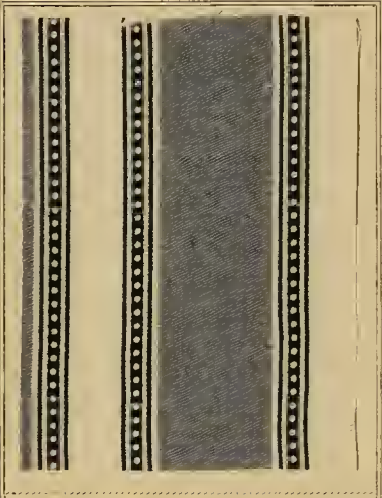
2% **Methylene Green extra yellow D.**

Reactions upon the Fibre: conc. H_2SO_4 — somewhat greener; 10% H_2SO_4 — darker; conc. HCl — dark bluegreen; 10% HCl — dark green; 10% NaOH — dark brown; 25% NH_3 — little change; $SnCl_2$ + HCl — almost decolorised; 10% hydrosulphite NF conc. — decolorised.

METHYLENE GREYS.

Methylene Greys are put upon the market as greyish black powders soluble in water with a grey colour. They are fairly fast to chlorine, washing and light. In steam colour printing they are mostly used alone, in order to produce dark and pale grey tints. Oxidising agents easily destroy them. They are very stable to tin crystals, and are used for the production of grey tin discharges and resists, but they are not sufficiently stable to reducing agents, in order to be employed in connection with hydrosulphite. They are furthermore largely used for tannin discharged styles and as resists under Prud'homme Aniline Black. BD is the most blue and O the most yellow brand. The BD brand is mostly used.

For tables of fastness and discharge effects see page 75 and 76.



Dark Grey Pale Grey

Dark Violet Pale Violet
Green Grey

Dark Grey Printing Colour:

20 parts **Methylene Grey BD,**
70 parts acetic acid 9° Tw.,
158 parts water,
20 parts acetine,
600 parts thickening St. T.,
30 parts glycerine,
2 parts tartaric acid,
100 parts acetic acid tannin sol 1:1,
1000 parts.

Pale Grey Printing Colour:

Dark grey Printing Colour, reduced with Senegal gum thickening 1:2.

Dark Violet Printing Colour:

1,4% **Methyl Violet R,**

Pale Violet Printing Colour:

Dark Violet Printing Colour, reduced 1:6.

Green Printing Colour:

0,1 % **Brilliant Green cryst. extra,**
0,15% **Auramine conc.**

Grey Printing Colour:

0,5% Methylene Grey BD, with Senegal gum thickening.

Reactions upon the Fibre: conc. H_2SO_4 — greener; 10% H_2SO_4 — little change; conc. HCl — greener; 10% HCl — little change; 10% NaOH — browner; 25% NH_3 — darker; $SnCl_2$ + HCl — almost decolorised; 10% hydrosulphite NF conc. — slowly brown.

C. DYEING WITH BASIC COLOURS.

The dyeing with basic colours is almost exclusively carried out on a tannin antimony mordant, rarely on a ground produced with natural catechu. In very full plain shades a darkening of the tannin ground by means of a passage through iron is effected.

As is well known, the cotton fibre shows great affinity for tannin, especially moderately heated tannin baths readily give up their tannin to the cotton. The duration of the passage and the dilution of the mordanting liquid exercise a great influence upon the tannin mordanting. In order to obtain even results care must be taken that the tannin padding bath be not subjected to great variations of temperature, and the volume of the padding bath be kept proportionately small, lest the concentration of the bath suffer a perceptible change by possible extraction of tannin. This is particularly important where the goods pass only once through the tannin-bath and are immediately dried. If the tannin operation is done on the jigger, the addition of tannin must be regular, so that the two ends of the batch be evenly mordanted. The quantity of tannin in the padding bath is in proportion to the required depth of the shade. For lighter shades only the better, rather whiter sorts of tannin can be employed; for darker colours the cheaper liquid brands of tannin can also be used.

The concentration of the fixing baths of tartar emetic is usually half the strength of the tannin baths. The mordanting of the material which has previously been well boiled or bleached, is carried out in the following manner: The cotton goods are padded twice through the padding machine in a warm bath of 140° F., containing $1^1/_2$—6 oz tannin per gall. water; are left to lie rolled up for 1 hour without drying; then passed twice through the warm tartar emetic bath at 86° F. ($^3/_4$—3 oz tartar emetic per gall.), and finally well washed and dyed. The mordanting and fixing operations can also be effected on the jigger.

For dyeing the goods are entered into the cold dyebath to which have been added 1—5% acetic acid or 2—10% alum, and are worked well whilst the dyestuff is added in several portions. After $^1/_2$ hour the bath is gradually heated to the boil, and the dyeing operation continued until the bath is exhausted. Afterwards the goods are thoroughly washed and dried.

As the Auramines lose in intensity when dyed at the boil, care must be taken not to raise the temperature of the dye bath in this case above 176—194° F.

Particular care must be taken when dyeing discharged tannin goods. This process will be described in detail further on.

D. RESISTING AND DISCHARGING BASIC COLOURS.

1. TARTAR EMETIC RESISTS.

By printing suitably composed resists, containing mainly antimony or zinc salts, and subsequent overprinting with basic steam colours, it is possible to obtain white resists. This method applies to all basic dyestuffs.

By adding to the tartar emetic resists certain dyestuffs which are fixed with chrome acetate (Alizarine Yellow GG etc.), or pigments with albumine and some ammonia, coloured resists are obtained. Tartar emetic resists to which citric acid, tartaric acid or their salts have been added are also able to resist Alizarine Steam Colours. On the other hand alkaline antimony resists or antimony resists with reducing agents can resist a Steam Aniline Black cover.

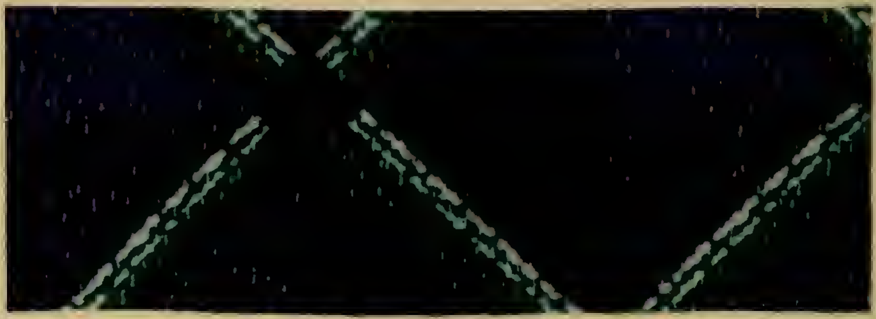
Reducing agents, e. g. stannous hydrate, added to the resists, can serve to simultaneously discharge a ground dyed with dischargeable Dianil dyestuffs.

The white material, or goods which have been dyed with direct colours, are printed with the resists; then printed or padded with basic dyestuffs containing some tannin; steamed for 1 hour without pressure, finally passed in the usual manner through tartar emetic, washed and soaped.

Tartar Emetic Resists:

I.		II.	
250 parts	British gum 1 : 1,	500 parts	gum solution,
100 parts	water,	150 parts	antimony oxalate,
250 parts	china clay,	20— 50 parts	citric acid,
400 parts	sodium tartar emetic,	330—300 parts	water,
1000 parts.		1000 parts.	

Pattern printed at a printworks.



Tartar Emetic Resist I Pale Blue Dark Blue Green

Pale Blue Printing Colour:	1,4 %	**New Methylene Blue N,**
	0,6 %	**Violet Crystals O,**
Dark Blue Printing Colour:	15 %	**Acetinduline R solution new,**
	0,3 %	**New Methylene Blue N,**
	0,6 %	**Violet Crystals O,**
Green Printing Colour:	1,2 %	**Malachite Green, cryst. extra,**
	0,8 %	**Auramine O,**

2. DISCHARGING THE TANNIN GROUNDS BY MEANS OF STRONGLY ALKALINE COLOURS AND SUBSEQUENT DYEING WITH BASIC DYESTUFFS.

(TANNIN DISCHARGED STYLES.)

By printing with very strong alkaline discharges and subsequent steaming for a short time in the Mather-Platt ager it is possible to destroy tannin or its antimony lake quantitatively upon the fibre. In dyeing the discharged ground with suitable basic dyestuffs, discharged designs on coloured grounds are obtained. This tannin discharged style distinguished for the depth and brightness of the colours obtained has gained a great importance in calico printing, notwithstanding that only a few fast effects can be obtained with it. These bright effects upon schreinered sateens have been generally adopted in almost all printworks. On a very large scale blue, violet and navy blue shades are dyed, for the production of which mostly Methyl Violet, New Methylene Blue, Marine Blue and Methylene Blue have been used. The fastness to light of this style was considerably improved by suitably replacing the loose Methyl Violet by mixtures of Methylene Blue with Methylene Violet or Methylene Heliotrope O. Besides blue shades dark green, claret and brown shades are also dyed. Dark blues are best dyed with Fast Blue for Cotton TAI, which dyestuff has, in addition to its great fastness to light and washing, the further great advantage of scarcely colouring the discharged white. Together with Auramine Fast Blue for Cotton TAI produces very good dark green shades.

This tannin discharged style is carried out as follows:

The well bleached cotton cloth is mordanted and fixed exactly as described on page 105. After mordanting, fixing, washing and drying the goods are printed with the following discharge:

Discharge White L:

100 parts British gum powder and
650 parts soda lye 77° Tw. are heated together, then whilst luke warm,
250 parts sodium bisulphite 66° Tw. and when cold,
5 parts Alizarin Brown paste are added.
1000 parts.

In order to detect „doctor streaks“, litmus or a Phenolphtaleine solution can be used. In order, however, to obviate doctor streaks or any possible injury by the alkaline discharge upon the tannin ground, due to unevennesses of the printing rollers, it is advisable to pad the goods before printing with a solution of about 3 oz chloride of ammonia per gall. water, and then to dry them; or to add to the tartar emetic bath a corresponding quantity of chloride of ammonia, in which case the goods are not washed, but dried straight off.

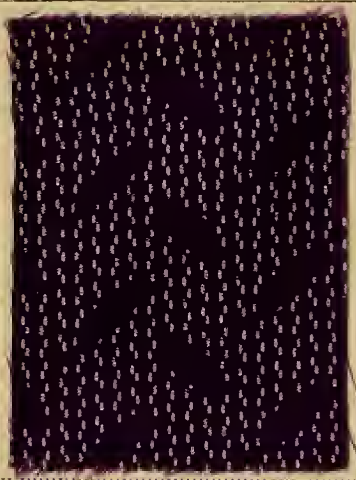
If the tannin ground is not fixed with antimony before discharging, it is of advantage to add the chloride of ammonia to the tannin padding bath.

The fixing of the tannin is, in this case, only effected after the printed goods have been steamed. The antimony bath must then be kept correspondingly acid. The discharge colour must be used in accordance with the strength of the tannin ground and the depth of the engravings. After printing the goods are well dried, then steamed in the Mather-Platt ager for $^1/_2$—1 minute at 212—216° F., afterwards passed for $^1/_2$ minute through diluted sulphuric acid, thoroughly washed, and finally soaped for 5 minutes at 113° F.

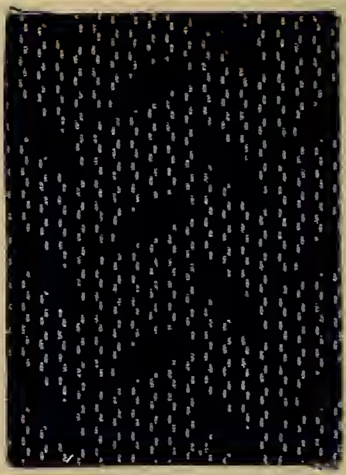
The dyebath contains the 50 fold amount of water, and an addition of 30 parts tartar emetic and 20 parts alum per 1000 parts of the material. These additions act very favourably upon the depth and brightness of the dyed shades and particularly upon the purity of the discharged white.

After dyeing the goods are well washed, soaped and, if required, chemicked.

It is essential for obtaining a pure, slightly coloured white, that the goods, after being passed through sulphuric acid and washed, be dyed as soon as possible, without being allowed to lie for a long time. It goes without saying that an excess of colour must be avoided in dyeing. Most of the basic colours are suitable for dyeing on discharged tannin mordant. We recommend the following brands for obtaining the fastest effects: Methylene Yellow H, Auramine conc., Azophosphine GO, Methylene Violet 3RA extra, Methylene Heliotrope O, Victoria Blue B, Methylene Blue DR, New Methylene Blue N, Thionine Blue GO, Fast Blue for Cotton TAI, TAII and TAIV, Indophene Blue AE, and Methylene Green extra yellow conc., as also Violet Crystals O for shading, in small quantities.



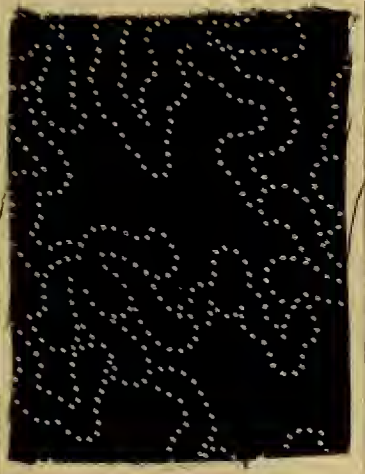
1 % tannin — Discharge white L
Dyestuff:
1 % Methylene Heliotrope O



2 % tannin — Discharge white L
Dyestuffs: 0,32 % Methylene Violet 3RA extra, 0,6 % Methylene Blue DR and 0,09 % Azophosphine GO

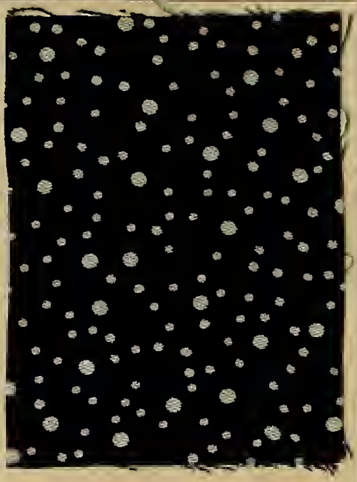
3 °/₀ tannin — Discharge white L
Dyestuff:
2 °/₀ Marine Blue BI

4 °/₀ tannin — Discharge white L
Dyestuff:
2½ °/₀ Indophene Blue AE



4 °/₀ tannin — Discharge white L
Dyestuff:
2 °/₀ Fast Blue for Cotton TAI

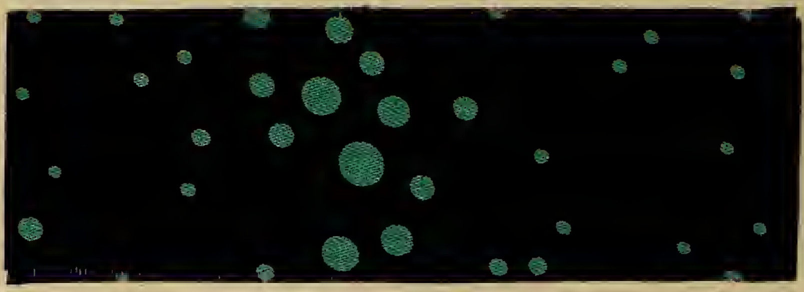
4 °/₀ tannin — Discharge white L
Dyestuffs: 1,4 °/₀ Cotton Fast Blue TAI, 0,3 °/₀ Violet Crystals O and 0,3 °/₀ New Methylene Blue N



3 % tannin — Discharge white L
Dyestuffs: $1^1/_4$ % Marine Blue BI
and $1^3/_4$ % Methylene Yellow H

4 % tannin — Discharge white L
Dyestuffs: 0,5 % Auramine conc.
and 1 % Fast Blue for Cotton TAI

Very often the tannin discharged style is combined with steam colour printing in such a manner that the dyed goods are padded with a light steam colour after a good white has already been obtained. Steaming in the Mather-Platt for a short time suffices for fixing the pad colour.



4 % tannin — Discharge white L
Dyestuffs: 1,8 % Methylene Heliotrope O, and 0,2 % New Methylene Blue N,
Cover: 0,25 % Methylene Yellow H and 0,15 % Methylene Blue DBB extra conc.

3. DISCHARGING TANNIN GROUNDS BY MEANS OF SLIGHTLY ALKALINE COLOURS OR SULPHITES.

(TANNIN HALF DISCHARGED STYLES.)

Fine half discharge effects are obtained by printing upon the tannin mordanted goods alkaline carbonates, silicates and sulphites, and subsequent steaming for 3 minutes, fixing and dyeing with basic colours. By printing caustic soda, as described previously, in combination with these half discharges, a white may be obtained in addition to the half discharge effect.

Half Discharge S

220 parts	British gum powder,
80 parts	china clay paste 2 : 1,
200 parts	water,
500 parts	potassium sulphite 90° Tw.
1000 parts.	

4 % tannin — Half discharge S
Discharge white L
Dyestuff: 2 % Safranine AN extra

4 % tannin — Half discharge S
Discharge white L
Dyestuff: 2 % Brilliant Green, cryst. extra

4. DISCHARGE EFFECTS BY MEANS OF OXIDISING AGENTS.

A large number of basic colours can be completely destroyed by the so-called chlorate discharge. It is thereby possible to obtain white and coloured discharges on tannin colours. There are, however, only very few basic dyestuffs which are easily discharged to a perfect white, and there is always the danger of weakening the fibre in the printed places, a disadvantage excluded e. g. in the so-called tannin discharged style. The chlorate discharges are consequently not used to the same extent as the tannin discharged styles.

Chlorate discharges are carried out in the following way:

The cotton fabric prepared in the usual manner with tannin and tartar emetic and dyed with basic colours is printed with chlorate discharges, to which are added, in order to obtain multicoloured effects, either discharge lakes with albumen solution, or basic dyestuffs that resist the chlorate discharge. According to the strength of the chlorate discharge the goods are steamed in the Mather-Platt for 3—6 minutes, or for a longer time in the large steamer. In order to prevent the fibre from becoming tender and also to obtain a good discharge, it is advisable to notch the rollers of the steaming apparatus longitudinally so that the least possible surface of the cloth comes into contact with the hot copper rollers. Care must also be taken that the acid vapours be completely removed from the steamer with all possible speed by a vigorous current of steam.

After steaming the goods are washed, then passed through a bath at 104° F containing 1 pint caustic soda 76° Tw. per 10 gall., washed again and dried. The alkaline passage acts favourably upon the purity of the white.

The following chlorate discharges are suitable for discharging tannin colours, chlorate of alumina being especially recommended for dark shades. As chlorate of alumina is a very strongly oxidising compound, its use may easily cause a corrosion of the fibre, it must, therefore, be employed with care.

I.

300 parts	British gum powder,
415 parts	water,
200 parts	chlorate of soda,
50 parts	yellow prussiate,
35 parts	citrate of ammonia 53° Tw.
1000 parts.	

II.

250 parts British gum powder,
500 parts water,
30 parts citric acid,
200 parts chlorate of soda,
10 parts red prussiate,
10 parts vanadium solution 1 : 100,
1000 parts.

III.

220 parts British gum powder,
50 parts water,
560 parts chlorate of alumina, 42° Tw.,
150 parts chlorate of soda,
20 parts red prussiate,
1000 parts.

IV.

150 parts chlorate of soda,
200 parts chlorate of barium,
250 parts water,
40 parts flour, boil and add, at 122° F.,
130 parts sulphate of alumina,
120 parts water, then add cold,
110 parts red prussiate,
1000 parts.

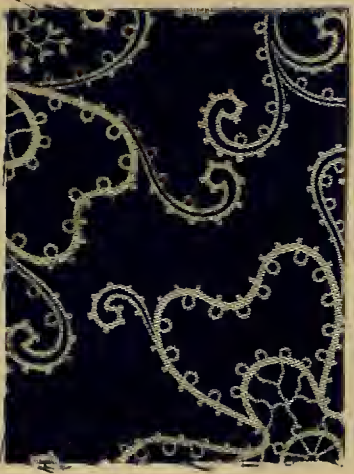
V.

450 parts strarch tragacanth thickening,
200 parts chlorate of soda,
200 parts china clay paste 1 : 1,
50 parts yellow prussiate, before use add,
100 parts citric acid,
1000 parts.

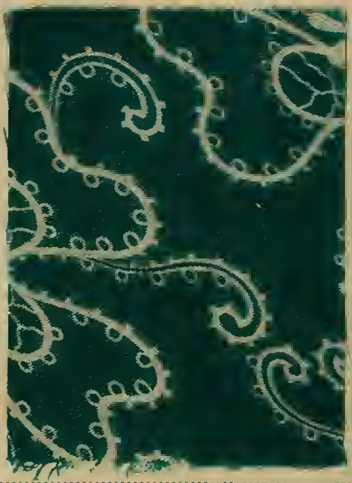
The tannin lakes of the following basic dyestuffs can be discharged with chlorates: Auramine, Azophosphine GO, Phosphine, Leather Yellow, Magenta, New Magenta, Cerise, Maroon, Grenadine, Brilliant Green, Malachite Green, Methyl Violet, Violet Crystals O, Victoria Blue, Ethyl Blue, Indophene Blue.

In medium and lighter shades the following may be discharged: Rosazeine, Safranine, Methylene Blue, Thionine Blue, Methylene Green and Methylene Grey.

Multicoloured discharges upon easily dischargeable light shades can also be obtained by adding to the chlorate discharge dyestuffs which are more difficult to discharge. Oxydianil Yellow even withstands very strong chlorate discharges, and is, therefore, most suitable for yellow discharges. Besides the above the following dyestuffs can also be used, for this purpose: Safranine, Rosazeine, 4G extra, 6G extra, 6GD extra and Methylene Heliotrope O.



2 % tannin — Dyestuff:
$1^{1}/_{2}$ % Victoria Blue B
Discharge Colour III, reduced 2 : 1



1 % tannin — Dyestuff:
1 % Brilliant Green cryst. extra.
Discharge Colour III, reduced 1 : 2

$1^{1}/_{2}$ % tannin. — Dyestuff: 1 % Methyl Violet BB
Discharge Colour III, reduced 1 : 1

5. DISCHARGE EFFECTS BY MEANS OF REDUCING AGENTS.

Certain basic colours can be destroyed by the following reducing agents, viz: Zinc-dust, hydrosulphite, sulphite, tin crystals, stannate of soda, and caustic soda discharges. The first named however have almost completely disappeared since the introduction of hydrosulphite discharges prepared with Hydrosulphite NF conc.

a) Hydrosulphite Discharges.

Basic colours, when discharged by means of reducing discharges, produce leuco-compounds which can never be completely destroyed nor perfectly removed from the fibre, consequently the discharged white is always slightly tinted. These discharges can, however, be applied for multicoloured effects, for which purpose the discharges described under "direct colours" can be used. Serviceable multicoloured discharge effects can be obtained upon Magenta, Brilliant Green, Malachite Green, Victoria Blue, Azophosphine, Methyl Violet, Violet Crystals, Chrysoidine, Vesuvine, Janus Brown R and B, Janus Red B.

For the production of multicoloured discharges the following dyestuffs, which are stable to reducing agents, are used: Methylene Yellow H., Auramine, Flavophosphine, Rosazeine 4G extra, 6G extra, 6GD extra, Thionine Blue GO, Chromoglaucine VM, BMJ, Philochromine B, G, Indigo etc.

b) Sulphite Discharges.

Neutral sulphites, in steaming, destroy the tannin antimony lakes of the undermentioned dyestuffs, in such a manner as to produce white upon light shades, but only partial discharges upon dark shades. By adding to these discharges sulphite-resisting dyestuffs, which fix themselves with the tannin of the ground colour, useful half discharge effects are obtained, which can be variously employed in printing.

Dyestuffs dischargeable in light shades are: Azophosphine, Magenta, New Magenta, Methylene Blue, New Methylene Blue N, Brilliant Green, Malachite Green and Methylene Green.

Sulphite White Discharge I.

500 parts sulphite of potassium 90° Tw.,
300 parts British gum powder,
200 parts water,
1000 parts.

Sulphite White Discharge II.

550 parts sulphite of potassium 90° Tw.,
130 parts sulphocyanide of potassium,
50 parts caustic soda 76° Tw.,
250 parts British gum powder,
20 parts water,
1000 parts.

The following sulphite-resisting dyestuffs are suitable for multicoloured discharges: Auramine Methylene Yellow H, Phosphine, Flavophosphine, Methyl Violet, Safranine, Methylene Heliotrope, Victoria Blue, Ethyl Blue, Rosazeine. By adding, caustic alkali to the sulphite discharge (Sulphite White Discharge II) it is possible to discharge also Auramine and Rosazeine.

Sulphite White Discharge III.

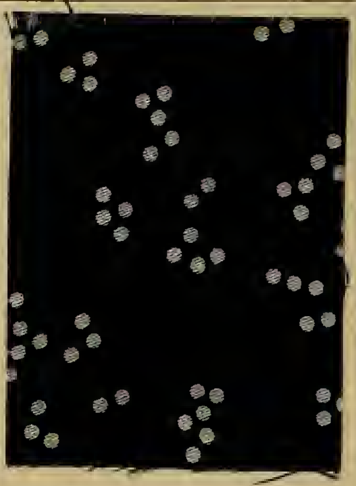
200 parts British gum powder,
100 parts china Clay 1 : 1,
600 parts sulphite of potassium 90° Tw.,
100 parts sodium acetate,
1000 parts.

Sulphite Coloured Discharge.

20 parts dyestuff (see above),
200 parts water,
300 parts British gum powder,
480 parts sulphite of potassium 90° Tw.,
1000 parts.

The sulphite discharges are printed on the dyed material, the latter then steamed for 1—3 minutes in the Mather-Platt, washed and chemicked.

3 % tannin. — Dyestuff:
$1^{1}/_{2}$ % Methylene Green extra yellow DG
Sulphite White Discharge I.



4 % tannin. — Dyestuff:
1,3 % New Methylene Blue N,
0,7 % New Fast Blue cryst.
Sulphite Coloured Discharge with 2 % Auramine conc.

4 % tannin. —
Dyestuffs: 0,8 % Methyl Violet 3R, and 0,4 % Victoria Blue B.
Printed: Sulphite White Discharge III.
Covered: White Discharge V (see page 113).

c) Tin Discharges.

Some basic colours, especially the Indophene Blues and Janus Blues are discharged red by tin crystals. This reaction is often utilized in order to produce the favourite Blue Red style. Best suited for this purpose is Indophene Blue R, which thus gives a bright red. By adding Auramine, Rosazeine, or Safranine to the discharge colour, this red may be embellished.

4 % tannin. —
Dyestuff: 2 % Indophene Blue R. Red Discharge S.

Red Discharge S.

4 parts	Auramine conc.,
26 parts	Rosazeine 4G extra,
230 parts	acetic acid 9° Tw.,
250 parts	acid starch thickening,
40 parts	tartaric acid,
150 parts	acetic acid tannin sol 1 : 1,
300 parts	standard white,
1000 parts.	

Standart White.

368 parts	stannous acetate 33° Tw.,
148 parts	british gum,
74 parts	gum solution 1 : 1,
37 parts	citric acid,
40 parts	water,
222 parts	tin crystals,
37 parts	acetate of soda,
74 parts	water,
1000 parts.	

d) Stannate of Soda Discharges.

The discharge recommended for Turkey red can also be used for the following colours in light shades: Auramine, Azophosphine GO, Rosazeine, Magenta, Methyl Violet (red shades), Malachite Green, Brilliant Green, whereas Victoria Blue and Safranine resist the discharge.

e) Caustic Soda Discharges.

For this purpose caustic soda 76° Tw., thickened with British gum and wheat starch is used.

Still better results are obtained if the dyed material is prepared before printing with a glucose solution, or by adding the glucose to the caustic soda discharge.

The caustic soda discharge acts similarly to the stannate of soda discharge.

II.

MORDANT COLOURS.

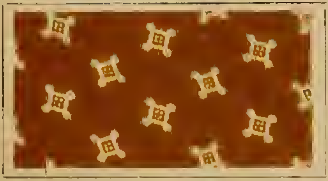
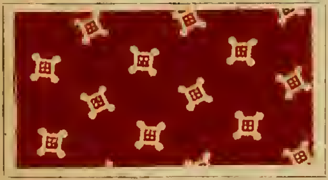
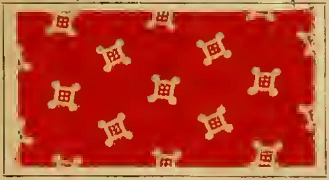
Whilst the dyestuffs described in the foregoing chapter are of basic character, and, consequently, have to be fixed on the fibre by an acid, namely tannin, the so-called mordant dyestuffs, which we now propose to discuss, are of acid character, and, therefore, form with basic substances — the metal oxides — mostly very fast and characteristic compounds.

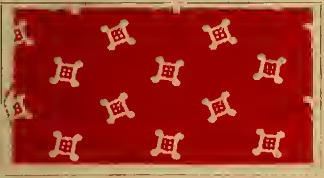
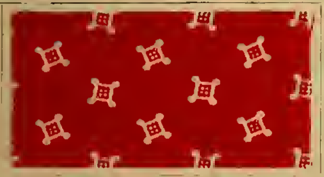
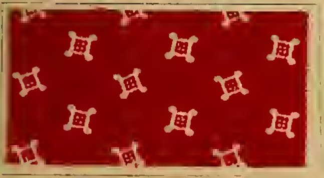
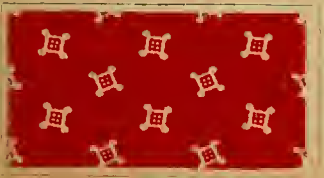
The presence of tannin in the colour lake scarcely, or very slightly, changes the shades of the basic dyestuffs. Quite different, however, is the reaction of mordant dyestuffs, which, generally, produce no pronounced colour when used by themselves, but only furnish a valuable colour in combination with the metal oxide of the mordant.

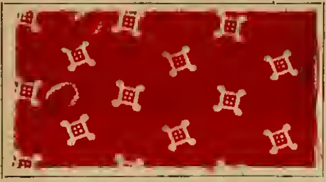
Moreover, the colour differs in many mordant dyestuffs according to the nature of the mordant, e. g. the alumina lake of Alizarine is red, the iron lake violet, and the chrome lake red brown. This difference occurs principally in all those mordant dyestuffs which have a great affinity to alumina, whilst the proper chrome colours, such as Alizarine Blue, Alizarine Yellow, show only very little or no change of shade of the colour lake with the various mordants. The mordant colours are mostly employed where great fastness to light and washing is especially desired.

A. SYSTEMATIC TABLES OF THE MORDANT COLOURS.

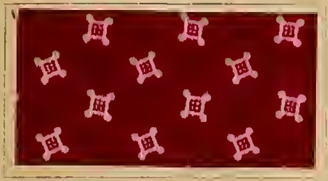
FOR EXPLANATION OF THE FIGURES SEE PAGE 60.

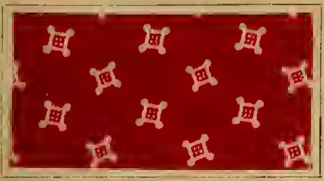
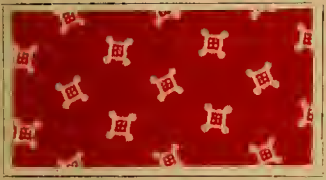
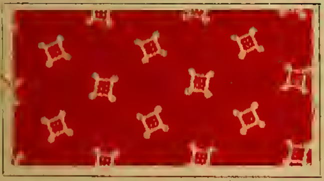
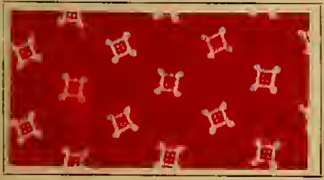
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Alizarine Yellow 5 G powder 	4—5	4	5—4	2	2	2	3	Fixed as chrome lakes, either by themselves or in mixtures with other steam colours. These salicylic acid dyestuffs fix basic colours very fast, for which reason they can be used in combination with Methylene Blue etc. for the production of fast green and olive shades. Are also very suitable for dyeing on chrome mordants.
Calico Yellow O 	3	1—2	4	1	1—2	2	2	
Alizarine Yellow GG paste 	4—5	4	5—4	2	1	2—3	2—3	
Alizarine Yellow R paste 	4	3	4	2—1	1—2	3—4	3—2	
Alizarine Orange paste printed with alumina 	4—5	4—5	5	4—5	2	2—3	2	Is much used in steam colour printing alone and in combination with other dyestuffs for the production of orange and brown shades. Also very suitable for dyeing on alumina and chrome mordants.
Alizarine Orange paste printed with chrome 	2—3	4—5	5	5—4	2—1	2—3	1	
Alizarine Red SDG paste 20% 	3	5	5	5	1	2	2	see following page.

Name of Dyestuff	Discharges				Fassness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Alizarine Red G G paste 20 % 	3	5	5	5	1	2	1—2	The chief use of Alizarine Reds is in steam colour printing and dyeing for the production of fast red and pink shades with alumina mordants. The blueish brands give very fast violet shades with iron mordants. The brown and brown violet chrome lakes are mostly used shaded with other dyestuffs for chocolates, or in light shades for the production of strawberry effects. Alizarine Reds withstand the usual discharging agents very well, they can, however, be discharged to a pure white with the glucose-alkali discharge, with the strongly alkaline hydrosulphite discharge, and also in the chloride of lime vat.
Alizarine Red 5 F paste 20 % 	3	5	5	5	1	2	1—2	
Alizarine Red 2 R G paste 20 % 	3	5	5	5	1	2	1—2	
Alizarine Red No. 2 paste 20 % 	3	5	5	5	1	2	1	
Alizarine Red 2 A G paste 20 % 	3	5	5	5	1	2	1	
Alizarine Red 2 A paste 20 % 	3	5	5	5	1	2	1	
Alizarine Red 4 N G paste 20 % 	3	5	5	5	1	2	1—2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Alizarine Red 4 N B paste 20 % 	3	5	5	5	1	2	1 – 2	The chief use of Alizarine Reds is in steam colour printing and dyeing for the production of fast red and pink shades with alumina mordants. The blueish brands give very fast violet shades with iron mordants. The brown and brown violet chrome lakes are mostly used shaded with other dyestuffs for chocolates, or in light shades for the production of strawberry effects. Alizarine Reds withstand the usual discharging agents very well, they can, however, be discharged to a pure white with the glucose-alkali discharge, with the strongly alkaline hydrosulphite discharge, and also in the chloride of lime vat.
Alizarine Red R X paste 20 % 	3 – 4	5	5	5	1	2	1 – 2	
Alizarine Red I B paste 20 % 	3 – 4	5	5	5	1	2	1	
Alizarine Red No. I paste 20 % 	3 – 4	5	5	5	1	2	1	
Alizarine Claret R paste printed with alumina 	2	4 – 5	5	5	2	3	1 – 2	Is used with alumina mordant for the production of fast claret shades, and furnishes with alumina chrome mordants deep clarets shades which are very fast to light and soaping. Are also used for the production of dyed styles.
Alizarine Claret R paste printed with chrome 	2	5 – 4	5	5	2	4	1 – 2	
Alizarine Blue S B powder 	2 – 1	5 – 4	5	5	2	2	1 – 2	see following page.

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Alizarine Blue S R powder 	2 – 1	5 – 4	5	5	2	2	1 – 2	Alizarine Blues are used in steam colour printing as chrome lakes for the production of very fast blue shades; for brighter shades nickel-, zinc- and magnesium mordants are used which, however, give only lakes of small fastness to washing. They can also be used in chlorate discharge styles.
Alizarine Blue S 2 R paste 	2 – 1	5 – 4	5	5	2	2	1 – 2	
Alizarine Blue S R X paste 	2 – 1	5 – 4	5	5	2	2	1 – 2	
Philochromine B paste 	1	5	4	4	1 – 2	3	2	Are used, alone and in mixtures, on account of their fastness and beauty, for steam-, padding-, and printing colours, and also for dyeing on discharged chrome mordant. Are very important for chlorate discharges, and as additions to reducing discharges.
Philochromine G paste 	1	5	4	4 – 5	2 – 3	3	2	
Chromoglaucine V M paste 	1	5	4	5	2	3	1 – 2	Are used, like Philochromines, for the production of very fast dark blue and violet shades in steam colour printing and chlorate discharges. Are very important as additions to tin- and hydrosulphite discharges, especially for the production of blues on Para Red.
Chromoglaucine BMJ solution 	1	5	4	5	2	3 – 4	1 – 2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Alizarine Green S paste 	2	5	5—4	5	2	3	1—2	Is very serviceable in steam colour printing, for chlorate discharges and for dyeing on chrome mordants.
Ceruleine SW paste 	2	5	4—5	4—5	1	4	1—2	Is used alone and mixed with other chrome colours for the production of fast green and olive shades, in steam colour printing and for dyeing in chrome mordant styles.
Alizarine Brown paste 	2	5—4	5	5	2	3	1—2	Is much used alone and in mixtures in steam colour printing for dyeing on chrome mordants and for chlorate discharges.
Solid Green O paste 50% printed with iron 	5—4	4	4	4	1—2	2—3	2—3	Are used in steam colour printing for obtaining dark green and brown shades. Chiefly for dyeing on iron mordant, and as steam padding colours printed subsequently with resists.
Solid Green O paste 50% printed in alkaline solution with copper 	3	4—5	5—4	4—5	2	3—4	2—3	
Rosazeine extra 	—	—	—	—	3	3	3—4	Rosazeine and Eosine dyestuffs are occasionally used as alumina or chrome lakes for the production of cheap and bright pink shades which are not required to be very fast to washing and light.
Rose Bengale G 	—	—	—	—	3	3	3—4	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlor-ate	Tin	Sulphite	Hydro-sulphite				
Phloxine O 	—	—	—	—	3	3—4	3—4	Rosazeine and Eosine dyestuffs are occasionally used as alumina or chrome lakes for the production of cheap and bright pink shades which are not required to be very fast to washing and light.
Erythrosine A 	—	—	—	—	3	3—4	3—4	
Eosine extra yellow 	—	—	—	—	3	3—4	3—4	
Brilliant Orange G 	—	—	—	—	2	4—5	4—5	Scarlets, Victoria Scarlets, Oranges and Croceines are used as alumina lakes for the production of bright red and orange shades, for export goods, and upholstery and curtain materials, for which no fastness in required.
Brilliant Croceine yellowish 	—	—	—	—	2	4—5	5	
Victoria Scarlet 3 R 	—	—	—	—	2	5	5	
Alkaline Blue 2B 	—	—	—	—	3	4—5	3—4	Alkali Blues etc. are used in export goods etc. for the production of bright blue shades.

B. DIRECT OR STEAM COLOUR PRINTING WITH MORDANT COLOURS.

The method pursued for fixing mordant dyestuffs as steam colours upon cotton goods is, generally speaking, identical with that described for steam colour printing with basic dyestuffs. The principal difference consists in the composition of the printing colours which, instead of tannin, contain metal mordants as fixing agents.

The mordants used for fixing the mordant colours are alumina, iron and chrome compounds. Supplementary mordants are lime, tin, less frequently magnesia, zinc or nickel mordants, as well as fatty mordants, notably Turkey red oil. Their characteristic features and preparation have been described on page 25. The entry of fatty mordants into the colour lake effects mostly an improvement in fastness, and in Alizarine a considerable embellishment of the colour lake. Fatty mordants are generally used for preparatory treatment of the goods to be printed. For this purpose the pieces are padded with a solution of 5—8 oz neutral Turkey red oil per gallon. It is essential that only well sulphonated and well washed Turkey red oil which does not turn the goods yellow in steaming, should be used.

In printing with colours sensitive to iron, such as Alizarine Red and Pink, lacquered or composition doctors must be used.

The goods are usually steamed for a somewhat longer time than with basic colours, and it is advisable, especially in order to obtain a brilliant, deep red with Alizarine, to steam for $1\,^1/_2$—2 hours without pressure.

After steaming the goods are treated in a bath containing about 3 oz chalk per gallon for $^1/_2$ minute at 122° F., then washed, malted and soaped in exactly the same manner as described for basic colours. In order to obtain very bright shades Alizarine Red and pink are generally soaped hot in the rope for a longer time.

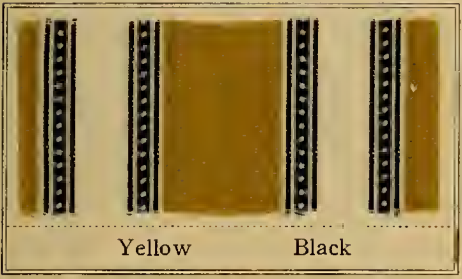
Resorzine and acid dyestuffs are sometimes printed with metal mordants. The effects thus produced are, however not fast to washing and are usually finished directly after steaming without being washed.

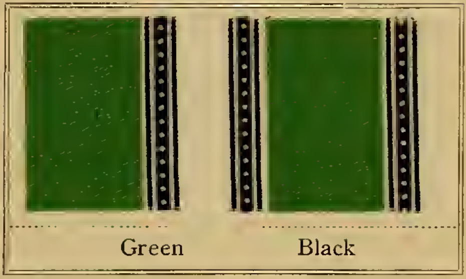
On the following pages the mordant colours are separately discussed as to their properties and mode of employment. The respective shades are shown partly in the accompanying patterns, partly also in the systematic tables on page 122.

ALIZARINE YELLOW.

Alizarine Yellows are salicylic acid Azo Colours which yield very fast lakes with chrome oxide. Owing to their great fastness they class themselves well with the proper Alizarine Colours with which they are often combined. They are put upon the market as pastes or powder, the former being more suitable for printing purposes. Alizarine Yellows are fixed upon the fibre with chrome mordants, and are largely used in steam colour printing alone and in mixtures with Alizarine and Basic Colours for the production of green, olive and drab shades. They are all very fast to washing, chlorine and light. The KR brand is the most soluble in water, and can be used as a substitute for the chrome lake of Persian Berries. The 5G brand gives a pure greenish shade of yellow and is much used in combination with Methylene Blue for the production of green shades in steam colour printing. Alizarine Yellow GG and Calico Yellow O produce gold yellow, and the R brand yellow orange shades. The chrome lakes are partly destroyed by oxidising and reducing agents. Alizarine Yellows are also used for the production of dyed styles upon chrome mordants as they stain the white only very slightly.

For scale of shades, tables of fastness and discharge effects see page 122.





Yellow Printing Colour:

20 parts	**Alizarine Yellow 5G** powder,
400 parts	hot water,
400 parts	wheat starch tragacanth thickening,
50 parts	formic acid conc.,
30 parts	glycerine,
100 parts	acetate of chrome 32° Tw.,
1000 parts.	

Black Printing Colour:

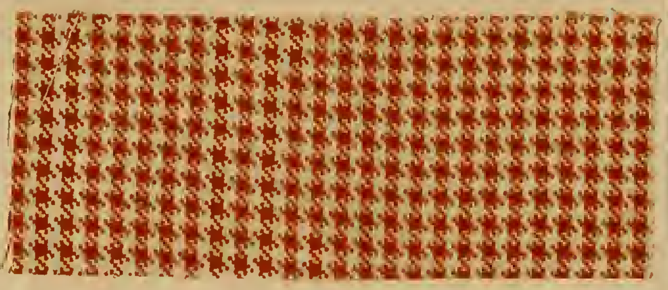
$3^{1}/_{2}\%$ Diphenyl Black Base I.

Green Printing Colour:

20 parts	**Alizarine Yellow 5G** powder,
340 parts	hot water,
400 parts	wheat starch tragacanth thickening,
50 parts	formic acid conc.,
30 parts	glycerine,
$2^{1}/_{2}$ parts	**Methylene Blue DBB,**
$57^{1}/_{2}$ parts	water,
100 parts	acetate of chrome 32° Tw.,
1000 parts.	

Black Printing Colour:

$3^{1}/_{2}\%$ Diphenyl Black Base I.



15 % Alizarine Yellow R paste

Yellow Printing Colour:

150 parts	**Alizarine Yellow R paste,**
150 parts	water,
600 parts	wheat starch tragacanth thickening,
100 parts	acetate of chrome 32° Tw.,
1000 parts.	

Reactions upon the Fibre:

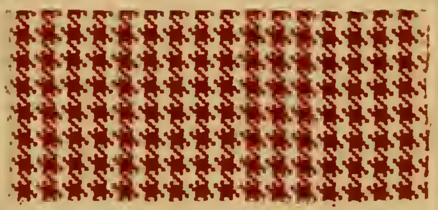
	Alizarine Yellow 5G	Alizarine Yellow GG	Alizarine Yellow R
conc. H_2SO_4	red	orange	orange
diluted H_2SO_4	„	„	„
conc. HCl	„	„	„
diluted HCl	„	„	„
conc. HNO_3	„	„	„
10 % NaOH	lighter	lighter	red brown
25 % NH_3	little change	little change	little change
$SnCl_2 + HCl$	pink	decolorised	decolorised
10 % Hydrosulphite NF conc.	lighter	lighter	lighter

ALIZARINE ORANGE.

Alizarine Orange or Nitroalizarine is put upon the market as a yellow paste consisting of fine lustrous crystals not very soluble in water but easily soluble in alkalies. It is fixed upon the fibre as alumina or chrome lake, the former being coloured a bright orange, but not as fast to soap as the red brown, very fast chrome lake. It is extensively used in steam colour printing, alone and also in combination with other Alizarine dyestuffs, for the production of orange and brown shades. Besides this it is used for the production of dyed-styles upon alumina and chrome mordants, as it colours the white very slightly. It is easily destroyed by oxidising agents, but withstands reducing agents fairly well.

For tables of fastness and discharge effects see page 122.

12 % Alizarine Orange paste



10 % Alizarine Orange paste

Orange Printing Colour:

120 parts	Alizarine Orange paste,
79 parts	water,
600 parts	thickening for red,
110 parts	nitroacetate of alumina 18° Tw.,
36 parts	acetate of lime 28½° Tw.,
5 parts	tartaric acid,
50 parts	water,
1000 parts.	

Brown Printing Colour:

100 parts	Alizarine Orange paste,
245 parts	water,
500 parts	wheat starch tragacanth thickening,
30 parts	olive oil,
30 parts	glycerine,
5 parts	tartaric acid,
90 parts	acetate of chrome 32° Tw.,
1000 parts.	

Reactions upon the Fibre: H_2SO_4 and HCl — little change; conc. HNO_3 — lighter; 10% $NaOH$ and 25% NH_3 — browner; $SnCl_2 + HCl$ — lighter; 10% Hydrosulphite NF conc. — little change.

ALIZARINE RED.

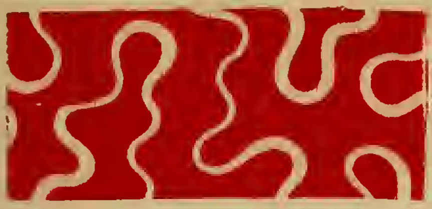
Alizarine Red is a reddish yellow to brownish yellow substance which is sold as a powder or a 20 % or 40 % paste. Almost insoluble in cold water, Alizarine Red easily dissolves in ammonia, strong and weak alkalies, borax, solution ether etc. According to the percentage of Alizarine, Anthrapurpurine or Flavopurpurine in the Alizarine Red brands the shade of the alumina lake varies from blueish red to yellow red. Alizarine Red No. 1, 1B, and DIB are pure blue shade brands which contain only Alizarine — 1. 2.-Dioxyanthraquinone. The Alizarine Red RX brand contains only Anthrapurpurine — 1. 2. 7-Trioxyanthraquinone, — whereas Alizarine Red SDG contains almost only Flavopurpurine — 1. 2. 6-Trioxyanthraquinone. The remaining brands are mixtures of these three dyestuffs.

Alizarine Red belongs to the colours which are considered fast to washing and light; it is therefore very largely used for printing and dyeing purposes. Where extreme fastness is required, it is used on alumina, chrome, iron and mixed mordants for red, brown and violet shades. Alumina produces a bright red, chrome a deep chocolate, and iron a violet. In order to obtain mixed shades, these mordants may be combined as required. Of all Alizarine brands in the market the "yellow shade" brands are mostly used on alumina-lime mordants for the production of fiery red shades. The more "blue shade" brands give blueish reds and pinks on alumina-lime mordants, browns on chrome mordants, and violets on iron mordants.

In steam colour printing the Alizarines fixed with alumina are printed on the goods prepared with Turkey red oil, or the printing colours contain additions of fatty mordants, as only in the presence of the latter bright and sufficiently fast shades are produced. As the Alizarines are very sensitive to iron, lacquered or composition doctors have to be used. The Alizarines to be fixed with chrome and iron, are best printed on unprepared materials. The goods printed with Alizarine Reds are steamed for 1—1$^1/_2$ hours with or without pressure, then washed and soaped. A passage through chalk before washing acts favourably upon the fixing operation. Alizarines are sometimes shaded with basic dyestuffs.

Alizarines are, moreover, used for the production of all kinds of printed, resisted and discharged dyed effects on alumina, chrome and mixed mordants.

For tables of fastness and discharge effects see page 122.



10 % Alizarine Red 5F paste 20 %

Red Printing Colour:
550 parts thickening for red,
150 parts water,
100 parts **Alizarine Red 5F paste 20 %**,
20 parts chlor oil,
20 parts stannous hydrate paste 17 %,
20 parts tin oxalate 25° Tw.,
30 parts acetate of lime 28½° Tw.,
40 parts nitrate of alumina 18° Tw.,
70 parts sulphocyanide of alumina 18° Tw.,
1000 parts.

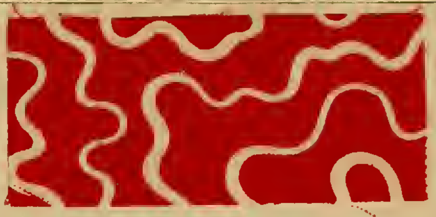
Printed on oiled goods.

Red Pink

Red Printing Colour: as above

Pink Printing Colour:
10 parts **Alizarine Red No.1 paste 20 %**
400 parts acid starch thickening,
200 parts tragacanth (60 : 1000),
369 parts water,
14 parts nitrate of alumina 18° Tw.,
4 parts acetate of lime 28½° Tw.,
3 parts tin oxalate 25° Tw.,
1000 parts.

Printed on goods prepared with 3 % Turkey red oil.



10 % Alizarine Red 5F paste 20 %

Red Printing Colour:
550 parts thickening for red,
90 parts water,
50 parts Para soap PN,
100 parts **Alizarine Red 5F paste 20 %**,
40 parts acetate of lime 28½° Tw.,
90 parts sulphocyanide of alumina 18° Tw.,
30 parts acetate of alumina 18° Tw.,
20 parts tin oxalate 25° Tw.,
30 parts tartaric acid 1:6,
1000 parts.

Printed on unoiled goods.

Dark Violet Light Violet

Dark Violet Printing Colour:
100 parts **Alizarine Red No.1 paste 20 %**,
600 parts wheat starch tragacanth thick.,
70 parts acetic acid 9° Tw.,
55 parts acetate of lime 28½° Tw.,
45 parts acetate of iron 32° Tw.,
5 parts **Methyl Violet BB**,
10 parts acetic acid 9° Tw.,
115 parts water,
1000 parts.

Light Violet Printing Colour:
15 parts **Alizarine Red No.1 paste 20 %**,
600 parts wheat starch tragacanth thick.,
70 parts acetic acid 9° Tw.,
15 parts acetate of lime 28½° Tw.,
3 parts yellow prussiate,
297 parts water,
1000 parts.

Red Printing Colour (as before)

Pink Printing Colour:

8 parts	**Alizarine Red No. 1 paste 20 %,**
600 parts	acid starch thickening,
361 parts	water,
10 parts	acetate of alumina 18° Tw.,
3 parts	acetate of lime $28^1/_2$° Tw.,
3 parts	tin oxalate 25° Tw.,
15 parts	1 % Rosazeine 6 G extra solution,
1000 parts.	

Olive Printing Colour:

4,5 % Alizarine Yellow GG paste,
4 % Philochromine G paste.

Blue Printing Colour:

5 % **Philochromine B paste.**

Dark Grey Printing Colour:

3,3 % Alizarine Yellow GG paste,
2,2 % Chromoglaucine VM paste.

Light Grey Printing Colour:

Dark Grey Printing Colour reduced 1:3.

Olive Printing Colour:

4,5 % Alizarine Yellow GG paste,
4 % Philochromine G paste.

Pink Printing Colour:

10 parts	**Alizarine DIB new paste 20 %,**
280 parts	water,
600 parts	wheat starch tragacanth thickening,
20 parts	acetic acid 9° Tw.,
20 parts	glycerine,
20 parts	nitro-acetate of alumina 18° Tw.,
10 parts	acetate of lime $28^1/_2$° Tw.,
40 parts	tartaric acid 1 : 10,
1000 parts.	

Printed on goods prepared with 3 % Turkey red oil.

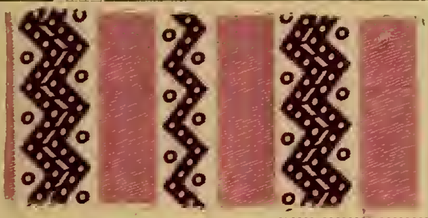
Reactions upon the Fibre:

	Alizarine with Alumina	with Chrome	with Iron
conc. H_2SO_4	browner	browner	orange
diluted H_2SO_4	brighter	yellow brown	yellow
conc. HCl	orange	„	„
diluted HCl	brighter	red brown	„
conc. HNO_3	orange	orange	„
10 % NaOH	more violet	more violet	more blue
25 % NH_3	„	„	„
$SnCl_2 + HCl$	orange	yellow brown	yellow
10 % Hydrosulphite NF conc.	little change	little change	almost decolorised.

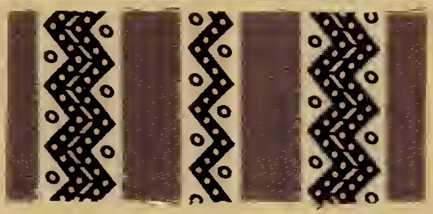
ALIZARINE CLARET.

Alizarine Claret is Amidoalizarine and is sold as a red brown paste, which is almost insoluble in water, but dissolves readily in alkalies. In printing it gives bright claret shades with alumina-lime-mordants, and deep claret shades with alumina-chrome-lime-mordants, the latter shades being extremely fast to light and soap. It is, therefore, largely used, either by itself or for shading other mordant colours. As Alizarine Claret stains the white very little, it is also used for the production of dyed styles. It is easily resisted and is destroyed by oxidising agents.

For tables of fastness and discharge effects see page 124.



Dark Claret Light Claret



Dark Violet Light Violet

Dark Claret Printing Colour:

200 parts	**Alizarine Claret R paste,**
20 parts	water,
400 parts	thickening for red,
200 parts	British gum thickening 1:1,
110 parts	nitro-acetate of alumina 18° Tw.,
70 parts	acetate of lime $28^1/_2$° Tw.,
1000 parts.	

Light Claret Printing Colour:

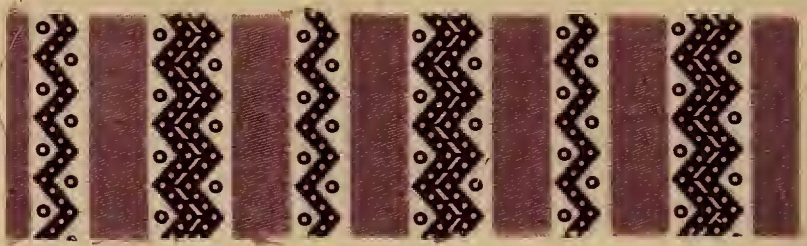
Dark Claret Printing Colour reduced 1:4 with Senegal gum thickening.

Dark Violet Printing Colour:

200 parts	**Alizarine Claret R paste,**
150 parts	water,
500 parts	wheat starch tragacanth thickening,
150 parts	acetate of chrome 32° Tw.,
1000 parts.	

Light Violet Printing Colour:

Dark Violet Printing Colour reduced 1:4 with Senegal gum thickening.



Dark Claret Light Claret

Dark Claret Printing Colour:

200 parts	**Alizarine Claret R** paste,
20 parts	water,
200 parts	British gum thickening 1 : 1,
380 parts	wheat starch tragacanth thickening,
90 parts	acetate of chrome 32° Tw.,
60 parts	nitro-acetate of alumina 18° Tw.,
50 parts	acetate of lime $28^1/_2$° Tw.,
1000 parts.	

Light Claret Printing Colour:

Dark Claret Printing Colour reduced 1 : 2 with Senegal gum thickening.

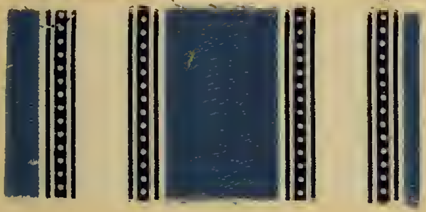
Reactions upon the Fibre:

		Alizarine Claret	
	with alumina	with alumina and chrome	with chrome
conc. H_2SO_4	orange	orange	more red
diluted H_2SO_4	little change	little change	little change
conc. HCl	orange	orange	red
diluted HCl	little change	little change	little change
conc. HNO_3	orange	orange	orange
10% NaOH	lighter	lighter	lighter
25% NH_3	little change	little change	little change
$SnCl_2 + HCl$	orange	yellow brown	more reddish
10% Hydrosulphite NF conc.	little change	little change	more reddish and lighter

ALIZARINE BLUE.

Alizarine Blue is β-Dioxyanthraquinonequinoline and is put upon the market as a paste or powder little soluble in water. For the purposes of calico printing the S brands of Alizarine Blue which contain the bisulphite compound of β-Dioxyanthraquinonequinoline and easily dissolve in water with a yellow brown colour, are alone to be considered. They are decomposed by heating the solution above 158° F. or by strong acids and alkalies. With chrome mordants Alizarine Blue yields indigo-like shades of extreme fastness to washing, chlorine and light, which are much used for very fast blues, especially in steam colour printing. In order to obtain brighter effects Alizarine Blue is sometimes shaded with basic colours. Special Fast Violet H is especially to be recommended for this purpose as it gives bright shades which are fast to washing. The alumina lake of Alizarine Blue cannot be used; the nickel lake gives purer but less fast colours than the chrome lake, and is, like the zinc lake, mostly employed in conjunction with the chrome lake. Alizarine Blue is also used for dyeing on a discharged chrome mordant. It is easily destroyed by oxidising agents. The bisulphite compound of Alizarine Blue is put on the market in the following brands: SB powder, SR powder, S2R paste, SRX paste and SRX powder. The SB brand is the one mostly employed in calico printing. The SRX is the newest brand and produces the brightest shades.

For tables of fastnes and discharge effects see page 124.



Dark Blue Light Blue

4,2% Alizarine Blue SB powder
0,8% Special Fast Violet H

Dark Blue Printing Colour:

70 parts	**Alizarine Blue SB powder,**
360 parts	water,
500 parts	wheat starch tragacanth thickening,
70 parts	acetate of chrome 32° Tw.,
1000 parts.	

Light Blue Printing Colour:

20 parts	**Alizarine Blue SB powder,**
700 parts	Senegal gum thickening 1:1,
260 parts	water,
20 parts	acetate of nickel 15° Tw.,
1000 parts.	

Blue Printing Colour:

42 parts	**Alizarine Blue SB powder,**
100 parts	cold water,
8 parts	Special Fast Violet H,
300 parts	hot water,
500 parts	wheat starch tragacanth thickening,
50 parts	acetate of chrome 32° Tw.,
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — darker; conc. HNO_3 — yellow; conc. HCl — more violet; 10% HCl — brighter; 10% NaOH — green; 25% NH_3 — little change; $SnCl_2$ + HCl — brown; 10% Hydrosulphite NF conc. — brown.

CHROMOGLAUCINES.

Chromoglaucines are Leuco compounds of dyestuffs of the Gallocyanine series and are put upon the market as a powder or paste. Fixed with chrome mordants, they yield very bright violet to violet blue lakes of considerable fastness to washing, light and chlorine. Being very stable to reducing agents, they are suitable for coloured hydrosulphite dicharges, but are easily discharged by oxidising agents. They are fixed by steaming for a short time, and are therefore used for illuminating Azo Colour styles. In steam colour printing they are much used, alone and in combination with other mordant dyestuffs, for the production of violet, blue, green etc. shades. They also serve for dyeing on discharged chrome mordants. The following brands are put on the market: Chromoglaucine VM paste and powder, and Chromoglaucine BMI solution and powder. 2 parts Chromoglaucine VM paste correspond to 1 part Chromoglaucine VM powder; 2 parts Chromoglaucine BMI solution to 0,3 parts Chromoglaucine BMI powder.

For tables of fastness and discharge effects see page 125.

3% Chromoglaucine BMI powder

Dark Violet Light Violet I
Olive Light Violet II

Blue Printing Colour:

30 parts	**Chromoglaucine BMI powder,**
200 parts	water,
600 parts	wheat starch tragacanth thickening,
50 parts	formic acid,
120 parts	acetate of chrome 32⁰ Tw.
1000 parts.	

Dark Violet Printing Colour:

35 parts	**Chromoglaucine VM paste,**
265 parts	water,
400 parts	acid starch thickening
200 parts	tragacanth (60 : 1000),
100 parts	acetate of chrome 32⁰ Tw.,
1000 parts.	

Light Violet I Printing Colour:

Dark Violet Printing Colour, reduced 1 : 6.

Olive Printing Colour:

4,5 % **Alizarine Yellow GG paste**
4 % **Philochromine G paste.**

Dark Violet, Light Violet and Olive Printing Colours, as above.

Brown Printing Colour:

17 parts Orange Printing Colour, 3 parts Blue Printing Colour.

Orange Printing Colour:

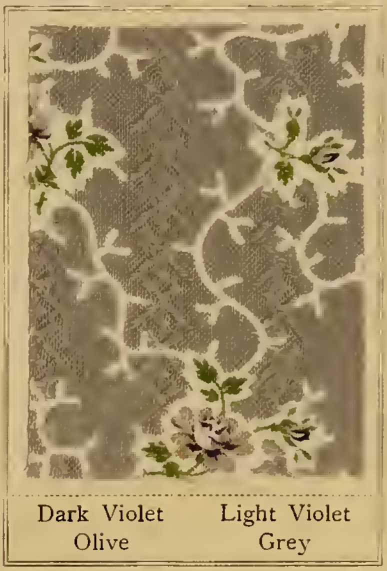
120 parts **Alizarine Orange paste,**
155 parts water,
625 parts Senegal gum thickening 1 : 1,
100 parts acetate of chrome 32° Tw.,
1000 parts.

Blue Printing Colour:

50 parts **Chromoglaucine VM paste,**
200 parts water,
625 parts Senegal gum thickening 1 : 1,
125 parts acetate of chrome 32° Tw.,
1000 parts.

Light Violet II Printing Colour:

5 parts **Chromoglaucine VM paste,**
175 parts water,
800 parts Senegal gum thickening 1 : 1,
20 parts acetate of chrome 32° Tw.,
1000 parts.



Dark Violet, Light Violet and Olive Printing Colours, as above.

Grey Printing Colour:

1 part Yellow Printing Colour, 2 parts Blue Printing Colour, reduced with Senegal gum thickening 1 : 6.

Yellow Printing Colour:

150 parts **Alizarine Yellow GG paste,**
130 parts water,
600 parts wheat starch tragacanth thickening,
120 parts acetate of chrome 32° Tw.,
1000 parts.

Blue Printing Colour:

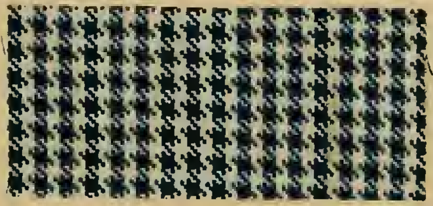
50 parts **Chromoglaucine VM paste,**
225 parts water,
600 parts wheat starch tragacanth thickening,
125 parts acetate of chrome 32° Tw.,
1000 parts.

Reactions upon the Fibre: conc. H_2SO_4 — blue violet; 10 % H_2SO_4 — more violet; conc. HNO_3 — red brown; conc. HCl — more violet; 10 % HCl little change; 10 % NaOH — duller; 25 % NH_3 — little change; $SnCl_2 + HCl$ — almost decolorised — yellowish; 10 % Hydrosulphite NF conc. — light yellow.

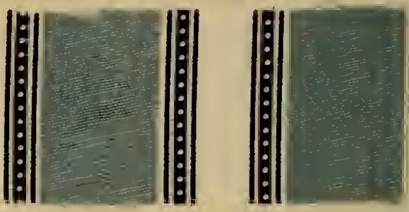
PHILOCHROMINES.

Philochromines are also Leuco-compounds of dyestuffs of the Gallocyanine series, and are put upon the market as pastes. They are fixed with chrome, and give very bright, pure blue shades which are very fast to washing and light and fairly fast to chlorine. They are very easily discharged by oxidising agents, but are very stable to hydrosulphite, and can therefore be used for hydrosulphite coloured discharges. In steam colour printing they are used for light and medium blue shades, and also, mixed with Alizarine Yellow, for green and olive shades. Philochromines can also be employed for dyeing on discharged chrome mordants. There are two Philochromine brands in the market: the G brand, giving a greenish hue, and the B brand, giving a more blueish and essentially purer shade than the G brand.

For tables of fastness and discharge effects see page 125.



20 % Philochromine G paste



Violet Blue

Blue Printing Colour:

200 parts	**Philochromine G paste,**
265 parts	water,
450 parts	wheat starch tragacanth thickening,
25 parts	formic acid,
60 parts	acetate of chrome 32° Tw.,
1000 parts.	

Violet Printing Colour:

5 % **Chromoglaucine VM paste.**

Blue Printing Colour:

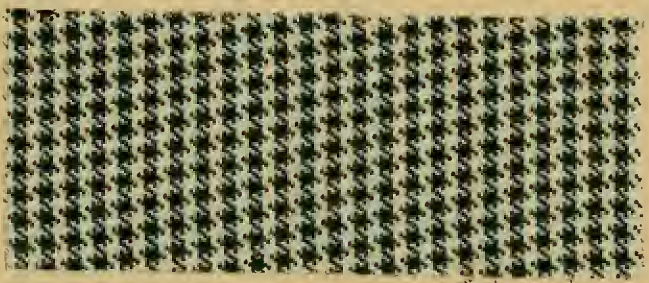
50 parts	**Philochromine B paste,**
800 parts	Senegal gum thickening 1:1,
20 parts	glycerine,
25 parts	formic acid,
15 parts	acetate of chrome 32° Tw.,
90 parts	water,
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — darker; conc. HNO_3 — red brown; conc. HCl — more violet; 10 % $NaOH$ — more violet; 25 % NH_3 — little change; $SnCl_2 + HCl$ orange; 10 % Hydrosulphite NF conc. — light yellow.

ALIZARINE GREEN.

Alizarine Green is the bisulphite compound of the α-Alizarinequinoline, and is put upon the market as a blueish red, crystalline paste or powder. It dissolves easily in water with a red violet colour. The chrome lake is fast to washing, light and chlorine, and is used in steam colour printing either alone for the production of leek green shades, or also in mixtures with other mordant dyestuffs. It is, moreover, used for dyeing on discharged chrome mordants. It is easily destroyed by oxidising agents, and can, consequently, be easily discharged and resisted.

For tables of fastness and discharge effects see page 126.



15 % Alizarine Green S paste

Green Printing Colour:

150 parts	**Alizarine Green S paste,**
650 parts	British gum thickening 1 : 1,
15 parts	water,
30 parts	glycerine,
120 parts	bisulphite of nickel $32^1/_2{}^0$ Tw.,
35 parts	bisulphite of chrome 34^0 Tw.,
1000 parts.	

Reactions upon the Fibre: conc. H_2SO_4 — brown; conc. HNO_3 — yellow; conc. HCl — reddish violet; 10 % HCl — brighter; 10 % NaOH and 25 % NH_3 — little change; $SnCl_2 + HCl$ — red brown; 10 % Hydrosulphite NF conc. — brown.

CERULEINE.

Ceruleines are Phtaleine dyestuffs which are put upon the market as a black powder or paste, insoluble in water. The bisulphite compounds of Ceruleine, like those of Alizarine Blue are soluble. These S brands are sold in powder and in paste form. The olive chrome lake of Ceruleine is very fast to washing and light, and moderately fast to chlorine; it is stable to reducing agents, but easily destroyed by oxidising agents. The S brands of Ceruleine are largely used in steam colour printing and for dyeing upon printed chrome mordants. The brands most important for calico printing are: Ceruleine conc., Ceruleine A paste, Ceruleine S conc., S, SW paste.

For tables of fastness and discharge effects see page 126.

20 % Ceruleine A paste

Green Printing Colour:

200 parts Ceruleine A paste or
27 parts Ceruleine conc., mixed with 173 parts water,
100 parts bisulphite $71\frac{1}{2}$° Tw., allowed to stand for 2 days,
520 parts wheat starch-tragacanth thickening,
50 parts glycerine,
30 parts olive oil,
100 parts acetate of chrome $32\frac{1}{2}$° Tw.,
1000 parts.

Red Pink
Olive Green

Red Printing Colour:

10 % **Alizarine Red 5F paste 20 %.**

Pink Printing Colour:

0,8 % **Alizarine Red No. 1 paste 20 %,**

Olive Printing Colour:

4,5 % **Alizarine Yellow GG paste,**
4 % **Philochromie G paste.**

Green Printing Colour:

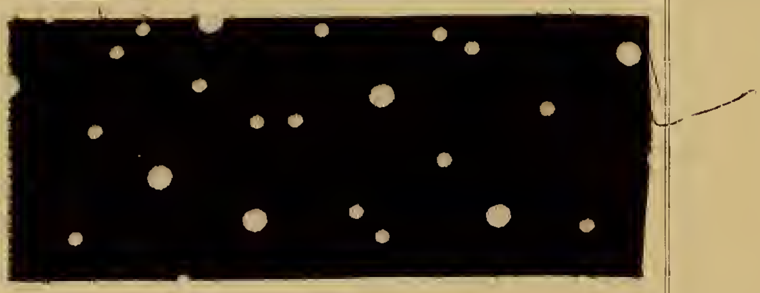
200 parts **Ceruleine SW paste,** or
36 parts **Ceruleine S conc.,**
240 respectively 404 parts water,
400 parts wheat starch-tragacanth thickening,
30 parts glycerine,
30 parts oil.
100 parts acetate of chrome $32\frac{1}{2}$° Tw.,
1000 parts.

Reactions upon the Fibre: conc. H_2SO_4 — brownish black; conc. HNO_3 — red brown; conc. HCl — darker; 10 % $NaOH$ — lighter; 25 % NH_3 — little change; $SnCl_2 + HCl$ — red brown; 10 % Hydrosulphite NF conc. — brown.

ALIZARINE BROWN.

Alizarine Brown or Trioxyanthraquinone is put upon the market as a dark brown paste or as a powder, and is almost insoluble in water, but dissolves easily in alkalies. The brown chrome lake is very fast to washing, light and chlorine. The alumina lake is brighter than the chrome lake, but not as fast. Now and then it is used for dyeing upon printed alumina mordants. Alizarine Brown is easily destroyed by oxidising agents, but is moderately stable to reducing agents. In steam colour printing Alizarine Brown is frequently used as chrome lake by itself and in mixtures with other mordant dyestuffs for the production of dark brown shades. It is also employed for the production of dyed styles upon chrome mordants.

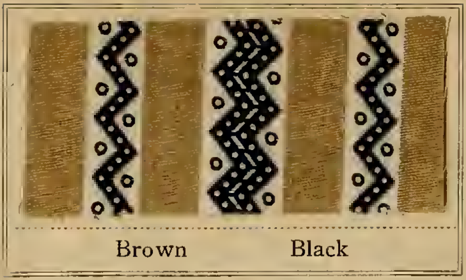
For tables of fastness and discharge effects see page 126.

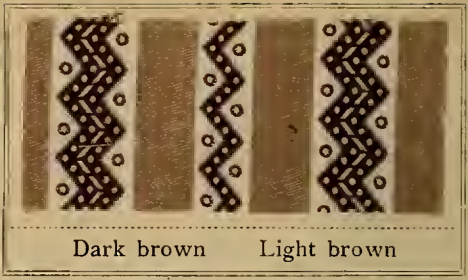


10 % Alizarine Brown paste

Brown Printing Colour:

100 parts	Alizarine Brown paste,
20 parts	borax,
500 parts	wheat starch-tragacanth thickening,
316 parts	water,
64 parts	neutral chrome mordant,
1000 parts.	





Brown Printing Colour:

12	parts **Alizarine Brown paste,**
1,3	parts **Alizarine Orange paste,**
7,5	parts **Alizarine Yellow 5 G powder,**
550	parts wheat starch-tragacanth thickening,
30	parts glycerine,
376,7	parts water,
22,5	parts acetate of chrome $32^1/_2{}^0$ Tw.,
1000	parts.

Dark Brown Printing Colour:

as above.

Light Brown Printing Colour:

Dark Brown Printing Colour, reduced 1 : 5.

Black Printing Colour:

$3^1/_2$ % **Diphenyl Black Base I.**

Reactions upon the Fibre: conc. H_2SO_4 — darker; conc. HNO_3 — orange; conc. HCl — darker; 10 % $NaOH$ — brown black; 25 % NH_3 — little change; $SnCl_2 + HCl$ — brown; 10 % Hydrosulphite NF conc. — little change.

SOLID GREEN.

Solid Green or Dinitrosoresorcine is a yellowish brown paste not easily soluble in cold water, but very easily soluble with a brown colour in alkalies, especially in ammonia. Solid Green is fixed with iron-, chrome- and nickel mordants or with alkaline copper solutions, but it is little used in steam colour printing. The iron lake is darkgreen, the chrome lake is brown. The shades obtained with Solid Green are very fast to washing and light, and fairly fast to chlorine. Solutions with ammonia produce on cotton cloth after steaming brown shades which, in combination with chrome-, nickel- or copper mordants are very fast. Oxidising and reducing agents easily destroy the dyestuffs, and can, therefore, be used for the production of white and coloured styles. In dyeing Solid Green is chiefly used for obtaining a dark green on an iron mordant; in padding it is employed as a steam padding colour, which is often subsequently overprinted with resists (see page 166).

For tables of fastness and discharge effects see page 126.

8 % Solid Green O paste 50 %

5 % Solid Green O paste 50 %

Brown Printing Colour:

80 parts **Solid Green O paste 50 %**,
320 parts water,
50 parts caustic soda 77° Tw.,
dissolve cold, and strain slowly into
500 parts tragacanth (60 : 1000),
50 parts alkaline copper solution,
— (see page 158),
1000 parts.

Green printing Colour:

50 parts **Solid Green O paste 50 %**,
240 parts water,
100 parts ammonia 25 %,
500 parts tragacanth (60 : 1000),
30 parts glycerine,
80 parts yellow prussiate,
1000 parts.

Reactions upon the Fibre (Solid Green with iron): conc. H_2SO_4 — brown; conc. HNO_3 — yellow brown; conc. HCl — more yellow; diluted HCl — little change; 10 % NaOH — darker; 25 % NH_3 — brown black; $SnCl_2 + HCl$ decolorised; 10 % Hydrosulphite NF conc. — decolorised.

ROSAZEINE AND EOSINE DYESTUFFS.

The Phtalic acid dyestuffs designated as Rosazeines, Eosines, Phloxines etc. yield with chrome mordants bright red or pink lakes; their fastness to light and washing is limited, but they are occasionally used as steam colours, on account of their bright shades. These colours can also be resisted with citric acid, tartaric acid and their alkaline salts. The most important brands are illustrated in the table on page 126.

For tables of fastness see page 126.

3 % Eosine extra yellow

30 parts	**Eosine extra yellow,**
245 parts	water,
600 parts	tragacanth (60 : 1000),
35 parts	acetic acid 9° Tw.,
90 parts	acetate of chrome 32½° Tw.,
1000 parts.	

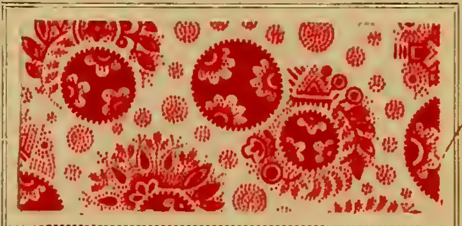
ACID DYESTUFFS.

Acid dyestuffs are very rarely used in steam colour printing, as they possess no fastness whatever to washing. They are only employed where very bright shades are required which are not washed. They are printed with an addition of alumina-mordants, steamed for 1 hour and finished without being washed.

For range of shades and tables of fastness see page 127.

3 % Alkaline Blue 2B

30 parts	**Alkaline Blue 2B,**
170 parts	water,
700 parts	thickening StB,
50 parts	ricinoleic acid,
50 parts	bisulphite of chrome $32^1/_2{}^0$ Tw.,
1000 parts.	



3% Victoria Scarlet 3R

30 parts	**Victoria Scarlet 3R,**
245 parts	water,
600 parts	wheat starch-tragacanth thickening,
125 parts	acetate of alumina 23^0 Tw.,
1000 parts.	

C. PRINTING AND PADDING WITH MORDANTS AND SUBSEQUENT DYEING WITH MORDANT COLOURS.

The mordanting of cotton goods can be effected either by printing or padding. The most important mordants in use are:

1. Alumina mordant,
2. Chrome mordant,
3. Iron mordant.

The preparation and characteristics of the mordants have been minutely described on page 25 ff. These mordants can be mixed in order to obtain intermediate effects.

1. ALUMINA MORDANT.

Printing Colour:

80 parts wheat starch,
40 parts water,
50 parts burnt starch,
800 parts acetate of alumina $10^{1}/_{2}{}^{0}$ Tw.,
15 parts olive oil,
15 parts turpentine,
1000 parts boil, allow to cool, and strain.

If the mordant is required to penetrate well to the back of the fabric, as e. g. for better class shawls (dyed cloths), it is of advantage to use flour- instead of starch thickening, and to facilitate the penetration of the printing colour by means of a gum roller.

Alumina Padding Mordant.

Acetate, sulphate or basic sulphate of alumina 9—12° Tw. are used, and these are sometimes thickened. For thickening burnt starch, leiogomme or tragacanth are used. The addition of small amounts of tin compounds to the printing or padding colour makes the shade yellower and the red produced with Alizarine Red more brilliant. After printing or padding the mordant is fixed by hanging the pieces in the oxidation chamber 97° F. and 90° humidity), whereby any Oxidation Aniline Black which was printed along with the mordant colour is developed. The latter can also be fixed by passing the goods through the Mather-Platt ager and then for a short time through an ammonia box, after which the material is „dunged".

The object of „dunging“ is to fix the mordant and to perfectly get rid of the thickening; care must be taken that the unprinted parts are not soiled by some of the washed off mordant.

The „dunging“ baths generally contain chalk, silicate of soda, phosphate of soda, or sometimes also cow-dung in varying proportions.

Malt likewise, especially in the second „dunging“ bath, offers advantages.

„Dunging“ Bath No. I.

440 gallons	water,
44 lbs	chalk,
176 lbs	cow-dung,
4 lbs 6 oz	phosphate of soda cryst.

The goods are passed open through this bath at 140° F. for 2 minutes and are then well washed. Then follows

„Dunging“ Bath No. II.

110 gallons	water,
4 lbs 6 oz	chalk,
22 lbs	cow-dung.

The goods are worked in this bath in the rope for 20—30 minutes at 122°—140° F. and are then thoroughly washed.

In order to obtain a brilliant red together with a pure white, the following precautions are necessary: The material must be well bleached (to test this, the unprinted parts of the pieces are dyed with some Alizarine, when no uneven marks or cloudy places must become apparent). The mordant must be perfectly fixed by hanging and „dunging“; and the white must be well cleared by washing in clean water.

The goods are then dyed with Alizarine Red, with certain additions to the dyebath, such as tannin, glue, sumach, blood albumen, Turkey red oil etc. which partly increase the depth of the red, partly favourably influence the purity of the white.

The water used for dyeing must, of course, be absolutely free from iron, and not of two great hardness. Water containing very little lime requires additions of lime salts, mostly chalk, to the dyebath. Water of about 6° hardness is well adapted for dyeing Alizarine Red.

In order to obtain a pure white along with a deep red it is indispensable to accurately measure the quantity of Alizarine according to requirement, so that an excess of the dyestuff may not colour the white. By a trial dyeing of a small fent the required quantity of dyestuff can be ascertained. In order to judge the result of the dyeing operation, small tabs of cloth printed with alumina mordant, are sewn onto the pieces to be dyed, and from their appearance the duration of the dyeing operation etc. can be estimated.

The dyebath must be exhausted after dyeing, and no Alizarine reaction must be apparent upon the addition of caustic soda to a small sample of it.

Dyebath for 100 lbs. of material.

7 lbs 8 oz	**Alizarine Red paste 20%,**
12 oz	sumach leaves,
1 lbs 12 oz	glue,
2 lbs 8 oz	Turkey red oil 75% (sulphoricinoleate, half neutralized),
1 lbs	chalk,
200 gallons	water.

The goods are treated ½ hour cold, 20 minutes at 122° F., then the temperature is raised within 20 minutes to 140° F., and within a further 20 minutes to 167° F. The pieces are then well washed, treated for about 10 minutes at 140° F. in a bath containing 4 oz bran per gallon, washed again and dried.

In order to convert the brownish Alizarine lake into the brilliant Turkey red shade, the pieces are oiled with Turkey red oil, dried, steamed, and finally soaped.

Oiling: 8 oz Turkey red oil 50% per gallon water.

To this bath are sometimes added certain quantities of oxalate of ammonia or arseniate of soda, in order to produce a purer white, e. g.

4	gallons	water,
3—4	lbs.	ammonia Turkey red oil 75%,
6	oz	oxalic acid,
¾	gallon	water
—		neutralized with ammonia and made up to
4	gallons.	

Steaming: 1 hour under pressure of 1½ atmospheres.

Soaping: 10 minutes to ½ hour at 140° F. with 2 parts soap, and if necessary, with an addition of ½ part tin crystals per 1000 parts liquid. After soaping the goods are mostly steam-chemicked in order to clear the white.

Suitable for alumina printing and dyeing styles are: Alizarine Orange, Alizarine Red, Alizarine Brown, Alizarine Claret.

For the production of Turkey red, dyed red, black-red and red discharge styles, the so-called New Red process, is employed, in which an oil bottom is given before the alumina mordant.

New Red Process.

The goods are boiled before dyeing with 2—3% soda, washed and dried.

I. Oiling: The goods are padded on the padding machine at 86° F. with a solution of 1 lb. Turkey red oil 50% per gallon in two passages, and dried at 140° F. by hanging for about 12 hours.

II. Mordanting: The oiled and well dried goods are passed once on the padding machine through a bath of acetate of alumina $7^1/_4{}^0$ Tw., and then dried in the same manner as after the oil mordant.

III. Fixing: The goods are passed open and afterwards, if necessary, in the rope at 113^0 F., through a bath containing 10 parts chalk per 1000 parts liquid, and are then thoroughly washed.

IV. Dyeing. The goods are dyed in 30 times the quantity of water; the latter must be corrected, according to its hardness, and to the bath are added:

9 % Alizarine Red paste 20 %,
$1^1{}_2$ % acetate of lime $28^1/_2{}^0$ Tw.,
0,15 % tannin,

or a corresponding amount of sumach.

The material is dyed cold for $^1/_4$ hour, the temperature being then raised to 176^0 F. within $1^1/_4$ hours, and dyed at this temperature for another $^1/_2$ hour. It is then washed, steamed for 2 hours under pressure of $1^1/_2$ atmospheres, soaped for $^1/_2$ hour with 2 parts soap per 1000 parts liquid at 140^0 F., then washed again and dried.

In order to thoroughly dye thick or closely woven fabrics Turkey red, it is advisable to add to the oil mordant bath some Alizarine dissolved in ammonia.

2. CHROME MORDANT.

Chrome mordant GAII for dark shades.

200 parts	Chrome mordant GAII 64^0 Tw.,
30 parts	glycerine,
770 parts	water,
1000 parts.	

The white, bleached material is impregnated with the chrome mordant on a two roller padding machine, dried in the hotflue, aged for 1—2 minutes in the Mather-Platt, then passed open through a 3 % solution of soda at 140—176^0 F., well washed and dyed. It is to be noted that goods impregnated with chrome mordant GAII should not be exposed to light, as this mordant is rather sensitive to it.

An easily fixable chrome mordant is the so-called alkaline chrome mordant of Horace Koechlin (see page 36).

The goods are padded with this mordant, rolled, left to lie for some hours, well washed, and are then ready for dyeing. They are usually dyed cold for 20 minutes in a bath containing some acetic acid, then the temperature is raised within 1 hour to the boil and the pieces worked for 20 minutes at this temperature, until the colour is completely exhausted. The same method may be pursued with the alkaline chrome mordant of Henri Schmid (see page 36).

Besides the abovenamed mordants bisulphite of chrome is also used.

The goods are padded with bisulphite of chrome on a two roller padding machine, rolled, then left to lie for 2 hours, dried, aged in the Mather-Platt, passed through soda and washed.

For dyed styles upon printed chrome mordant the following colours are suitable:

Alizarine Yellow 5G, GG, R, KR,
Calico Yellow O,
Alizarine Orange, all brands,
Alizarine Red, all brands except the "S" brands,
Alizarine Claret R,
Alizarine Brown, all brands,
Alizarine Blue, all brands,
Alizarine Green, S powder and paste,
Ceruleine, all the "S" (bisulphite) brands,
Galleine, all brands,
Philochromine B and G paste,
Chromoglaucine, all brands,
Solid Green O paste 50 %.

3. IRON MORDANT.

The most generally employed Iron mordants are ferrous compounds which are converted on the fibre into ferric oxides either by oxidation in the air, or by steaming. It is to be remarked that very concentrated iron mordants are liable to injure the fibre during the oxidation. For this reason, and also in order to effect a better fixation of the iron oxide, the employment of ferrous acetates is advisable.

The iron mordant most frequently used is pyrolignite of iron, either by itself or in conjunction with alumina or chrome mordants. Sometimes small quantities of arsenic compounds, such as arsenic-glycerine, or also chloride of ammonia etc. are added to it.

The following colours are suitable for dyeing upon iron mordants:

Alizarine Red, all brands exept the "S" brands,
Solid Green O paste 50 %.

Iron mordant dyed with Solid Green O paste 50 %.

300 parts pyrolignite of iron 21° Tw. (see page 38),
450 parts water,
130 parts acetic acid 9° Tw.,
100 parts acid starch paste,
20 parts chloride of ammonia,
1000 parts.

The well bleached material is padded with the iron mordant, dried in the hotflue, hung in the oxidation chamber for 24 hours at 90° F. and 82° humidity (or passed through the Mather-Platt ager) and treated for 3 minutes at 140° F. in a bath containing 2 parts phosphate of soda and 30 parts chalk per 1000 parts. It is then well washed, and finally dyed with 6—10% Solid Green O paste 50%. It is best to use water free from lime for dyeing, and to heat the bath, without the addition of acid, to the boil within 1 hour, and then to boil for $^{1}/_{2}$ hour. After dyeing the material is washed and, if necessary, soaped.

Printing Colour for Dyed Alizarine Lilac styles.

350 parts British gum powder,
570 parts water,
50 parts glycerine, boil, cool and add
30 parts pyrolignite of iron $21^{1}/_{4}$° Tw.,
1000 parts.

After printing the goods are hung in a warm, damp drying chamber, or steamed for 3 minutes in the Mather-Platt ager, fixed with phosphate of soda and chalk and finally dyed with Alizarine Red. The Violet produced upon iron mordant by means of Alizarine Red „blue shade", can be embellished by the addition of Methyl Violet to the dye bath. In this case a small addition of tannic acid in the form of sumach or as tannin has the effect of fixing the Methyl Violet better and of improving the fastness to light.

The operations for obtaining a pure white by treating the goods with bran, soaping and chemicking, are the same as described for Alizarine Red.

Alumina-Iron Mordant.

870 parts acetate of alumina 9° Tw.,
100 parts pyrolignite of iron 15° Tw.,
30 parts glycerine,
1000 parts.

This alumina-iron mordant is used for the production of dark brown shades by means of Alizarine by itself or in conjunction with sumach, fustic and logwood.

Chrome-Iron Mordant.

80 parts Chrome Mordant GAII 64° Tw.,
120 parts pyrolignite of iron 15° Tw.,
30 parts glycerine, and made up with water to
1000 parts.

The above is used for the production of dark brown shades with Alizarine Brown, and for the production of very dark blue shades with Alizarine Blue.

The padded goods are treated exactly as described for alumina and chrome mordants.

4. STEAM PADDING COLOURS WITH MORDANT DYESTUFFS.

a) Colours fixed subsequently with mordants.

(Erban-Specht's or two-baths process.)

The Alizarine dyestuffs are dissolved in water free from lime by means of Ammonia or Dissolving Ether MLB, then diluted and mixed with neutral Turkey red oil. The easily soluble mordant colours, however, such as Alizarine Blue S, Philochromine, Chromoglaucine etc., require no special solvent. The well bleached cotton is impregnated with this liquid, dried at 122—140° F., and then passed trough a second bath containing the required mordants (acetate of alumina, chrome, iron or lime). The material is wrung evenly, then either dried first, or immediately steamed in the moist state for 1—2 hours with or without pressure, and finally soaped and cleared.

The following colours are suitable for this operation:

Alizarine Yellow 5 G, G G paste, K R,
Calico Yellow O,
Alizarine Orange,
Alizarine Red, all brands,
Alizarine Claret R paste,
Alizarine Brown,
Solid Green O 50 %,
Ceruleine paste A,
Alizarine Blue, all brands,
Alizarine Green S paste,
Philochromine B and G paste,
Chromoglaucine all brands.

1. Pink on Piece Goods.

By the following method very even and solid pink shades of great beauty are obtained.

Alizarine solution: 100 parts Alizarine Red paste 20 %,
1300 parts water free from lime,
200 parts ammonia 25 %.

I. Bath	1.	2.	3.	4.	5.
Water free from lime	8 675 parts	8 550 parts	8 300 parts	7 800 parts	7 300 parts
Neutral Turkey red oil 80 % solution 1:4	1 200 parts	1 200 parts	1 200 parts	1 200 parts	1 200 parts
Alizarine solution	125 parts	250 parts	500 parts	1 000 parts	1 500 parts
	10000 parts	10000 parts	10000 parts	10000 parts	10000 parts
II. Bath					
Water	10000 parts	10000 parts	10000 parts	10000 parts	10000 parts
Acetic acid 9° Tw.	25 „	25 „	25 „	25 „	25 parts
Basic sulpho acetate of alumina 18° Tw.	13,5 „	27 „	54 „	108 „	162 parts
Acetate of lime 28° Tw.	2,35 „	4,75 „	9,5 „	19 „	28,5 „

III. Clearing
10000 parts water
5 parts soda
1 part tin cryst.
5 parts soap
} steamed for 2 hours under pressure of 2 atmospheres.

If acetate of iron is used as a mordant, violet shades are obtained.

2. Alizarine Pad Red on Cotton Goods.

The boiled or bleached goods are passed cold on the padding machine through the following padding bath:

2000 parts Alizarine Red paste 20 %,
6250 parts water free from lime,
470 parts ammonia 25 %,
1280 parts Turkey red oil 80 %,
10000 parts.

After being dried in the hotflue, the pieces are passed cold through the following mordant:

8500 parts water,
1000 parts acetate of alumina 15° Tw.,
500 parts acetate of lime 28° Tw.,
10000 parts.

The goods are then dried again and steamed: for 1 hour without pressure, $^1/_2$ hour under pressure of 1 atmosphere, and for another $^1/_2$ hour under pressure of 2 atmospheres. They are then washed, soaped at the boil for $^1/_4$ hour (2 lbs. soap per 10 gallons water), washed again and cleared for 2—6 hours under pressure of 2 atmospheres, with

10 gallons water,
1 oz soap, 1 oz soda crystals, $^1/_6$—$^1/_4$ oz tin cryst.

For heavier cloths (Moleskins, Flanellettes etc.) the baths are diluted with $^1/_4$—$^1/_2$ of their volume of water. Instead of the usual ammonia or sodium Turkey red oil the Monooxy acid of Schmitz in Heerdt or castor oil soap may be employed.

3. Fancy Shades.

The goods are padded in the first bath (Alizarine solution), dried at 140° F. and then passed through the second bath, dried again, and the colours developed by steaming for 1—2 hours without pressure. Dissolving Ether (especially recommended for dark shades), is an excellent alkaline solvent of mordant dyestuffs.

The Colour solutions are made up as follows:

for light shades:		for dark shades:	
50 parts	dyestuff made into a paste with	800 parts	dyestuff are made into a paste with
450 parts	water,	8200 parts	water free from lime,
8750 parts	water free from lime,	300 parts	ammonia 25 %,
250 parts	ammonia 25 % 1:10,	300 parts	Dissolving Ether MLB,
500 parts	Turkey red oil 80° 1:4,	400 parts	Turkey red oil 80 %,
10000 parts.		10000 parts.	

When using Alizarine Brown and Ceruleine it is advisable to filter the solutions. For Solid Green O less dyestuff and correspondingly more water is required, e. g. for dark shades 320 parts dyestuff and 8680 parts water.

The Mordant solutions are made up as follows:

Alumina Mordant:

for light shades:

9395 parts water,
380 parts acetic acid 9° Tw.,
175 parts acetate of alumina 15° Tw.,
50 parts acetate of lime $28^1/_2$° Tw.,
10000 parts.

for dark shades:

7750 parts water,
1750 parts acetate of alumina 15° Tw.,
500 parts acetate of lime $28^1/_2$° Tw.,
10000 parts.

Chrome Mordant.

9508 parts water,
380 parts acetic acid 9° Tw. 1:10,
87 parts acetate of chrome $32^1/_2$° Tw.,
25 parts acetate of lime $28^1/_2$° Tw.,
10000 parts.

8875 parts water,
875 parts acetate of chrome $32^1/_2$° Tw.,
250 parts acetate of lime $28^1/_2$° Tw.,
10000 parts.

Iron Mordant (for Alizarine Lilac).

9345 parts water,
380 parts acetic acid 9° Tw. 1:10,
250 parts acetate of iron 15° Tw.,
25 parts acetate of lime $28^1/_2$° Tw.,
10000 parts.

b) Colours fixed simultaneously with mordants

(one-bath process).

The padding liquid contains, in addition to the mordant dyestuffs, the mordant required for fixing. In order to obtain even shades, certain solvents, such as alkalies, borax, glycerine, Turkey red oil, Dissolving Ether etc., are mostly added to the padding liquid.

The goods are padded on the padding machine, dried in the hotflue, steamed for 1 hour without pressure, then washed and soaped.

The following are recipes for padding liquids:

Drab:

30 parts **Calico Yellow O**,
21 parts **Alizarine Red No. 1 paste 20 %**,
3,5 parts **Alizarine Green S paste**,
850 parts water,
22 parts borax,
100 parts acetate of chrome $32^1/_2$° Tw., made up to
1000 parts.

Fraise (strawberry):

60 parts **Alizarine Red No. 1 paste 20 %**,
20 parts ammonia 25 %,
25 parts glycerine,
50 parts tragacanth (60 : 1000),
815 parts water,
30 parts acetate of chrome $32^1/_2$° Tw.,
1000 parts.

Dark Blue:

125 parts	**Chromoglaucine BMI** solution,
20 parts	**Chromoglaucine VM** paste,
593 parts	water,
2 parts	Hydrosulphite NF conc.,
50 parts	tragacanth (60:1000),
15 parts	formic acid,
15 parts	glycerine,
100 parts	water,
80 parts	acetate of chrome $32^1/_2{}^0$ Tw.,
1000 parts.	

Light Blue:

60 parts	**Philochromine G** paste,
925 parts	water,
15 parts	acetate of chrome $32^1/_2{}^0$ Tw.,
1000 parts.	

Solid Green Bister.

Alkaline Solid Green solutions, padded and steamed on cotton cloth, produce bister shades which can be shaded with Alizarine dyestuffs in combination with acetate of chrome.

Borax, ammonia and caustic soda are suitable solvents for Solid Green. For light and medium shades borax acts as a sufficiently strong dissolving agent; dark shades require the addition of ammonia or caustic soda. To these solutions may be added Alizarine dyestuffs and, for fixing purposes, also acetate of chrome. The addition of alkaline solution of copper greatly increases the fastness to light.

Padding Baths.

I.

120 parts	**Solid Green O** 50 % made into a paste with
2000 parts	water, mixed into,
150 parts	borax,
2000 parts	water, then added
50 parts	Turkey red oil 50 %,
2000 parts	water, and
150 parts	acetate of chrome $32^1/_2{}^0$ Tw.,
2000 parts	water, made up to
10000 parts.	

II. (shaded).

80 parts	**Solid Green O** paste 50 %,
28 parts	caustic soda $71^1/_2{}^0$ Tw.,
2000 parts	water,
40 parts	**Ceruleine** conc.,
56 parts	caustic soda $71^1/_2{}^0$ Tw.,
2000 parts	hot water,
35 parts	Turkey red oil 50 %,
1000 parts	water,
170 parts	acetate of chrome $32^1/_2{}^0$ Tw.,
1000 parts	water,
150 parts	alkaline copper solution,
1000 parts	water, made up to
10000 parts.	

III.

120 parts **Solid Green O paste 50 %**,
2000 parts water,
150 parts borax,
2000 parts water,
50 parts Turkey red oil,
1000 parts water,
150 parts acetate of chrome 32½° Tw.,
2000 parts water,
150 parts alkaline copper solution,
2000 parts water, made up to
10 000 parts.

IV.

800 parts **Solid Green O paste 50 %**,
2000 parts water,
450 parts borax,
2000 parts water,
500 parts ammonia,
50 parts Turkey red oil,
2000 parts water,
150 parts alkaline copper solution,
2000 parts water, made up to
10000 parts.

Alkaline Copper Solution.

1000 parts chloride of copper 76° Tw.,
500 parts tartaric acid,
1200 parts caustic soda 76° Tw.,
400 parts glycerine.

Eosine padded with chrome mordants.

The Phtalic acid dyestuffs can be fixed tolerably fast with chrome mordants.

The bleached cotton cloth is padded with the padding colours, dried, steamed for one hour without pressure, washed and slightly soaped.

Padding Liquid.

3 parts **Eosine**,
100 parts water,
100 parts gum solution 1:1,
750 parts water,
30 parts acetate of chrome 32½° Tw., made up to
10000 parts.

In the same manner all Eosines, Phloxines, Rose Bengale etc. can be padded.

D. RESISTING AND DISCHARGING MORDANT OOLOURS.

The oxides of mordants produce, in combination with certain non-volatile organic acids, salt-like compounds which behave in a perfectly inert manner towards mordant dyestuffs. This reaction is largely utilized in calico printing for resisting and discharging mordant dyestuffs.

1. RESISTS UNDER STEAM MORDANT COLOURS.

Suitable resisting agents are: tartaric acid, citric acid, oxalic acid and their alkali salts, as also oxalate of antimony which, at the same time, can be used for resisting tannin dyestuffs.

The resists are printed by themselves or next to Alizarine colours on cloth prepared with Turkey red oil, then printed over with Alizarine colours; afterwards steamed for 1—$1^1/_2$ hours without pressure, passed through chalk, washed and soaped.

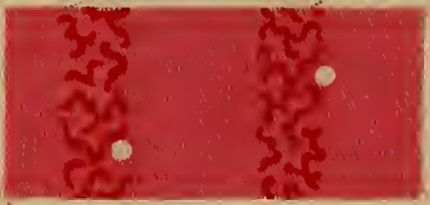
White Resist Z for Steam Alizarine Pink and -Violet.

300 parts	British gum powder,
600 parts	water,
30 parts	citric acid,
50 parts	china clay,
20 parts	citrate of soda 48° Tw.,
1000 parts.	

Chrome dyestuffs which are easily destroyed by oxidising agents can be resisted by means of colours containing chlorates. Very good effects can be produced: if, e. g., the following resist is printed by itself or next to Black and Alizarine colours, and then printed over with dyestuffs easily dischargeable with chlorate, such as Chromoglaucine or Philochromine.

Oxidising Resist C.

650 parts	British gum thickening 1 : 1,
200 parts	china clay paste 1 : 1,
50 parts	citrate of soda $52^1/_2$° Tw.,
50 parts	chlorate of soda,
10 parts	red prussiate,
40 parts	water,
1000 parts.	



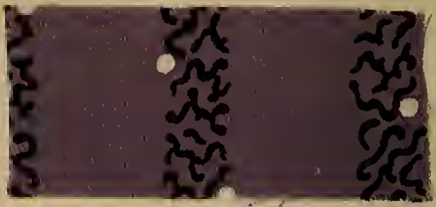
White Resist Z Red
Pad Colour: Pink

Red Printing Colour:
10 % **Alizarine Red D5F paste 20 %**,

Pink Printing Colour:

20 parts	**Alizarine DIB new paste 20 %**,
700 parts	gum solution 1 : 1.
86 parts	water,
80 parts	acetic acid 9° Tw.,
30 parts	glycerine,
20 parts	nitroacetate of alumina 18° Tw.,
14 parts	acetate of lime 28½ Tw.,
50 parts	tartaric acid solution 1 : 10,
1000 parts.	

Printed on oiled cloth.



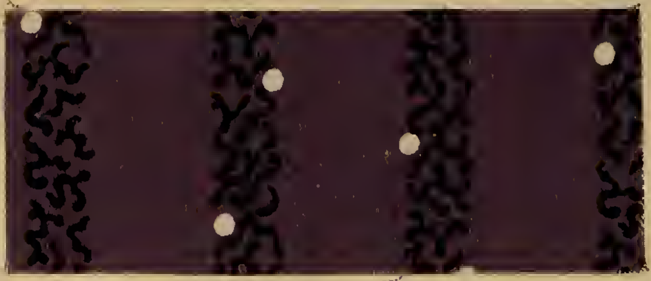
White Resist Z Dark Lilac
Pad Colour: Light Lilac

Dark Lilac Printing Colour:
10 % **Alizarine Red N. 1 paste 10 %**.

Light Lilac Printig Colour:

20 parts	**Alizarine Red DIB new paste 20 %**,
126 parts	water,
700 parts	gum solution 1 : 1,
80 parts	acetic acid 9° Tw.
20 parts	acetate of lime 28½° Tw.,
4 parts	yellow prussiate,
50 parts	water,
1000 parts.	

Printed on unoiled cloth.



Oxidising resist C Dark Violet
Pad Colour: Light Violet

Dark Violet Printing Colour: 5 % **Chromoglaucine VM paste**
Light Violet Printing Colour: 1 % **Chromoglaucine VM paste**

2. DISCHARGING MORDANTS BY MEANS OF ORGANIC ACIDS AND SUBSEQUENT DYEING.

a) White discharge for alumina mordants.

In order to produce discharge effects on an alumina mordant, the cloth is first padded in the alumina mordant, described on page 148, dried and is then printed with the discharge white, either alone or next to Oxidation Aniline Black; the mordant is then fixed, as described on page 148, by hanging or ageing and „dunging". The further treatment resembles that described on page 149.

The discharge white consists chiefly of citric acid or tartaric acid, either alone or mixed with their alkaline salts, china clay, and sometimes bisulphate.

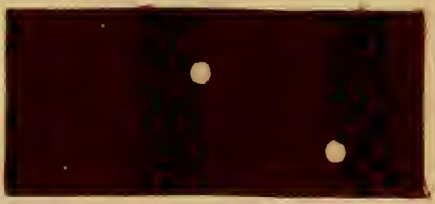
Discharge White ZN.

150 parts china clay 1 : 1,
150 parts citric acid,
100 parts citrate of soda $52^{1}/_{2}{}^{0}$ Tw.,
600 parts gum solution 1 : 1,
1000 parts.

Colours suitable for dyeing discharged alumina-mordants are:

Alizarine Orange, all brands,
Alizarine Red, all brands except the „S" brands.
Alizarine Claret paste,
Alizarine Brown paste.

Alumina mordant 6° Tw. Discharge White ZN 5% Diphenyl Black Oil DO
Dyebath: 6% Alizarine Red No. 1 paste 20%
3% Alizarine Red 5F paste 20%



Alumina mordant 6° Tw.
Discharge White ZN, Steam Aniline Black
Dyebath: 9% Alizarine Brown paste
1% Alizarine Red DIB new paste 20%

b) White Discharge for Chrome mordants:

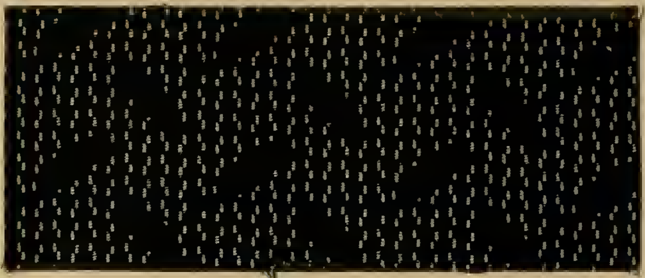
For discharging the chrome mordant described on page 151 the following discharge white is used:

Discharge White Z.

100 parts china clay 1 : 1,
150—200 parts citric acid or tartaric acid,
750—700 parts gum solution 1 : 1,
1000 parts.

After printing the goods are steamed for 5 minutes, then passed through soda (30 parts per 1000 parts), at 122° F., well washed and dyed.

For dyeing discharged chrome mordants, the colours mentioned on page 152 are used.



Chrome mordant GAII Discharge White Z
Dyebath: 12% Ceruleine SW paste

Very fine effects can be produced by padding the bleached material twice with a weak chrome mordant and then passing without drying on the padding machine through a 3% soda solution at 140—176° F. The material is then well washed and dried. Upon these slightly chrome mordanted goods discharge white and dark chrome printing pastes are printed; they are then steamed for an hour with slight pressure and thoroughly washed.

Discharge White ZW:

800 parts gum solution 1:1,
181 parts water,
10 parts citric acid,
9 parts tartaric acid,
1000 parts.

Light Chrome mordant:

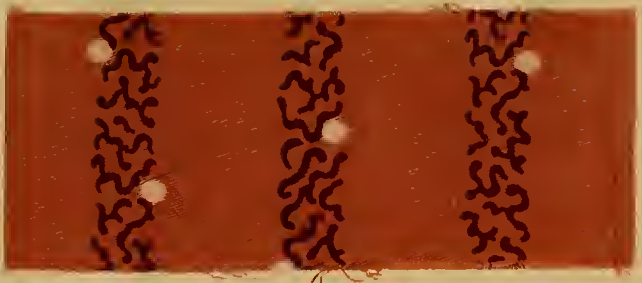
80—120 parts Chrome Mordant GAII 64° Tw.,
920—880 parts water,
1000 parts.

Dark Chrome Printing paste:

700 parts thickening TN,
300 parts acetate of chrome $32^1/_4$° Tw.,
1000 parts.

Dyebath.

The dyebath for 100 lbs material is prepared with 3 lbs Alizarine Orange paste and the 50 fold quantity of water. The goods are dyed cold for $^1/_4$ hour in a weak acetic acid bath; then the temperature is raised to the boil within $^3/_4$ hours, and kept at the boil till the shade is completely developed. Finally the goods are washed, soaped and chemicked in the usual manner.



Light Chrome mordant. Discharge White ZW
Dark Chrome Printing paste
Dyebath: 3 % Alizarine Orange paste

c) White Discharge for Iron-Mordants.

The material mordanted with the iron mordant described on page 152 is printed with the same discharge white that is suitable for the alumina padding mordant, and which may be made rather stronger, if necessary. It is fixed in the manner described above, and dyed with Solid Green O paste 50 % or with Alizarine Colours.

Iron mordant for Solid Green
(see page 152)
Discharge White ZN.
Dyebath: 6 % Solid Green O paste 50 %

Printing Colour for Alizarine Lilac
(see page 153). Discharge White ZN
5½ % Diphenyl Black Oil DO
Dyebath: 3 % Alizarine Red No. 1
paste 20 % 0,2 % Methyl Violet BB

d) White Discharge for Alumina-Iron Mordants.

The material is padded in the alumina-iron mordant described on page 153, printed with the white used for discharging alumina mordants, and further treated in the same manner as stated for the alumina mordanted material.

For dyeing the Alizarine Red blue shade brands are chiefly employed.

Alumina-Iron Mordant (see page 153). Discharge White ZN
Dyebath:
9% Alizarine Red No. 1 paste 20%, 1% Alizarine Orange paste

3. DISCHARGING THE STEAM PADDING COLOURS PREPARED WITH MORDANT DYESTUFFS.

The steam padding effects produced, according to the one- or two-baths method, with Alizarine Colours, are discharged by means of organic acids or their alkaline salts, with oxalate of antimony, or, with oxidising discharges.

The discharge made with oxalate of antimony can, at the same time, serve for resisting tannin colours.

The oxidising discharges are especially employed for Alizarine chrome padding colours.

The strength of the discharges used is regulated by the depth of the dyed shades.

The discharges are printed on the padded material, which is then steamed, either in the Mather-Platt or in a closed steam-box, washed, soaped and chemicked in the manner usually employed for Alizarine Colours.

Discharge White I.

800 parts gum solution 1:1,
100 parts tartaric acid,
100 parts citric acid,
1000 parts.

Discharge White II.

700 parts British gum thickening 1:1,
200 parts caustic soda $71\frac{1}{2}$° Tw.,
100 parts citric acid,
1000 parts.

Reduced as required from 1:1 to 1:4.

Discharge White III.

850 parts gum solution 1:1,
150 parts oxalate of antimony,
1000 parts.

Discharge White IV.

840 parts gum solution 1:1,
120 parts oxalate of antimony,
40 parts tartaric acid,
1000 parts.

Besides the chlorate discharges given on pages 112 and 113, the following discharge prepared with Discharge Salt I and II can be used:

Discharge White B.

400 parts gum solution 1:1,
120 parts sodium chlorate,
408 parts Discharge Salt I (MLB),
72 parts Discharge Salt II (MLB),
1000 parts.

Discharge Salt II ist sodium bromide bromate.

Fine effects can also be obtained by first printing on the padded material a resist, consisting of sodium acetate, then printing a cover with a chlorate discharge, and finally steaming, washing and soaping the goods.

Resist A.

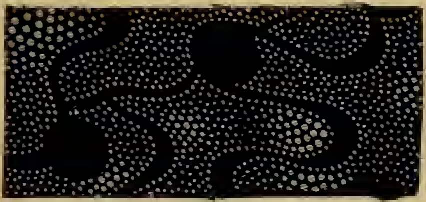
300 parts sodium acetate,
500 parts tragacanth (60:1000),
200 parts water,
1000 parts.

Chlorate Discharge I.

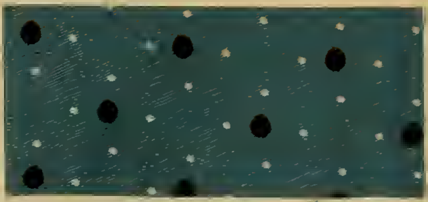
75 parts china clay made into a paste with
A 75 parts water,
200 parts gum solution 1:2,
140 parts sodium chlorate,
100 parts powdered tartaric acid,
B 50 parts water,
100 parts gum solution 1:2,
16 parts powdered yellow prussiate,
44 parts water,
200 parts gum solution 1:2,
1000 parts.

Chlorate Discharge II.

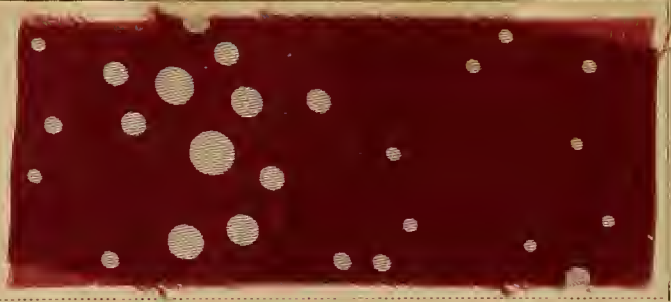
375 parts wheat starch tragacanth thickening,
200 parts sodium chlorate,
200 parts china clay 1:1,
50 parts yellow prussiate,
100 parts citric acid,
75 parts water,
1000 parts.



Dark Blue Colour (see page 157).
Resist A. Chlorate discharge I
reduced 3:2



Light Blue Colour (see page 157).
Chlorate discharge II reduced 1:1
Logwood Black



Strawberry Colour (see page 156). Chlorate discharge III (see page 113).

Steam padding colours prepared with Solid Green O are discharged with sulphite discharges. The discharges are printed on the Solid Green padded material, steamed for 1 hour without pressure, well washed and soaped.

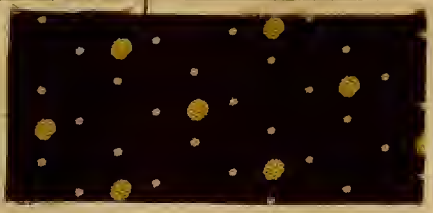
For coloured resists, direct dyeing colours, or chrome lakes of mordant colours, such as Alizarine Blue SB and Ceruleine S, are suitable.

Discharge White S.

80 parts	china clay are made into a paste with
80 parts	water,
440 parts	sulphite of potassium 91° Tw.,
80 parts	bisulphite of soda 64° Tw.
	stirred into
200 parts	British gum powder,
120 parts	citrate of soda $52^1/_2$° Tw.,
1000 parts.	

Coloured Discharges for Solid Green Bister.

	Discharge Yellow S	Discharge Blue S	Discharge Green S
Aurophenine O	30 parts	—	—
Dianil Blue H6G	—	20 parts	9 parts
Dianil Yellow 3G	—	—	20 parts
Water	425 parts	435 parts	426 parts
British gum powder	260 parts	260 parts	260 parts
Sulphite of potassium 91° Tw.	250 parts	250 parts	250 parts
Bisulphite of soda 64° Tw.	35 parts	35 parts	35 parts
	1000 parts	1000 parts	1000 parts



Solid Green O paste 50%
(Padding bath IV see page 158)
Discharge White S. Discharge Yellow S

Solid Green O paste 50%
(Padding bath IV see page 158).
Discharge White S. Discharge Blue S.

4. DISCHARGING DYED MORDANT COLOURS.

a) Discharging Turkey Red by means of Chloride of Lime.

The dyed material is printed with thickened organic acids, e. g. citric acid, or with arsenic acid by itself for discharge white; or with citric acids and lead salts for discharge yellow; or with tartaric acid and a solution of Prussian Blue in oxalic acid for discharge blue. By mixing discharge blue with discharge yellow, discharge green is obtained. After printing the goods are passed through a roller cistern, of several compartments, the first of these contains a strong solution of chloride of lime (100 parts to 1000 parts water), and the others water. After the passage through chloride of lime, which effects the discharge, the yellow and green are developed in a tepid weak chrome bath. Instead of citric, tartaric or oxalic acid, lactic acid may be used with advantage.

Half discharge C. Dyebath: 9% Alizarine Red No. 1 paste 20% and 1% Alizarine Red RX paste 20%. Cover: Discharge Yellow C.

The oiled and mordanted goods are printed with the Half Discharge C, hung for 24 hours in the oxidation chamber, then passed open through a chalk bath, washed and dyed. After dyeing they are cleared, washed, dried and printed with Discharge Yellow C. Then the goods are passed through a strong solution of chloride of lime, thoroughly washed and finally chromed in order to develop the yellow, then washed again.

Half Discharge C.

150 parts starch,
780 parts water,
50 parts tartaric acid,
20 parts oxalic acid,
1000 parts.

Discharge Yellow C.

150 parts British gum powder,
150 parts dextrine solution (300 parts per 1000 parts water),
290 parts tartaric acid,
170 parts nitrate of lead,
240 parts water,
1000 parts.

b) Discharging Turkey Red by the Glucose-Alkali Process.

This process, founded upon the Schlieper-Baum discharge styles (Indigo prints on Turkey red) is carried out as follows:

The goods dyed with Turkey red are prepared with a strong glucose solution, and quickly dried.

After that they are printed with strong alkaline printing pastes.

Discharge White ZT I.

100 parts tin crystals are added, at a temperature not exceeding 95° F. to,
700 parts alkaline thickening, then
200 parts silicate of soda 71—77° Tw. are added and made up to
1000 parts.

Discharge White ZT II.

55 parts tin crystals,
35 parts sulphate of zinc,
75 parts glycerine,
$157^1/_2$ parts gum solution 1:4,
535 parts caustic soda 106° Tw.,
125 parts silicate of soda $52^1/_2$° Tw.,
15 parts turpentine,
$2^1/_2$ parts Indigo MLB paste 20 %,
1000 parts.

Discharge Yellow ZT.

600 parts alkaline thickening ZT,
20 parts water,
300 parts lead hydrate paste 50 %,
80 parts silicate of soda $76^1/_2$° Tw.,
1000 parts.

Discharge Green ZT.

800 parts Discharge Yellow ZT without silicate solution,
100 parts Discharge White ZT II,
100 parts Indigo MLB paste 20 %,
1000 parts.

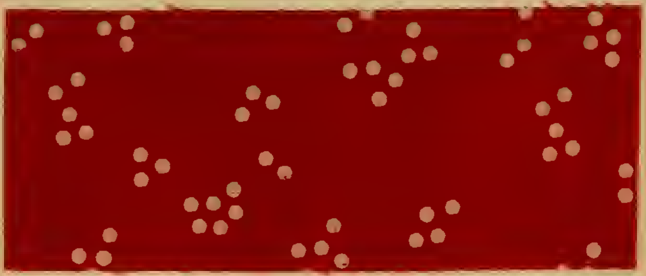
Discharge Blue.

180 parts gum solution 1:4,
550 parts caustic soda 106° Tw.,
20 parts starch,
40 parts water,
35 parts glycerine,
15 parts turpentine,
160 parts Indigo MLB paste 20 %,
1000 parts.

Alkaline Thickening ZT.

165 parts yellow dextrine,
835 parts caustic soda 106° Tw.,
1000 parts.

After printing the goods are thoroughly dried, and immediately steamed for 2—3 minutes in the Mather-Platt ager, with very powerful steam. The steamed goods are then passed through a bath of silicate of soda (20 parts per 1000 parts of water) at the boil, washed, and chromed in an acidified bath of potassium bichromate, finally well washed and dried. In order to simplify the process, the previous preparation of the goods with glucose may be dispensed with. In that case the glucose is added to the discharge colours. These discharge colours, however, are only stable for a short time.



Discharge White ZT I

Discharge White ZT II. Discharge Yellow ZT. Discharge Blue ZT.
Discharge Green ZT. Steam Aniline Black.

c) Discharging Turkey Red by means of Hydrosulphite and Caustic Soda.

This method is principally used for the production of the so-called "Blue-Red" styles by printing Indigo in combination with caustic soda and Hydrosulphite NF conc. The goods dyed with Turkey red are printed with the Indigo printing colour prepared as follows, aged for 2—3 minutes in the Mather-Platt, well washed in running water, in order to re-oxidise the Indigo, and finally soaped.

Indigo Z

75 parts Hydrosulphite NF conc. are dissolved in
125 parts water, the cooled solution added in several portions to
450 parts alkaline thickening, then
{ 150 parts Indigo MLB paste 20 %, which have been stirred into
{ 200 parts cold alkaline British gum thickening are added
1000 parts.

Indigo Z

d) Discharging dyed Mordant Colours by means of Chlorate Discharges.

Alizarine Colours dyed upon chrome mordanted material are printed with one of the chlorate discharges described on page 113, steamed for 1—3 minutes in the Mather-Platt, then passed through a chalk bath, washed and soaped.

The following colours are discharged by chlorates:

Alizarine Orange, all brands,
Alizarine Red, all brands (exept the "S" brands),
Alizarine Claret R paste,
Alizarine Brown, all brands,
Alizarine Blue, all brands in powder and paste,
Alizarine Green S, powder and paste,
Chromoglaucine, all brands,

Galleine, all brands,
Philochromine B and G paste,
Ceruleine, all brands,
Solid Green O paste 50 %.

10 % Alizarine Blue F paste. Chlorate Discharge III
(see page 113)

III.

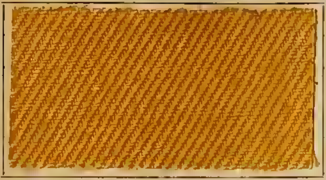
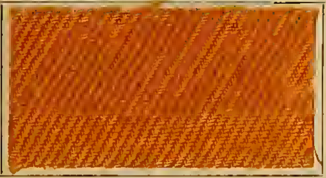
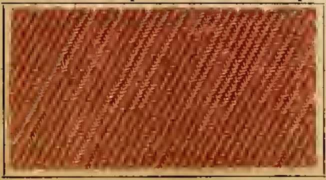
DIRECT DYEING COLOURS.

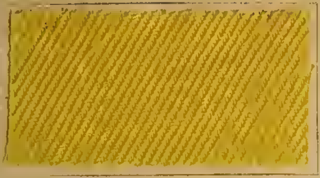
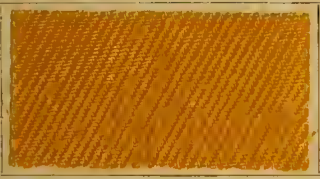
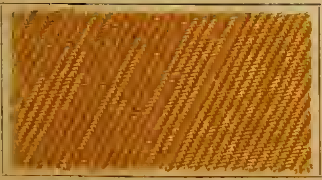
The Direct Dyeing or Dianil Colours are mostly Azo derivatives of certain Paradiamines; they possess great affinity for the vegetable fibre, with which they form, in dyeing, very fast compounds, without the assistance of mordants. Other Dianil dyestuffs, however, owe their capability of dyeing the vegetable fibre direct to certain characteristic constituents in their molecule.

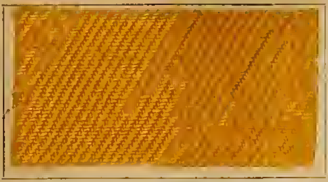
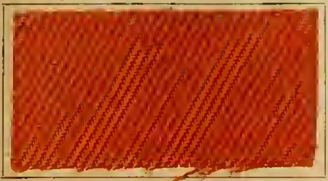
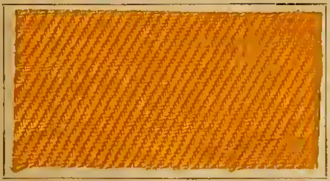
Salts with alkaline reaction, e. g. soda, phosphate of soda, soap, Turkey red oil etc., by increasing the solubility of the dyestuffs, act as auxiliaries in dyeing with Dianil dyestuffs. On the other hand neutral salts e. g. Glauber's salt or common salt, facilitate by "salting out" the transfer of the Dianil dyestuffs to the fibre. The dyed effects of certain Dianil Colours can be considerably improved by suitable aftertreatments. The following tables illustrate the direct and aftertreated shades of Dianil dyestuffs on cotton material, as also their degrees of fastness and dischargeability. In consequence of their easy application, the variety of obtainable shades, and, in most cases, their great dischargeability these dyestuffs have found very extensive use in printing.

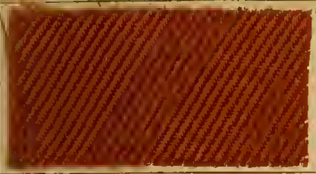
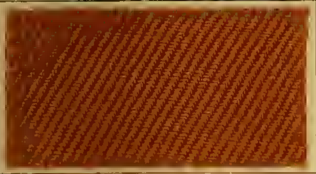
A. SYSTEMATIC TABLES OF THE DIRECT DYEING COLOURS.

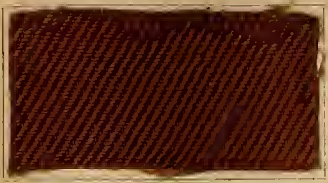
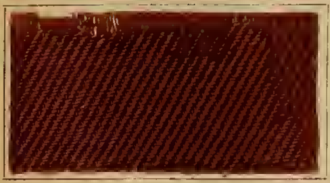
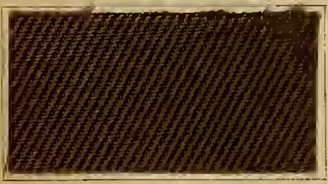
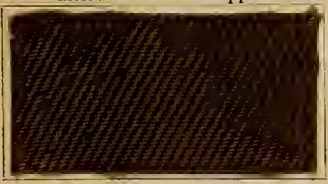
FOR EXPLANATION OF THE FIGURES SEE PAGE 60.

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Primuline O 	5	5—4	5	5	5	becomes orange yellow	2—3	Dyed in a neutral or alkaline salt bath. Is mostly diazotized and developed after dyeing, or aftertreated with chloride of lime. Rarely used as a direct colour, it yields red with β-Naphthol, claret with Claret developer. Finds limited application for discharge styles in calico printing.
Primuline O aftertreated with Azophor Red 	5—4	5—4	5	4	4—3	3	2	
Primuline O aftertreated with chloride of lime 	5	5	5	5	1	1	1	
Primuline O diazotized and developed with Resorcine 	3—4	3—4	5—4	4	4	5	2—3	
Primuline O diazot. and developed with β-Naphthol 	4	4	5	4	4—5	3—4	2	
Primuline O diaz. and developed with Schäffer's salt 	4	4	5	4	4—5	3—4	3	
Primuline O diaz. and develop. with Claret developer 	4—3	4—3	5	4—5	4—5	3—4	2—1	

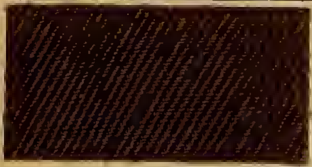
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Yellow 3G pat. 	5	3	5	3	4	4	4	Dyed in a bath containing common salt or Glauber's salt, with or without soda. Much used in cotton dyeing on account its greenish shade and comparatively great fastness to light.
Dianil Yellow 3G pat. aftertreated with copper 	5	3	5—4	3	3	4	3—4	
Dianil Pure Yellow HS 	5	4	5	5	4—5	3	2—3	Dyed in a neutral salt bath. Used in cotton dyeing on account of the purity of its shade, especially in combination with other Dianil colours.
Oxydianil Yellow G 	4	5	5	5	1	1	3—4	Dyed in a bath containing common salt or Glauber's salt with or without soda. Used in calico printing for padding light grounds. Suitable for chlorate discharges owing to its stability to chlorine. Suitable also for reducing discharges.
Oxydianil Yellow O 	5—4	5	5	5	1	1	3—4	
Cresotine Yellow G 	2	1—2	5	1	3	5—4	3	Dyed with phosphate of soda and soap or with Glauber's salt and soda. Used in calico printing for padding light grounds.
Dianil Yellow G 	3—4	4—5	5	3—4	5	3	4	Dyed in a bath containing common salt or Glauber's salt with or without soda.

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Aurophenine O 	1—2	4	5	1	2—1	1	4—5	Dyed in a neutral or alkaline salt bath. Can also be dyed cold. In calico printing for padding light cream, chamois etc. shades.
Dianil Yellow R pat. 	5—4	1—2	5	3	2	4—3	4—3	Dyed in a bath containing common salt or Glauber's salt, with or without soda. Much used in cotton dyeing on account of their great fastness to light.
Dianil Yellow 2 R pat. 	1—2	5	5—4	3	2	4—3	3—4	
Dianil Direct Yellow S 	5	3—4	5	4	2—3	1	3—4	In a bath containing common salt or Glauber's salt. Alkali turns the shade more red. Largely used in cotton dyeing an account of its fastness to washing chlorine and light.
Dianil Orange G pat. 	2	1—2	5—4	3—4	2—3	5—4	4	Dyed in a bath containing common salt or Glauber's salt, with or without alkali. Aftertreatment with copper sulphate increases its fastness to washing. Used for padding light grounds.
Dianil Orange N 	2	1—2	5	2	4—3	4—5	4—3	Dyed in an alkaline salt bath. Largely used in cotton dyeing on account of its dyeing strength and solubility. Developed with Azophor Red yields bright red brown shades fast to washing.
Dianil Orange N aftertreated with Azophor Red 	4	2—3	5	2	4—3	5	1—2	

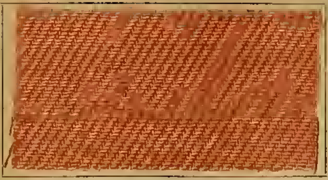
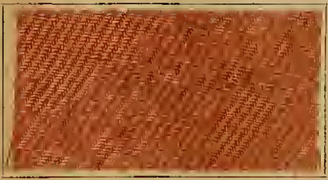
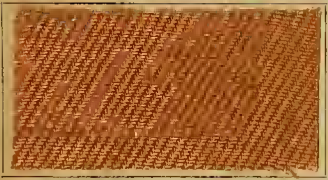
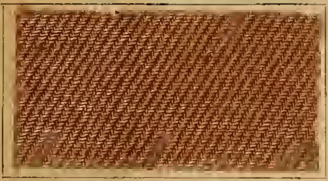
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Toluylene Orange R 	4—5	4—5	5	1—2	4—3	5	4	Dyed in an alkaline salt bath. Developed with Azophor Red yields bright and deep red brown shades fast to washing. Aftertreatment with chrome copper also largely used.
Toluylene Orange R aftertreated with Azophor Red 	4—5	3	5	3	4—3	5—4	1—2	
Dianil Brown 3 GO 	2—3	2	5	1	4—3	4	3—4	Dyed in a concentrated neutral or alkaline salt bath. Used as a direct colour and for goods fast to washing, with subsequent development with Azophor Red. Aftertreated with chrome copper for leather shades fast to washing. Dianil Brown 3GO developed with Azophor Red can be discharged with white and coloured hydrosulphite discharges.
Dianil Brown 3 GO aftertreated with Azophor Red 	3—4	2—3	5	1	4—3	4	3	
Dianil Brown 3 GO aftertreated with chrome copper 	2—3	3—4	5—4	2	4—3	4—5	2—3	
Dianil Brown 5 G 	3—4	2	5—4	3	3—4	5—4	3	
Dianil Brown 5 G aftertreated with Azophor Red 	3—4	2	5—4	2—3	3—4	4—5	2	

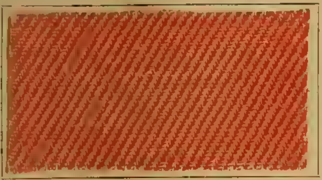
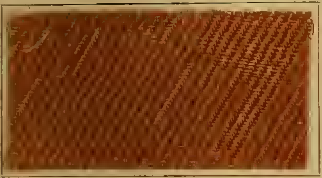
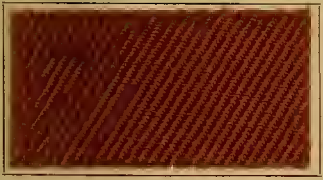
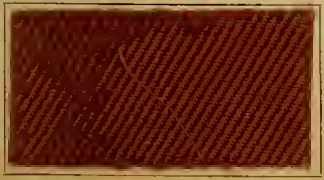
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Brown X 	1—2	2	4—5	1	3—4	5	3	Dyed in a concentrated neutral or alkaline salt bath. Used as a direct colour and, with subsequent development with Azophor Red for goods fast to washing. Dianil Japonine G aftertreated with chrome copper, is suitable for leather shades fast to washing. Dyed direct or aftertreated, it is easily discharged with Hydrosulphite NF conc.
Dianil Brown 2 G 	2—3	2—3	5—4	1	3—2	5	3—2	
Dianil Brown 2 G aftertreated with Azophor Red 	3—4	2	5—4	1	3	5	2	
Dianil Japonine G 	2	2	4—5	1	3	5—4	4—3	
Dianil Japonine G aftertreated with copper 	1—2	3	4—5	1—2	2—3	5	3—4	
Dianil Japonine G aftertreated with chrome copper 	1—2	3	4—5	1	3	5	3	
Dianil Brown 3 R 	2	2	5—4	1	3—4	5	3	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Brown R 	2	2	5	1	3—4	5	3	Dyed in a concentrated neutral or alkaline salt bath. Can be discharged white with Hydrosulphite NF conc.
Dianil Brown R aftertreated with Azophor Red 	2	2—3	5	1	3—4	5	2	
Dianil Brown MH 	2	2—3	5	1	3	5	4	Dyed in a neutral or alkaline salt bath. Can be specially recommended for aftertreatment; the fastness to washing and light is increased by chrome copper; diazotising and developing with Phenylendiamine or β-Naphthol yields considerably deeper shades and increases the fastness to washing. Dyed direct or aftertreated it is easily discharged with Hydrosulphite NF conc.
Dianil Brown MH aftertreated with chrome copper 	2—3	3—4	5	1—2	2	5	2	
Dianil Brown MH diaz. and develop. with Phenylendiamine 	2	3	5	1	4	5	3	
Dianil Chrome Brown R 	4	1	5	1	4	5	3	Dyed in a weak alkaline salt bath. Particularly suitable for the production of fast chromed effects on cotton. Also used as a substitute for catechu (cutch). Easily discharged with Hydrosulphite NF conc. or tin crystals.
Dianil Chrome Brown R aftertreated with chrome copper 	4	1—2	5	1—2	3—2	5	2	

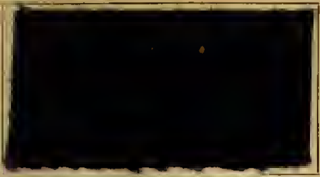
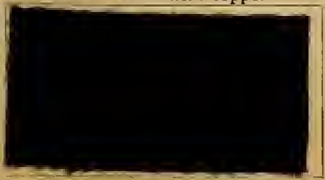
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Brown G 	2—3	2—3	5—4	1	3—4	5—4	3	Dyed in a concentrated neutral or alkaline salt bath. Both the direct dyed effects and those developed with Azophor Red can be discharged with white and coloured hydrosulphite discharges.
Dianil Brown M 	2—3	2—3	5—4	1	4—3	5—4	3	
Dianil Brown M aftertreated with Azophor Red 	3—4	3	5—4	1	3—4	4—5	2—1	
Dianil Fast Brown R 	3—4	3—4	5—4	1—2	3—4	5	3—4	
Dianil Fast Brown R aftertreated with copper 	2—3	3—4	5—4	1—2	3	5	2—3	
Dianil Fast Brown B 	3—4	3—4	5—4	1	3—4	5	3	
Dianil Fast Brown B aftertreated with copper 	3—4	3—4	5—4	1	3	5	3	

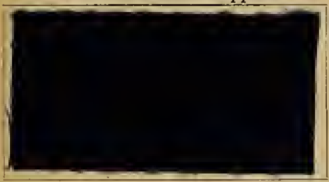
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Brown A (No. 8611) 	1—2	1	5—4	1	3—4	5—4	3—4	Dyed in a neutral or alkaline salt bath. The aftertreatment with Azophor Red considerably increases the fastness to washing. Easily discharged with Hydrosulphite NF conc., even if developed with Azophor Red.
Dianil Brown BD 	3—4	3	5	1	3—4	5—4	3	
Dianil Brown BD aftertreated with Azophor Red 	3—4	3	5	1	3—4	5—4	1—2	
Dianil Brown B 	2	3	4—5	1	3	5	3	
Dianil Brown B aftertreated with Azophor Red 	3	3	4—5	1	3—2	5	2—1	
Dianil Brown D 	2	3	4—5	1	3	5—4	3	
Dianil Brown D aftertreated with Azophor Red 	3	3	5—4	1	3—4	4—5	2—1	

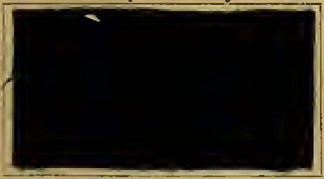
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Red 4 B 	1	2—3	5	2	4	4—3	3—4	Dyed in an alkaline salt bath. Are used for the production of certain discharged styles, e. g. blue on red etc. Are not altered by acetic acid.
Brilliant Dianil Red R 	1—2	1	5	2	4	5	3—4	
Dianil Red R 	1	1—2	5	2	4—5	4—5	3	
Deltapurpurine 5 B 	1—2	1	5	2—3	4	5	3—4	
Dianil Fast Scarlet 4 BS 	1	2	5	2	4—3	3	4	Dyed in an alkaline salt bath. Fairly fast to acids, as the shade is very little changed by diluted hydrochloric acid. Serves for the production of dischargeable pink shades.
Dianil Scarlet 2 R 	2—3	2	4—5	1	4	2—3	5—4	Dyed in an alkaline salt bath. Dyed direct or with subsequent development with Solidogene A. Very suitable for reducing discharges.
Dianil Scarlet 2 R aftertreated with Solidogene 	2—3	2	5—4	1	5	2—3	4—5	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Pink BD 	1—2	2	4—5	1	3—2	4	4—5	Dyed in a neutral or weak alkaline salt bath. Very suitable for the production of pink shades dischargeable with Hydrosulphite NF conc.
Dianil Fast Scarlet 8 BS 	2	1	5	1	3—4	2	4	
Dianil Red 10 B 	1	1—2	5	1	4	4	3—4	Dyed in alkaline salt bath, it is easily discharged but is affected by acids.
Dianil Fast Red PH 	4	2	5	1	2—3	5	4	Dyed in an alkaline salt bath, yield red shades very fast to light and easily discharged with Hydrosulphite NF conc.; their fastness to washing and acids can be increased by aftertreatment with chrome.
Dianil Fast Red PH aftertreated with chrome-alum 	4	4	5	1	4—3	5	3—2	
Dianil Crimson G 	3—4	4	5	2	3	5—4	4	Dyed in alkaline salt bath. Used in combination with other Dianil dyestuffs for the production of claret and dark red shades.
Dianil Crimson B 	4	4	5	2	2—3	4—5	4	

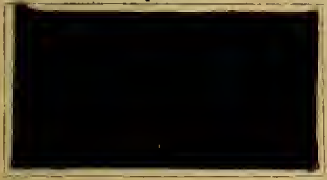
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Claret Red G 	1—2	2—3	4	1—2	3	5	3—4	Dyed in an alkaline salt bath. Yield claret shades which are not very fast to acids, but are easily discharged by Hydrosulphite NF conc.
Dianil Claret Red B 	1—2	2	4	1—2	3	5	3—4	
Dianil Violet H 	3—4	3	5	1	3—2	5	3	Dyed in a neutral or alkaline salt bath. Is very fast to acids and light. Easily discharged with Hydrosulphite NF conc.
Dianil Blue H6G 	1—2	1—2	5	1	4—5	4—5	3—4	Dyed in a neutral salt bath. The H brands can also be dyed in an alkaline-soda bath. Are easily discharged with Hydrosulphite NF conc. In order to increase the fastness to washing, and to prevent the discharged white from being stained in washing an aftertreatment with Solidogene is given.
Dianil Blue H3G 	2	2—3	5	1	5—4	4—5	3—4	
Dianil Blue G 	1—2	1—2	3—4	1	3—4	5	4	
Dianil Blue B 	2	2	3—4	1	4—5	5	4	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Blue H2G 	2	1—2	5	1	4—5	5	4	As before.
Dianil Azurine G 	1—2	2	3	1	4—5	4—5	3	Dyed in neutral salt bath. Can also be dyed in an alkaline-soda bath. Easily dischargeable with Hydrosulphite NF conc. In order to increase the fastness to washing, and also to protect the discharged white in washing an aftertreatment with Solidogene is given. Dianil Azurine G is somewhat faster to washing than the other direct dyeing blues. An aftertreatment with copper considerably increases the fastness to light of Dianil Azurine G.
Dianil Azurine G aftertreated with copper 	1—2	2	3	1	2	4	2—3	
Dianil Blue R 	1—2	2—3	3	1	4—5	5	4—3	
Dianil Blue 2R 	1—2	2	3—4	1	4—3	5	4—3	
Dianil Blue BX 	2—3	2—3	3—4	1	4—3	5	3—4	
Dianil Blue BX aftertreated with copper 	2—3	3	4	1	4—3	5	3—4	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Blue HG 	1—2	2	4	1	4—5	5	3—4	As before.
Dianil Indigo O 	3	2	4	1	4—3	5	4—5	
Dianil Indigo O aftertreated with copper 	1—2	2	4	1	2	5	4	Fastness to light is increased by aftertreatment with copper. Easily discharged with Hydrosulphite NF conc.
Dianil Dark Blue R 	1—2	1—2	4—5	1	4—3	5	3—4	To be dyed in an alkaline soda bath. Easily discharged with Hydrosulphite NF conc.
Dianil Dark Blue 3 R 	3	1—2	4—5	1	4	5	4	
Dianil Blue 3 R 	2—3	2—3	4	1	3—4	5	4—5	
Dianil Blue 4 R 	2—3	2—3	4	1	3—4	5	4—5	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Green B pat. 	2	2—1	4	1—2	3—4	5	3—2	Dyed only in a neutral salt bath. Are used for the production of green and olive shades which are easily discharged with Hydrosulphite NF conc.
Dianil Green G pat. 	2	1—2	4	1—2	4	4—5	3	
Dianil Dark Green B pat. 	2—3	3—4	4	1—2	3—4	4—5	2—3	
Dianil Black ES 	3—4	2	5	1	3	4—5	4	Dyed in a neutral or alkaline soda bath. Diazotizing and developing with β-Naphthol or Phenylendiamine considerably increases the depth of the shade and its fastness to washing. Can be easily discharged with Hydrosulphite NF conc.
Dianil Black ES diazot. and developed with β-Naphthol 	4—5	2	5	1	3—4	4	2	
Dianil Black ES diaz. and develop. with Phenylendiamine 	4—3	2	5—4	1	3—2	4—5	2	
Dianil Black CR 	4—3	2	5—4	1	3	4—5	4—3	Dyed in a neutral or alkaline salt bath. Fastness to washing is increased, by aftertreatment with chrome copper or Azophor Red. The Black shades are easily discharged with Hydrosulphite NF conc., even if aftertreated with Azophor Red.

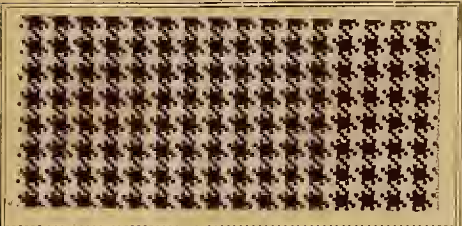
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Dianil Black CR aftertreated with chrome copper ■	2–3	2	5—4	2	3	5—4	2	Dyed in a neutral or alkaline salt bath. Fastness to washing is increased by aftertreatment with chrome copper or Azophor Red. The Black shades are easily discharged with Hydrosulphite NF conc., even if aftertreated with Azophor Red.
Dianil Black CR aftertreated with Azophor Red ■	2—3	3	5—4	1	4	4–5	2	
Dianil Black CB pat. ■	3	2	5--4	1	4 3	5—4	4	
Dianil Black CB pat. aftertreated with chrome copper ■	2–3	2—3	4—5	2	3–2	5	3	
Dianil Black N pat. ■	4	2	4	1	2	4—5	3	
Dianil Black N pat. aftertreated with chrome copper ■	3—4	2—3	4—5	1	1–2	5	2–1	
Dianil Black N pat. aftertreated with Azophor Red ■	3—4	4	4—5	1	2—3	4—5	2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Patent Dianil Black FF conc. pat. 	3	3	5—4	1	3—4	4	3—4	Mostly dyed in an alkaline salt bath. Extensively used for the production of fast black shades an account of their great dyeing strength. Are easily discharged Hydrosulphite N F conc. Of all Patent Dianil Blacks the EB conc. brand possesses the greatest fastness to light.
Patent Dianil Black FFC conc. pat. 	3—4	2—3	5—4	1	3—4	4	3—4	
Patent Dianil Black EF conc. pat. 	3—4	2—3	5—4	1	3—4	4	3—4	
Patent Dianil Black FFA extra conc. pat. 	2—3	2	4—5	1	3—4	4	3—4	
Patent Dianil Black RW extra pat. 	2—3	2	5—4	1	3—4	4	3—4	
Patent Dianil Black EB conc. 	3—4	2	5—4	1	3	5—4	4—3	
Patent Dianil Black FB pat. 	3	2	5—4	1	3—4	4	3	

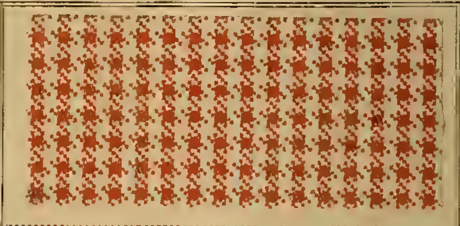
B. DIRECT OR STEAM COLOUR PRINTING WITH DIRECT COLOURS.

The direct colours are but little used for steam colour printing, as they are not sufficiently fast to washing, nor are the shades obtained very bright. They are, however, sometimes employed for printing upholstery goods, and for printing the backs of figured cloths, to imitate certain woven effects.

The direct colours are printed either with the addition of Turkey red oil, and phosphate of soda, or with albumen. After printing the goods are steamed for an hour with moist steam, washed and, if required, soaped lukewarm for a very short time. An aftertreatment with Solidogene A (see page 197) renders the colours faster to washing.



4 % Dianil Violet H



4 % Dianil Red 4B

Violet Printing Colour:

40 parts	**Dianil Violet H,**
150 parts	British gum powder,
490 parts	water,
200 parts	tragacanth (60:1000),
40 parts	sodium phosphate,
30 parts	glycerine,
50 parts	Turkey red oil 50 %,
1000 parts.	

Red Printing Colour:

40 parts	**Dianil Red 4 B,**
150 parts	British gum powder,
490 parts	water,
200 parts	tragacanth (60:1000),
40 parts	sodium phosphate,
30 parts	glycerine,
50 parts	Turkey red oil 50 %,
1000 parts.	

Dark Brown Light Brown

Dark Brown Printing Colour:

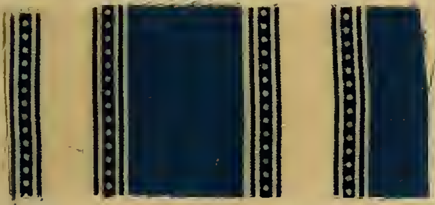
40 parts **Dianil Brown 2G,**
150 parts British gum powder,
490 parts water,
200 parts tragacanth (60:1000),
40 parts sodium phosphate,
30 parts glycerine,
50 parts Turkey red oil 50 %,
1000 parts.

4 % Dianil Green G

Green Printing Colour:

40 parts **Dianil Green G,**
150 parts British gum powder,
490 parts water,
200 parts tragacanth (60:1000),
40 parts sodium phosphate,
30 parts glycerine,
50 parts Turkey red oil 50 %,
1000 parts.

Light Brown Printing Colour: Dark Brown Printing Colour, reduced 1:5.

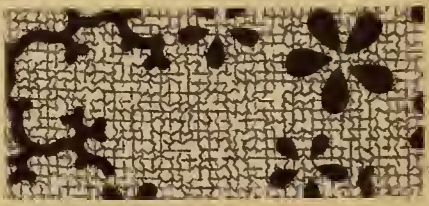


Dark Blue Light Blue

Dark Blue Printing Colour:

40 parts **Dianil Blue G,**
150 parts British gum powder,
490 parts water,
200 parts tragacanth (60:1000),
40 parts sodium phosphate,
30 parts glycerine,
50 parts Turkey red oil 50 %,
1000 parts.

Light Blue Printing Colour:
Dark Blue Printing Colour, reduced 1:5.

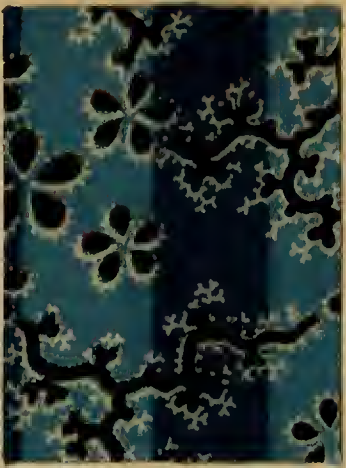


Dark Grey Light Grey

Dark Grey Printing Colour:

40 parts **Dianil Black CB**
150 parts British gum powder,
490 parts water,
200 parts tragacanth (60:1000),
40 parts sodium phosphate,
30 parts glycerine,
50 parts Turkey red oil 50 %,
1000 parts.

Light Grey Printing Colour:
Dark Grey Printing Colour, reduced 1:5.



Padding: 0,5 % Dianil Blue H6G
Dark Blue Printing Colour
Discharge White Black

Padding: 0,5 % Dianil Black CR
Dark Grey Printing Colour
Discharge White Black

Dark Blue Printing Colour:

40 parts	Dianil Blue H6G,
150 parts	British gum powder,
490 parts	water,
200 parts	tragacanth (60:1000),
40 parts	sodium phosphate,
30 parts	glycerine,
50 parts	Turkey red oil 50 %,
1000 parts.	

Discharge White: Discharge White NF (see page 205), reduced 1:2.

Black Printing Colour:
Logwood Black.

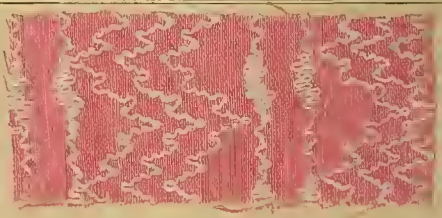
Dark Grey Printing Colour:

40 parts	Dianil Black CR,
150 parts	British gum powder,
490 parts	water,
200 parts	tragacanth (60:1000),
40 parts	sodium phosphate,
30 parts	glycerine,
50 parts	Turkey red oil 50 %,
1000 parts.	

Discharge White: Discharge White NF (see page 205), reduced 1:1.

Black Printing Colour:
Logwood Black.

Aurophenine O



Dianil Pink BD

$1^{1}/_{2}$	parts	Dyestuff,
$368^{1}/_{2}$	parts	water,
600	parts	tragacanth (60:1000),
10	parts	sodium phosphate,
20	parts	Turkey red oil 50 %
1000	parts.	

C. PADDING AND DYEING WITH DIRECT COLOURS.

For the production of plain shades, as e. g. in dyeing dark coloured and black linings, frequently no further preparatory treatment, except singeing, takes place. The undyed goods are entered direct into the dyebath. For medium shades they are previously boiled with soda or soda lye, and for light shades, according to the goods, a half- or fullbleach is used. In most cases the latter is indispensable for printed goods, especially for discharge styles.

The dyeing of piece goods is carried out, either by padding in a two roller padding machine, or by dyeing in the jigger or in a continuous dyeing machine.

1. PADDING.

The goods prepared for dyeing are dried, and are then taken to the padding machine in batches of 3—10 pieces. The padding bath is prepared in a high level cistern (made of tin, leaded iron or tinned copper), which is heated by indirect steam. The padding liquid runs into the feeding channel, thence over the whole breadth into the dye box, which has a capacity of about 2 quarts water (the box of the two roller padding machine holds $1^1/_2$ quarts).

After padding the goods can be immediately dried in the hotflue or on the cylinder drying machine. Some kinds of material may be allowed to lie with advantage for some time before drying.

The speed of the padding machine should be so regulated that 45 to 55 yards pass through it per minute, and the pressure must be such that the fabrics take up 60—70 % of their weight of padding liquid.

The padding bath is best prepared as follows: The high level cistern is filled about half with hot water. Into this are mixed the solutions of dextrine and sodium phosphate, as described below; then the previously boiled and filtered colour solution is added, and the vessel filled up to a certain mark.

A padding machine in good working order, with a small box, smooth rollers, uniform pressure, and running evenly is requisite for the success of the operation. The temperature of the padding liquid, which is always kept up to the same degree in the preparing vessel, must be even throughout the whole box. This is made possible by the overflow of the feeding channel over the whole breadth of the box. The same level of the padding liquid is easily maintained by means of an overflow in the dye box.

The following sketch shows the way the pieces run through the machine:

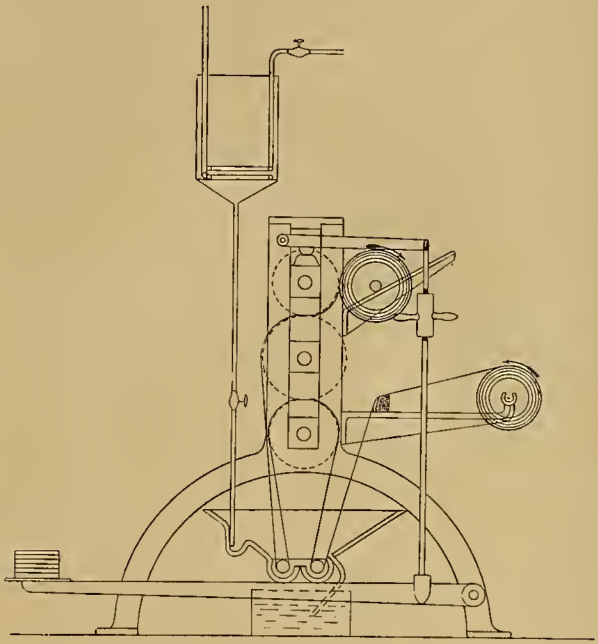


Fig. 11.

Preparation of the Padding liquid:

for	a) light	b) medium	c) dark shades
Dianil Dyestuff	1 part	5 parts	25 parts
Sodium Phosphate	25 parts	50 parts	50 parts
Dextrine	150 parts	150 parts	150 parts
for	10000 parts	10000 parts	10000 parts.

The goods are padded twice, for light shades at 140° F., for medium and dark shades at 176° F. The same effect is obtained in one passage on a three roller padding machine in the usual manner.

Every other kind of padding, used in printing is, of course, equally suitable for Dianil Colours.

2. DYEING IN THE JIGGER.

The jigger is the machine most used in piece dyeing; it is equally suitable for light and dark shades and also for blacks. In most cases the 5fold quantity of dye liquid, compared to the weight of the goods, is sufficient. For light shades the dyebath is replenished after each batch; for medium and dark shades the further use of the old bath must be adapted to requirements. For subsequent batches 15—20 % less dyestuff than was required for the initial bath are necessary and only $^1/_5$ of the quantity of soda and salt used in the first bath.[1]) The correct amount of salt to be used is, however, best controlled by measuring the degrees Twaddle in the usual manner.

The liquid cooled down to 59—68° F. shows for:

light shades	$1^1/_2$°— 3° Tw.,
medium shades	3°—$4^1/_2$° Tw.,
deep shades	$4^1/_2$°— 6° Tw.,

Light shades are dyed at 104—122° F., medium and dark shades at the boil. The duration of the dyeing operation is $^3/_4$—$1^1/_2$ hours, according to the depth of the shade and the size of the batches.

Many goods, especially in light and medium shades, can be hydroextracted and dried directly after leaving the dyebath. Deep shades and those to be developed or aftertreated with metal salts, are washed first after dyeing.

3. DYEING ON THE ROLLER CISTERN.

Continuous dyeing is effected on large roller cisterns, whereby the desired depth of shade is obtained by one passage of 4—6 minutes duration. The strength of the dyebath is kept up by constantly replenishing it with strong liquid, corresponding to the absorption of dyestuff by the goods.

This method of dyeing is only rational when the machine can be kept running uninterruptedly, and is to be chiefly applied for black and other staple colours.

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[1]) Dianil Blues are best dyed without soda.

4. AFTERTREATMENTS.

In order to obtain higher degrees of fastness, various Dianil Colours, especially Dianil Brown, Dianil Orange N, Toluylene Orange R, Primuline O, can be aftertreated. The following are the modes employed for printed styles.

a) **Azophor-Red** (for obtaining greater fastness to washing).

For deep shades per 100 lbs material are required

2 lbs Azophor Red PN,
1 lb acetate of soda.

The goods are treated for about $1^{1}/_{2}$ hours in a cold bath, well washed, soaped if required, and dried.

In order to dissolve 2 lbs Azophor Red, about $4^{1}/_{2}$ gallons cold water are required. They are first made into a paste with little water; then more water is added, and frequently stirred. After $^{1}/_{2}$ hour the solution can be strained and then added to the developing bath.

For larger requirements the Azophor Red is dissolved, in the same proportion, in a petroleum cask fitted with a tap about $1^{1}/_{4}$ inch from the bottom. By this means the clear liquid can be drawn off, and only the residue needs to be strained through a cloth.

The acetate of soda is always dissolved by itself and added to the developing bath shortly before use.

b) **Diazotising and Developing** (for obtaining greater fastness to washing).

The previously dyed and washed material is diazotised cold for $^{1}/_{2}$ hour, for dark shades with 2 lbs 8 oz nitrite and 7 lbs 8 oz hydrochloric acid $32^{1}/_{2}{}^{0}$ Tw.; it is then washed and treated in a new bath, also cold, for $^{1}/_{2}$ hour, with the addition of the respective developing agent; then again well washed and dried. The developing solution is prepared in hot water, with the addition of the necessary quantity of soda lye.

10 lbs β- or α-Naphthol	require	4 gallons sodium lye 36^{0} Tw.,
10 lbs Resorzine	„	8 gallons sodium lye 36^{0} Tw.,
10 lbs Phenol	„	6 gallons sodium lye 36^{0} Tw.

Meta-Phenylene and Toluylene Diamine are dissolved without any addition.

The Claret-developer for Primuline is dissolved with a quantity of hydrochloric acid equal to $^{1}/_{5}$ of its weight, and added to the developing bath.

c) Developing with Solidogene (Improvement of fastness to water and acid).

The previously dyed and washed material is treated for deep shades for $^1/_2$ hour at the boil in a bath made up with

2 lbs hydrochloric acid $32\,^1/_2{}^0$ Tw.,
5—6 lbs Solidogene A

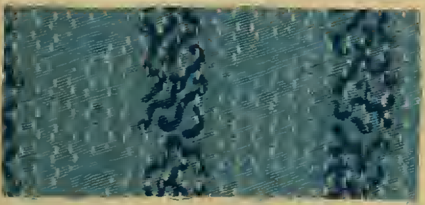
per 100 lbs material, and is then thoroughly washed.

5. PRINTING OF THICKENED SODA LYE AND SUBSEQUENT DYEING WITH DIANIL COLOURS.

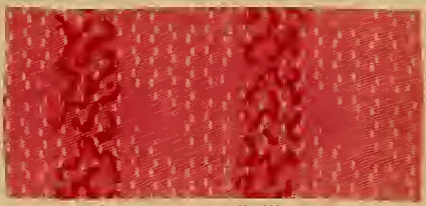
If white goods are printed with thickened soda lye, washed, and then dyed with Dianil Colours, dark and light shades are obtained at the same time by local mercerisation. — In order to assure a good effect, the goods must be dyed at a low temperature.

Alkaline Printing Colour.

100 parts British gum powder are heated with,
900 parts soda lye 76^0 Tw.,
1000 parts.



Alkaline Printing Colour.
Dyebath: $1^1/_2$ % Dianil Blue H6G
Cover: Discharge White NF 50.



Alkaline Printing Colour.
Dyebath: $1^1/_2$ % Dianil Fast Scarlet 8 BS.
Cover: Discharge White NF 50.

Discharge White NF 50.

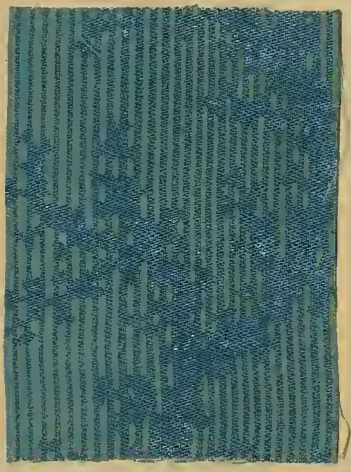
50 parts Hydrosulfite NF conc.,
250 parts water,
700 parts flour thickening (see page 205),
1000 parts.

6. DAMASK EFFECTS ON GOODS PADDED WITH DIANIL COLOURS.

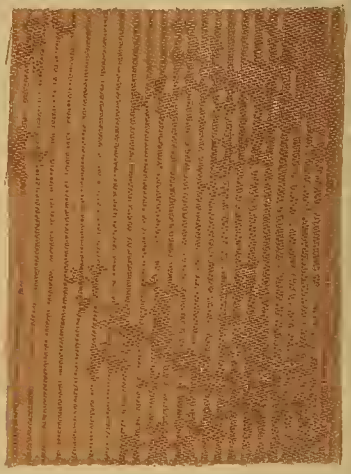
Beautiful Damask effects are produced by printing oxide of zinc and albumen upon goods previously padded with light Dianil Colours. After printing the goods are aged in the Mather-Platt, and then finished without being washed.

Oxide of Zinc Printing Colour:

300 parts	oxide of zinc,
50 parts	glycerine,
300 parts	egg albumen 1 : 1,
250 parts	tragacanth (60 : 1000),
75 parts	olive oil,
25 parts	turpentine,
1000 parts.	



Padding: 0,15 % Dianil Blue H6G
Oxide of Zinc Printing Colour.



Padding: 0,15 % Dianil Brown 2G
Oxide of Zinc Printing Colour

D. DISCHARGING DIANIL COLOURS.

The extensive employment of Dianil dyestuffs in printing is founded on their easy dischargeability. In the first place reducing discharges, which are capable of effecting a thorough decomposition of the dyestuffs are applicable for these styles. But certain Dianil Colours can also be destroyed by oxidising agents. We have, therefore, to deal with

Reducing and Oxidising Discharges.

According to the reducing agent the following discharges are to be distinguished:

1. Tin discharges.
2. Zinc dust discharges.
3. Hydrosulphite discharges.

For oxidising discharges Chlorates are used.

1. TIN DISCHARGES.

In tin discharges tin crystals, acetate of tin, or stannous oxide are employed. For the protection of the fibre sodium acetate or ammonium sulphocyanide with citric or tartaric acid are added to the tin cryst. colours.

To the printing colours produced with stannous oxide paste chloride of ammonia and tartrate of ammonia are added.

White Discharges.

Discharge White I.

450 parts acid starch thickening,
275 parts tin cryst.,
75 parts acetic acid 9° Tw.,
125 parts acetate of soda cryst.,
75 parts tragacanth (60 : 1000),
1000 parts.

Suitable for short steaming.

Discharge White II.

80 parts wheat starch,
80 parts water,
250 parts dextrine,
550 parts stannous acetate $32^1/_2$° Tw.,
40 parts citric acid,
1000 parts.

Suitable for longer steaming.

Discharge White III.

110 parts wheat starch,
820 parts stannous acetate $32^1/_2$° Tw.,
70 parts acetic acid 9° Tw.,
1000 parts Boil well.

Discharge White IV.

400 parts acid starch thickening,
100 parts tragacanth (60 : 1000),
240 parts tin cryst.,
100 parts water,
100 parts sulphocyanide of ammonia,
60 parts citric acid 36° Tw.
1000 parts.

Even when reduced, No. IV discharges very effectually, and produces a good white.

Discharge White V.

40 parts	wheat starch,
290 parts	water,
100 parts	British gum powder,
320 parts	stannous oxide paste 23 %,
150 parts	tartrate of ammonia $32^{1}/_{2}{}^{0}$ Tw.,
100 parts	chloride of ammonia,
1000 parts.	

For tables of the dischargeability of the Dianil Colours see page 173.

The coloured tin discharges contain, besides acetate of tin, either basic dyestuffs with the addition of tannin or pigment colours with albumen.

The preparation of coloured discharges is as follows:

Coloured Discharge I.

30 parts	dyestuff,
230 parts	acetic acid 9^{0} Tw.,
250 parts	acid starch thickening,
40 parts	tartaric acid,
150 parts	acetic acid-tannin sol. 1 : 1, then
300 parts	Standard White Z are added,
1000 parts.	

Standard White Z.

368 parts	stannous acetate $32^{1}/_{2}{}^{0}$ Tw.,
148 parts	British gum powder,
74 parts	gum solution 1 : 1,
37 parts	citric acid,
40 parts	water, boiled for 10 minutes, then
222 parts	tin cryst. are added, the whole stirred for 5 minutes, when cold,
37 parts	sodium acetate cryst. and
74 parts	water are added,
1000 parts.	

Coloured Discharge II (With Pigment Colours).

200 parts	Chrome Yellow paste,
100 parts	albumen solution 1 : 1,
700 parts	Discharge White II (see above).
1000 parts.	

The following colours can be used as coloured discharges:

Methylene Yellow H, Auramine, Flavophosphine, Phosphine, Magenta, Rosazeine 4G extra, 6G extra, 6GD extra, Rosazeine Scarlet G extra, Methylene Heliotrope, Methyl Violet, Marine Blue, Methylene Blue, Ethyl Blue, Victoria Blue, Brilliant Green, Malachite Green, Methylene Grey.

Tin Discharge styles.

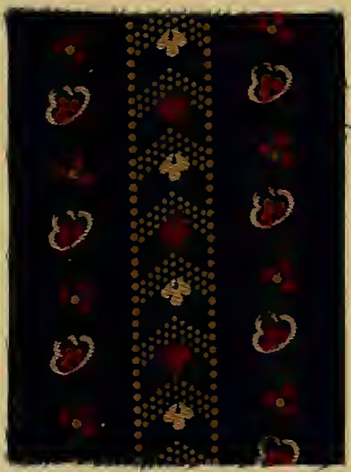
The bleached goods are dyed with Dianil Colours in the usual manner, printed with white or coloured tin discharges, and steamed. The steaming is varied from 3—10 minutes, or even longer, according to the depth of the dyed shade and to the strength of the discharge. Discharges which, besides acetate of tin, contain tin cryst. and acid, must not be steamed too long, and always with care, lest the material should be impaired. In most cases the Mather-Platt ager is used for this purpose. Prolonged steaming turns the white rather yellow. Then the goods are washed and, to improve the white, slightly soured, if necessary.

In many cases it is advisable to treat the steamed goods with Solidogene. This aftertreatment increases the fastness to acids (Dianil Red 4 B) and to washing (Dianil Blue), and at the same time improves the white, whilst it enhances in some cases the beauty of the shade. This operation is best carried out after steaming in an open washing machine.

Solidogene Aftertreatment.

The discharged goods are passed after steaming open for ½ minute through a bath containing 20 parts Solidogene A and 5—10 parts hydrochloric acid 36° Tw. per 1000 parts; they are then washed and, if necessary, passed for ½ minute through a weak, cold soda bath (5—10 parts soda per 1000) and washed again.

Dyebath: 1% Dianil Black G
Discharge White IV — Logwood Black



Dyebath: 3% Dianil Blue H 6 G
Discharge White IV
Discharge Yellow
Discharge Red Discharge Green

Discharge Yellow:	3 %	Auramine conc.
Discharge Red:	0,4 %	Auramine conc.,
	2,6 %	Rosazeine 4G extra.
Discharge Green:	2 %	Auramine conc.,
	1 %	Brilliant Green cryst. extra.

Dyebath: 4% Dianil Indigo O
Discharge White IV. —
Discharge Green.

Discharge Green:

2% **Auramine conc.,**
1% **Brilliant Green cryst. extra**

Dyebath:
3% Dianil Fast Scarlet 8BS
Discharge White IV. —
Discharge Dark Blue.
Discharge Light-Blue. —
Discharge Green.

Discharge Dark Blue:
3% **Victoria Blue B.**

Discharge Light Blue:
0,5% **Victoria Blue B.**

Discharge Green:
2% **Auramine conc.,**
1% **Brilliant Green cryst. extra.**

2. ZINC DUST DISCHARGES.

The zinc dust discharges are prepared with the finest zinc dust and bisulphite, for the latter sulphite of potash may be substituted. In these discharges there is mostly an excess of zinc dust; the hydrosulphite is liable to decompose and to reproduce bisulphite. This then is again reacted upon by the excess of zinc, and hydrosulphite is thus formed afresh.

Additions of formaldehyde increase the stability of the zinc dust discharges, they have, however, been superseded by the introduction of the stable compounds of hydrosulphite with formaldehyde (Hydrosulphite NF and NF conc.).

The presence of large quantities of the heavy zinc dust is liable to clog the engraving, and this is very prejudicial to the printing with these colours.

The dischargeability of the Dianil colours by means of zinc dust discharges is, generally speaking, equal to that of the tin discharges, and surpasses it in many cases, in regard to the purity and stability of the white discharge effect. The zinc dust and hydrosulphite discharges being analogous, we refer to page 174 where the degrees of dischargeability of the Dianil Colours by hydrosulphite discharges are shown.

After printing the goods are steamed for $^1/_2$ hour, then soured cold with 5 parts hydrochloric acid 36^0 Tw. per 1000, and thoroughly washed.

For zinc dust coloured discharges the following dyestuffs can be used: Oxydianil Yellow O, Phosphine, Rosazeine, Safranine, and Methylene Heliotrope O.

The following are typical recipes for zinc dust discharges:

Discharge White I.

250 parts	zinc dust, I. quality,
450 parts	gum solution 1:1,
50 parts	glycerine,
50 parts	ammonia,
200 parts	sodium bisulphite $66\,^1/_2$ Tw.,
1000 parts.	

Discharge White II.

250 parts	zinc dust, I. quality,
200 parts	gum soution 1:1, are finely ground, and whilst cooling,
400 parts	sodium bisulphite 66^0 Tw., slowly added when the reaction is complete,
30 parts	soda,
70 parts	water,
50 parts	glycerine are added,
1000 parts.	

Discharge White III.

400 parts	zinc dust,
200 parts	potassium sulphite 91^0 Tw.,
100 parts	glycerine,
300 parts	gum solution,
1000 parts.	

3. HYDROSULPHITE DISCHARGES.

By the discovery of the stable compound of hydrosulphite with formaldehyde the problem of discharging by means of hydrosulphite has, as already stated, been satisfactorily solved and a method of discharging has thereby been introduced into the printing industry which has become of the greatest importance for the production of discharge effects on Dianil dyestuffs.

The Dianil Colours can be easily discharged by Hydrosulphite NF or NF. conc., and generally require, even in darker shades, smaller quantities of this discharging agent than the insoluble Azo Colours. The white and coloured discharges are stable for a long time, and their preparation is the same as, or similar to that described for the insoluble Azo Colours. For thickening the following ingredients are used: gum, British gum, burnt starch or flour-, starch-tragacanth thickenings.

For coloured discharges basic dyestuffs are employed. These form leuco compounds with the discharging agent on steaming and are then converted back again to the corresponding dyestuff by oxidation in the air or by means of a chrome bath. Besides basic dyestuffs certain phtalic acid colours, e. g. Erythrosine, also colours of the Gallocyanine series fixed with chrome mordant, Indigo, Thiogene colours, as well as pigment colours, e. g. Chrome Yellow fixed with albumen can be used.

In consequence of the Dianil Colours being very sensitive to discharging agents doctor streaks and scumming caused by roughness of the printing roller make themselves apparent. In order to counteract this defect, it is advisable to prepare the material before printing with a weak chlorate solution (5—10:1000). After printing the goods are aged for 2—3 minutes in the Mather-Platt at about 212—216° F., then washed and dried. For coloured discharges prepared with basic dyestuffs the goods are passed through a tartar emetic solution in order to fix the colours better, and then washed. It is advantageous to allow the goods to lie for some time in the air, before washing or passing through tartar emetic, in order to allow the re-oxidation of the leuco compounds of the dyestuffs to take place. Under certain circumstances a subsequent chrome bath will also yield good results. The discharge effects with hydrosulphite on the Dianil Colours can be seen from the table on page 174. Some Dianil Colours are considerably improved by Azophor-Red — or Solidogene development, not only as to their properties of fastness, but also as to the purity of the discharge effect.

The treatment with Solidogene is the same as described on page 201, or the goods are padded before printing with a solution of 20—40 parts Rhodogene MLB per 1000 parts padding liquid, and dried. Rhodogene MLB contains merely a trace of inorganic acid, so that no injurious effect to the cotton fibre in drying or steaming can take place.

As specially suitable for hydrosulphite discharges we recommend the Solidogene treatments of Aurophenine O, Dianil Pink BD, Dianil Fast Scarlet 8BS, Dianil Red 10B, Dianil Violet H, Dianil Claret B and G, Dianil Blue H6G, G, B, Dianil Green G, B, Dianil Dark Green B, and all brands of Dianil Black; furthermore the Azophor Red development of Dianil Brown 3GO, 2G, R, M, BD, B, D, Dianil Indigo O, Dianil Black CR, R, PG, N, PR, also Dianil Black ES, diazotised and developed with Phenylendiamine, and all brands of Patent Dianil Black.

The stable hydrosulphite compounds will be described in detail under „Insoluble Azo Colours produced on the fibre“. For the present it is sufficient to state that the white and coloured discharges specified for Azo Colour styles are also applicable for discharging colours produced with Dianil dyestuffs.

The strength of the discharges, viz the proportions of Hydrosulphite NF or NF conc. must be regulated according to the depth of the dyed shades.

In printing thick and raised materials it is advisable, for the better utilization of the discharges, to add to them, especially to the white discharges, some china clay, zinc white or lithopone with some albumen solution, whereby a too deep penetration of the colour into the material and consequent weakening of the discharge is avoided.

The covering effect of these white pigment colours is also of advantage in those cases where it is impossible to obtain a perfect white by the reducing action alone.

The hydrosulphite coloured discharges are prepared without any free acids (acetic acid) as these have a decomposing effect upon Hydrosulphite NF conc. In order, however, to prevent a premature lake formation of the dyestuffs, glycerine, acetine and phenol are added. The addition of phenol is particularly effective.

For the preparation of coloured discharges we recommend: Methylene Yellow H, Auramine conc., Flavophosphine 4G conc. new, GG conc. new, G conc. new, R conc. new, Leather Yellow O, Rosazeine 4G extra, 6G extra, 6GD extra, Thionine Blue GO, Discharge Marine Blue S extra conc., Chromoglaucine VM powder and paste, BMI powder and solution, Philochromine Bpaste and Gpaste. For black, to be printed next to hydrosulphite colours, Logwood Black may be recommended as Aniline Black or Diphenyl Black are not fully developed in the presence of the reducing discharges.

Preparation of Discharges:

Discharge White NF.

200 parts	Hydrosulphite NF. conc.,
600 parts	flour thickening, are dissolved on the water bath; when cold,
200 parts	oxide of zinc 1:1 are added,
1000 parts.	

Thickening for Reductions:

700 parts	flour thickening,
100 parts	water,
200 parts	oxide of zinc,
1000 parts.	

Flour Thickening.

100 parts	flour,
900 parts	water,
1000 parts	boiled, then cooled.

The discharge white must always be heated a little before use.

The concentration of the discharge must be gauged according to the dischargeability of the dyed shade and the depth of the engraving.

	Discharge Yellow NF,	Discharge Orange NF,	Discharge Gren NF,	Discharge Blue NF
Auramine conc.	20 parts	—	—	—
Flavophosphine R conc. new	—	20 parts	—	—
Methylene Yellow H	—	—	20 parts	—
Thionine Blue GO	—	—	10 parts	20 parts
Glycerine	30 parts	30 parts	30 parts	30 parts
Acetine	10 parts	10 parts	10 parts	10 parts
Water	180 parts	180 parts	220 parts	230 parts
Wheat starch-tragacanth thickening	250 parts	250 parts	250 parts	250 parts
Phenol	60 parts	60 parts	60 parts	60 parts
Aqueous Tannin Solution 1:1	100 parts	100 parts	100 parts	100 parts
Hydrosulphite Thickening NF	350 parts	350 parts	300 parts	300 parts
	1000 parts	1000 parts	1000 parts	1000 parts

Discharge Blue VM.

50 parts **Chromoglaucine VM paste,**
200 parts water,
350 parts wheat starch-tragacanth thickening,
100 parts acetate of chrome $32^1/_2{}^0$ Tw,
300 parts Hydrosulphite Thickening NF,

1000 parts.

Hydrosulphite Thickening NF.

500 parts Hydrosulphite NF conc.
are dissolved at 122—140° F in
500 parts gum solution 1:1

1000 parts.

Also for coloured discharges the quantity of discharge must be adjusted according to requirements. The above named quantities are amply sufficient for the darkest shades.

Dyebath: 0,5 % Patent Dianil Black FF conc. Discharge White NF reduced 1 : 3

Dyebath: 1,5 % Dianil Violet H Discharge White NF reduced 1 : 3

Dyebath: 6 % Dianil Black CR Discharge White NF reduced 2 : 1

Dyebath: 5 % Dianil Brown B Azophor Red development Discharge White NF

Dyebath: 3 % Dianil Green G Discharge White NF, reduced 1 : 1 Logwood Black

Dyebath: 3,5 % Dianil Claret G Discharge White NF, reduced 2:3 Discharge Yellow NF, Discharge Orange NF, Discharge Green NF

IV.

THE THIOGENE COLOURS.

The Thiogene Colours are so-called Sulphur Colours which contain sulphur as a characteristic constituent of their molecule. They are produced by the reaction of sulphur, sulphides or polysulphides upon aromatic compounds; they are easily soluble in alkali-sulphides mostly in the form of leuco compounds, and dye the vegetable fibres direct without mordants, probably by forming with them chemical combinations, as may be inferred from the great fastness of these colours.

The Thiogene dyestuffs are supplied as powders or in solution.

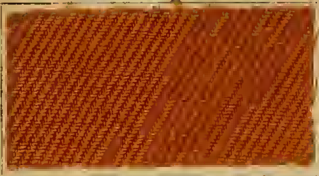
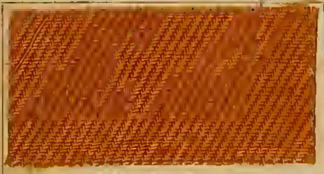
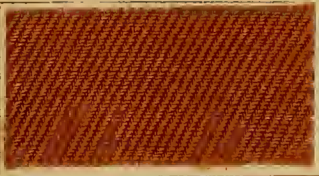
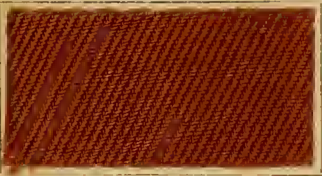
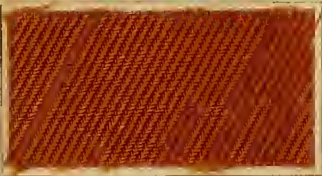
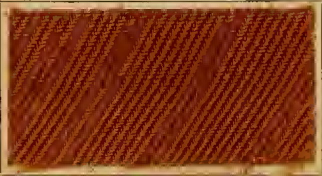
Owing to their excellent properties of fastness the Thiogene Colours have been taken up rapidly and to a very large extent by the dyeing industry; on the other hand they are still used comparatively little in printing. The reason of this lies chiefly in the looseness which most of the Sulphur Colours have to chlorine, and also in the circumstance that it was for a long time impossible to obtain a good solution of the dyestuffs, without tarnishing and corroding the rollers by action of sodium sulphide and the free sulphur.

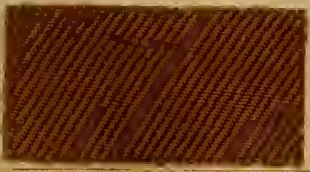
Since, however, Sulphur dyestuffs of greater fastness to chlorine, such as the Thiogene Cyanines, have been placed upon the market, and an excellent fixing agent for Sulphur Colours has been discovered in the stable formaldehyde compounds of hydrosulphites, the employment of this group of dyestuffs has been largely increased in printing. Trials had been instituted to counteract the tarnishing and corroding of the copper printing rollers by adding bisulphites and sulphites to the printing colour; but this method only met with a qualified success, especially with those printing colours, which contained hydrosulphite. Consequently, it became necessary to produce Sulphur Colours which are incapable of tarnishing copper, and which require no other additions but such ingredients as are necessary for dissolving, reducing and fixing. The Farbwerke Hoechst have produced a number of Thiogene dyestuffs especially suitable for printing purposes, which they have put upon the market with the distinguishing mark „D“. These D brands, (the patent for the production of which has been aplied for), are: Thiogene Black MD conc., Thiogene Grey BD extra strong, Thiogene Blue BD conc., Thiogene Cyanine GD conc., Thiogene Cyanine OD conc., Thiogene Violet BD extra strong, Thiogene Rubine OD extra strong, Thiogene Yellow GGD conc., Thiogene Green GLD extra conc., Thiogene Brown GCD conc., Thiogene Brown GRD conc., Thiogene Brown SD conc.

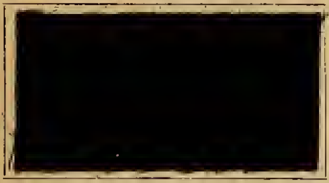
The various shades of these D brands are shown by the patterns given in chapter B: „The direct printing with Thiogene Colours“.

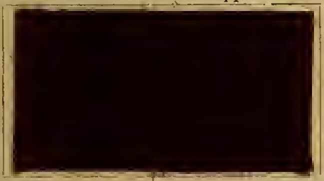
A. SYSTEMATIC TABLES OF THE THIOGENE COLOURS.

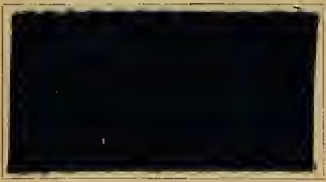
FOR EXPLANATION OF THE FIGURES SEE PAGE 60.

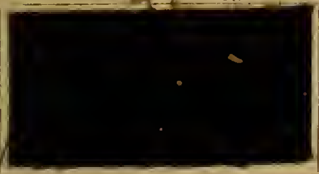
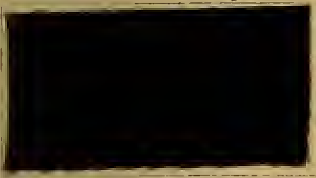
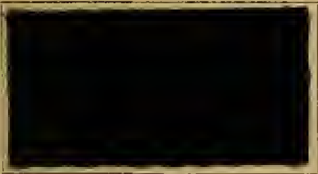
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Thiogene Golden Yellow AO 	2	5	5	5	2—3	4	1	Dyed in an alkaline sulphide bath. Thiogene Yellow G gives the best white when discharged with chlorate.
Thiogene Yellow GG 	2	5	5	5	2—3	4	1	
Thiogene Yellow G 	1—2	5	5	5	2	4—3	1	
Thiogene Orange OG 	1—2	5	5	5	2—3	4—3	1	Dyed in an alkaline sulphide bath. Aftertreatment with copper increases the fastness to light.
Thiogene Orange OG aftertreated with copper 	2	5	5	5	1—2	3—4	1	
Thiogene Orange RG 	2	5	5	5	2—3	4—3	1	
Thiogene Orange RG aftertreated with copper 	2—3	5	5	5	1—2	3—4	1	

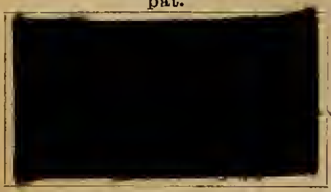
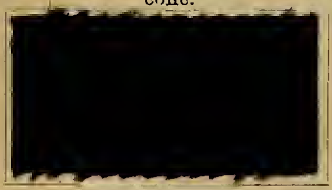
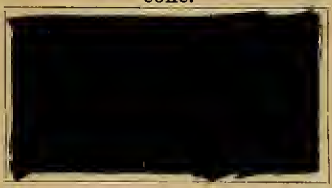
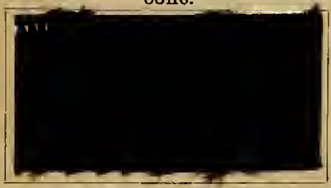
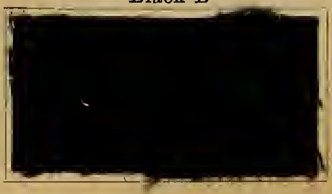
Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Thiogene Orange R 	3	5	5	5	2—3	4—3	1	Dyed in an alkaline sulphide bath. Aftertreatment with copper increases the fastness to light.
Thiogene Orange R aftertreated with copper 	3	5	5	5	1—2	4—3	1	
Thiogene Orange RR 	2	5	5	5	3	4	1	
Thiogene Orange RR aftertreated with copper 	2	5	5	5	2	4—3	1	Dyed in an alkaline sulphide bath. Aftertreatment with copper increases the fastness to light.
Thiogene Brown GC 	2	5	5	5	2	4	1	
Thiogene Brown GC aftertreated with copper 	2—3	5	5	5	1—2	4	1	
Thiogene Khaki O aftertreated with chrome coppe 	1—2	5	5	5	1—2	4—3	2—1	Dyed in an alkaline sulphide bath.

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Thiogene Brown GR 	3	5	5	5	2	4	1	Dyed in an alkaline sulphide bath. The aftertreatment with copper of Thiogene Brown R increases its fastness to light. Dischargeability imperfect, except Thiogene Catechu which is sometimes used for discharge styles.
Thiogene Brown GRR 	2—3	5	5	5	2	4	1	
Thiogene Brown R 	3—4	5	5	5	2—1	4	1—2	
Thiogene Brown R aftertreated with copper 	3—4	5	5	5	1—2	3—4	1	
Thiogene Brown RR 	3—4	5	5	5	2—1	4	1—2	
Thiogene Brown S 	3—4	5	5	5	2	4	1	
Thiogene Catechu R 	2	5	5	5	1	4—5	1	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Thiogene Dark Red G 	2–1	5	5	5	2	5	1—2	Dyed in an alkaline sulphide bath.
Thiogene Dark Red R 	2	5	5	5	2	5	1—2	
Thiogene Rubine O pat. 	1	5	5	4—5	2—3	5	1—2	Dyed in an alkaline sulphide bath. Aftertreatment with copper increases the fastness to light and washing. Are discharged to pure white with chlorate.
Thiogene Rubine O pat. aftertreated with copper. 	1	5	5	5–4	1	5	1	
Thiogene Heliotrope O pat. 	1	5–4	5	4—5	2—3	5	2—1	Dyed in an alkaline sulphide bath. Easily discharged with chlorate.
Thiogene Violet B pat. 	1	5	5	4—5	3	5	2	Dyed in an alkaline sulphide bath. Very easily discharged with chlorate.
Thiogene Violet V pat. 	1	5	5	4—5	3—2	5	2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Thiogene Cyanine G 	1	5	5	5	1—2	3—4	1—2	Dyed in an alkaline sulphide bath. Pure white discharge obtained with chlorate. Of all the Sulphur Colours these are the fastest to chlorine.
Thiogene Cyanine O 	1	5	5	5	1—2	3—4	1—2	
Thiogene Blue B 	1—2	5	5	5—4	1—2	5	1	Dyed in an alkaline sulphide bath. Easily discharged by chlorate. Thiogene Blue B can be recommended for imitation Indigo styles.
Thiogene Blue R 	1—2	5	5	5	1—2	5	1	
Thiogene Blue RR 	1—2	5	5	5	2—1	5	1	
Thiogene Dark Blue BL steamed 	1	5	5	5	2—1	5	1—2	
Thiogene Dark Blue BTL steamed 	1	5	5	5	2—1	5	1—2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Melanogene Blue BG pat. aftertreated with Fixing Salt 	1	5	5	5	2—3	4	1	Dyed in an alkaline salt bath without addition of sodium sulphide. These dyestuffs contain a considerable amount of sodium sulphide; they are chiefly used for plain shades and also for bottoms under Indigo. The combinations with Indigo are suitable for chlorate and chromate discharges.
Melanogene Blue B pat. aftertreated with Fixing Salt 	1	5	5	5	2—1	4	1	
Melanogene Blue B pat. aftertreated with copper 	1	5	5	5	1—2	4	1	
Thiogene Green B 	1	5	5	5	2—3	5	1—2	Dyed in an alkaline sulphide bath. Easily discharged with chlorate.
Thiogene Green GG 	2	5	5	5	2—3	5	1—2	
Thiogene Green BL extra pat. 	1	5	5	5	2	4—5	1—2	
Thiogene Green GL extra pat. 	1	5	5	5	2	4—5	1—2	

Name of Dyestuff	Discharges				Fastness to Light	Fastness to Chlorine	Fastness to Washing	Remarks
	Chlorate	Tin	Sulphite	Hydrosulphite				
Thiogene Black M liquid pat. 	2—3	5	5	5	1—2	4	1—2	Dyed in an alkaline sulphide bath. Are especially suitable for black dyeing; they are dyed with little sodium sulphide, and produce very bright shades. Are also used for certain discharge styles (men's wear).
Thiogene Black BB liquid pat. 	2	5	5	5	1—2	4	1—2	
Thiogene Black BRR liquid pat. 	2	5	5	5	1—2	4	1—2	
Thiogene Black MM conc. 	2	5	5	5	1—2	4	1—2	Dyed in an alkaline sulphide bath. Suitable for discharge styles. Correspond to the „liquid" brands, but are more concentrated than these.
Thiogene Black BB conc. 	2	5	5	5	1—2	4	1—2	
Thiogene Black BRR conc. 	2—3	5	5	5	1—2	4	1—2	
Thiogene Diamond Black B 	3	5	5	5	1—2	4	1—2	Dyed in an alkaline sulphide bath.

B. DIRECT PRINTING WITH THIOGENE COLOURS.

The Thiogene Dyestuffs, like the Indigo dyestuffs, form leuco compounds, and can therefore be fixed in printing, like the vat dyestuffs, by means of alkaline reducing agents, e. g. glucose or hydrosulphite. The presence of strong alkalies owing to their mercerising action increases very considerably the fixation of the sulphur colours. By replacing the caustic alkali by strong soda ash or potash, a good but not complete yield is obtained. Glucose which must be padded on the goods before printing, as is necessary for Indigo prints, Hydrosulphite conc. powder and Hydrosulphite NF conc. may be used as reducing agents.

On page 208 it has already been stated that the imperfect fastness of the sulphur colours to chlorine, also the tendency to tarnish the copper rollers had been a great obstacle to the introduction of Thiogene colours for direct printing.

Certain sulphur colours which contain little free sulphur or polysulphide, can, indeed, be used for printing if the injurious action of the sulphur upon the copper rollers is counteracted by the addition of sulphites or bisulphites (formation of thiosulphate), the results are, however, far less perfect than those obtained with the addition of hydrosulphite. On the other hand, the thiosulphate formed by sulphur colours with bisulphite, precludes the use of hydrosulphite, as thiosulphate combined with hydrosulphite forms sodium sulphide which again affects the printing rollers.

In block-printing and with such appliances as cannot be injuriously affected by sodium sulphide, — e. g. the wooden mangle in yarn printing, — the colours containing sodium sulphide or free sulphur are very suitable for printing with the addition of alkaline thickening.

When using a roller printing machine, however, the sulphur colours put on the market hitherto, have always more or less tarnished the copper or brass rollers when printed with alkaline thickening, whereby their use had become impossible.

In order to overcome these difficulties and to obviate the tarnishing of the rollers, the Farbwerke Hoechst have placed upon the market a series of purified Thiogene colours which, printed with hydrosulphite and alkali, can be very well fixed on the fibre and do not impair the rollers.

On account of their very great fastness to washing, soap and light the Thiogene Colours are suitable for direct printing, not only on plain goods, but also on raised materials, as goods printed with these colours are well adapted for raising. As they are easily fixed in the Mather-Platt they can also be used in combination with the insoluble Azo Colours produced on the fibre.

For patterns containing much white, the Thiogene Cyanine OD conc. and GD conc. which are fast to chlorine, are chiefly to be considered. But also the other Thiogene colours less fast to chlorine can very well be used with care in printing, as their excellent fastness to soap enables the white to be cleared by soaping at the boil. The method of printing which we recommend is characterized by the employment of strong caustic alkaline printing colours which contain, besides the sulphur dyestuffs, hydrosulphite, chiefly in the form of the stable formaldehyde compound — Hydrosulphite NF conc. — The fixing of these printing colours is effected by short steaming in the Mather-Platt ager with subsequent washing.

Hydrosulphite NF conc. gives more stable printing colours than the cheaper Hydrosulphite conc. powder, though in many cases the stability of the latter might be deemed sufficient.

Hydrosulphite conc. powder produces considerably redder and brighter shades with Thiogene Violet BD extra strong and Thiogene Rubine OD extra strong than Hydrosulphite NF conc., whereas with the latter darker shades are obtained in combination with Thiogene Cyanine OD conc. and GD conc. The remaining „D“ brands, viz: Thiogene Black MD conc., Thiogene Grey BD extra strong, Thiogene Blue BD conc., Thiogene Green GLD extra conc., Thiogene Brown SD conc., Thiogene Brown GRD conc., Thiogene Brown GCD conc. and Thiogene Yellow GGD conc., can be equally well fixed with both hydrosulphites, and it is advisable therefore to combine the two kinds, in order to obtain cheaper, yet stable printing colours.

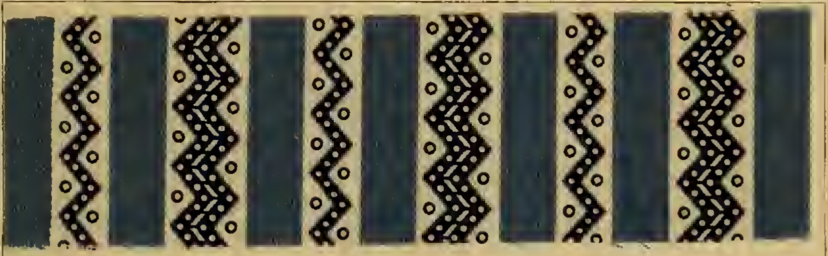
The printing colours are made up as follows: the dyestuff is made into a paste with water, glycerine, china clay paste, soda lye and hydrosulphite, and heated on the water bath until the dyestuff is reduced and completely dissolved. Then the reduced dyestuff solution is thickened with alkaline thickening and again heated to 122° F. whereby printing colours are obtained, which give even results.

The addition of glycerine acts very favourably on account of its hygroscopic character, in the steaming of sulphur colours, as they can only be well fixed by moist steaming. The china clay prevents the colour from bleeding into the white when steamed. For light shades or when complete utilization of the dyestuff is not the first consideration, only so much soda lye must be used as is necessary for dissolving the dyestuff, and the alkaline thickening is replaced by neutral gum or British gum thickening. By this method the following dyestuffs can be used: Thiogene Brown GCD conc., Thiogene

Cyanine GD conc., OD conc., Thiogene Green GLD extra conc., Thiogene Violet BD extra strong, and Thiogene Rubine OD extra strong.

The advantages of this method are: the outlines of the prints remain sharp in steaming; the back greys are not impaired and the workmen are no longer inconvenienced by having to handle strongly alkaline printing colours.

The printed goods must only be dried lightly. They are then steamed in the Mather-Platt ager (which must be free from air) for 3—6 min., according to depth of shade, with powerful moist steam at 212—216° F. By preference two passages are given. In order to prevent the alkaline printing colour from smearing the unprinted parts, the pieces must not drag over the narrow slit at their entry into the Mather-Platt. Afterwards the goods are washed in the open. After steaming it is advisable to pass Thiogene Yellow, Thiogene Green, Thiogene Rubine and Thiogene Violet through an acid bath. It is advisable to pass other Thiogene colour prints before washing through a bath (122° F.) containing 10 parts sulphuric acid 168° Tw. and 2 parts copper vitriol per 1000 parts. By this means fuller shades are obtained and the bleeding of the washed off dyestuff into the material is avoided. After washing it is advisable to soap the goods.



Thiogene Cyanine GD conc. Thiogene Blue BD conc.

Light Blue Printing Colour:

10 parts **Thiogene Cyanine GD conc.,**
25 parts glycerine,
165 parts water,
100 parts china clay paste 1:1,
10 parts soda lye 76½ % Tw.,
20 parts Hydrosulphite NF conc. 1 : 1 (water),
670 parts alkaline thickening,

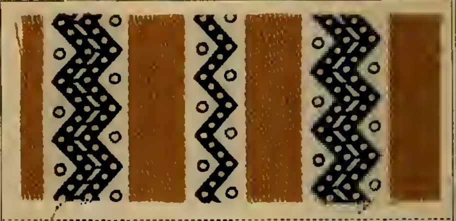
1000 parts.

Dark Blue Printing Colour:

30 parts **Thiogene Blue BD conc.,**
50 parts glycerine,
80 parts water,
100 parts china clay paste 1 : 1,
50 parts soda lye 76½ ° Tw.,
40 parts Hydrosulphite NF conc. 1:1 (water),
650 parts alkaline thickening,

1000 parts.

Thiogene Grey BD extra strong
Thiogene Black MD conc.



Thiogene Brown GCD conc.
Thiogene Black MD conc.

Grey Printing Colour:

2,5 parts **Thiogene Grey BD extra strong,**
50 parts glycerine,
137,5 parts water,
100 parts china clay paste 1:1,
50 parts soda lye $76^{1}/_{2}{}^{0}$ Tw.,
10 parts Hydrosulphite NF conc. 1:1 (water),
650 parts alkaline thickening,

1000 parts.

Brown Printing Colour:

10 parts **Thiogene Brown GCD conc.,**
25 parts glycerine,
165 parts water,
100 parts china clay paste 1:1,
10 parts soda lye $76^{1}/_{2}{}^{0}$ Tw.,
20 parts Hydrosulphite NF conc. 1:1 (water),
670 parts alkaline thickening,

1000 parts.

Black Printing Colour:

80 parts **Thiogene Black MD conc.,**
50 parts glycerine,
105 parts water,
75 parts china clay paste 1:1,
50 parts soda lye $76^{1}/_{2}{}^{0}$ Tw,
40 parts Hydrosulfite NF conc. 1:1 (water),
600 parts alkaline thickening,

1000 parts.

Treatment of the printed patterns: after printing the goods must only be lightly dried; they are then aged twice in the Mather-Platt (which must be free from air) for $2^{1}/_{2}$ minutes at 212—216° F, finally treated in the manner described on page 219.

Thiogene Cyanine OD conc.

Thiogene Brown SD conc.

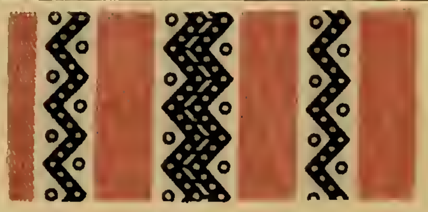
Blue Printing Colour:

25 parts	**Thiogene Cyanine OD conc.,**
50 parts	glycerine,
50 parts	soda lye 76$^1/_2$ % Tw.,
100 parts	china clay paste 1:1,
135 parts	water,
40 parts	Hydrosulphite NF conc. 1:1 (water),
600 parts	British gum thickening 1:1
1000 parts.	

Brown Printing Colour:

30 parts	**Thiogene Brown SD conc.,**
50 parts	glycerine,
50 parts	soda lye 76$^1/_2$ % Tw.,
80 parts	water,
100 parts	china clay paste 1:1,
40 parts	Hydrosulphite NF conc. 1:1 (water),
650 parts	alkaline thickening
1000 parts.	

Thiogene Green GLD extra conc.
Thiogene Black MD conc.



Thiogene Rubine OD extra strong
Thiogene Black MD conc.

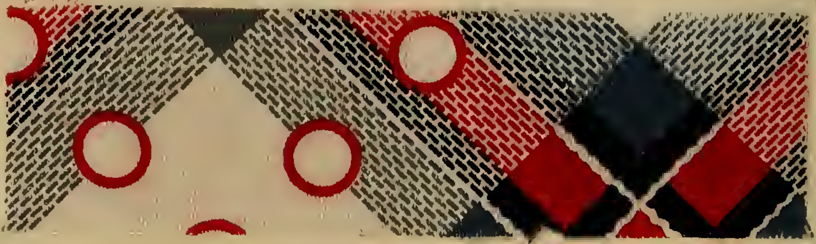
Green Printing Colour:

10 parts	**Thiogene Green GLD extra conc.,**
25 parts	glycerine,
170 parts	water,
5 parts	soda lye 76$^1/_2$ % Tw.,
100 parts	china clay paste 1:1,
20 parts	Hydrosulphite NF conc. 1:1 (water),
670 parts	alkaline thickening,
1000 parts.	

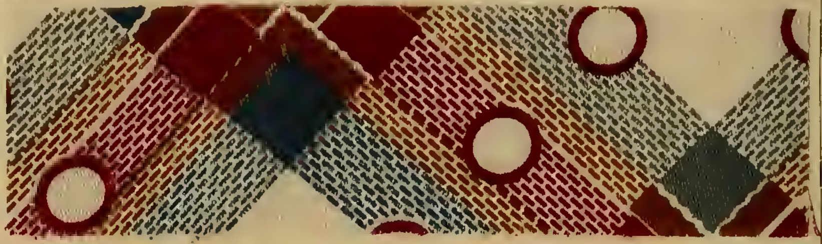
Purple Printing Colour:

25 parts	**Thiogene Rubine OD extra strong,**
155 parts	water,
50 parts	soda lye 76$^1/_2$ % Tw.,
100 parts	china clay paste 1:1,
20 parts	**Hydrosulphite conc. powder,**
650 parts	British gum thickening 1:1 heated to 122° F.,
1000 parts.	

The following two patterns illustrate the combination of **Thiogene Colours printed next to Azo Colours** on Naphthol prepare:



Naphthol ground: 20 parts/1000; Azo Pink BB: 26 parts/1000; Thiogene Cyanine GD conc.: 25 parts/1000; Thiogene Green GLD extra conc.: 25 parts/1000; Thiogene Black MD conc.: 80 parts/1000.

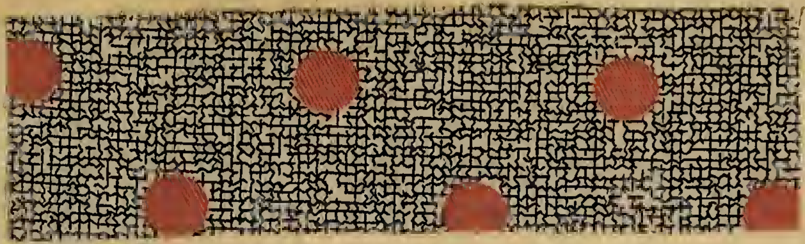


Naphthol ground: 20 parts/1000; α-Naphtylamine salt S powder: 28 parts/1000; Thiogene Cyanine GD conc.: 25 parts/1000; Thiogene Green GLD extra conc.: 25 parts/1000; Thiogene Brown GCD conc.: 25 parts/1000.

C. THE APPLICATION OF THE THIOGENE COLOURS IN RESIST AND DISCHARGE STYLES.

Owing to the alkaline and reducing properties of the printing colours produced with Thiogene dyestuffs, it is easy to use the latter for the production of very fast coloured resist and discharge styles.

The Thiogene Colours have already been successfully introduced into practice as resists under Aniline Black, Diphenyl Black, and other dyed and printed styles produced on the fibre by oxidation.

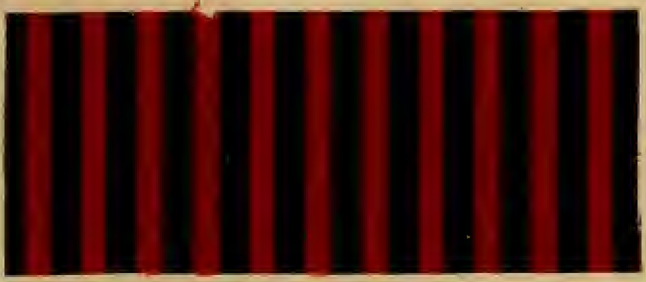


Thiogene Violet BD extra strong 25 parts/1000.
Cover: Diphenyl Black.

Steamed twice for $2^{1}/_{2}$ minutes, washed and soaped.

The strong alkalinity and great reducing power of the Thiogene printing colour pastes permit the discharge of Turkey Red, as well as of tannin- and chrome mordant grounds. For the latter an addition of citrate of soda is of advantage.

The possibility to utilize the Thiogene colours in tannin-discharged and chrome discharged styles is, however, a limited one, on account of their small degree of fastness to chlorine. The following patterns show a Thiogene Blue discharge upon Turkey Red and Para Red.



Turkey Red Thiogene Blue BD conc.

Thiogene Blue BD conc.
Discharge:

40 parts	**Thiogene Blue BD conc.**,
50 parts	glycerine.
50 parts	soda lye $76^{1}/_{2}$ % Tw.,
80 parts	china clay paste 1:1,
80 parts	Hydrosulphite NF conc. 1:1,
10 parts	water,
650 parts	alkaline thickening heated to 122° F. and
40 parts	silicate of soda $66^{1}/_{2}$ % Tw., added when cold,
1000 parts.	

After printing the goods are aged twice for $2^{1}/_{2}$ minutes, then very well washed, soaped and dried.

Para Red Thiogene Blue BD conc.

Thiogene Blue BD conc. Discharge:

40 parts **Thiogene Blue BD conc.,**
50 parts glycerine,
50 parts soda lye 106° Tw.,
100 parts china clay paste 1:1,
270 parts thickening BRW,
150 parts Hydrosulphite NF conc.,
heated to 122° F., and then
340 parts soda lye 76½° Tw. added when cold,
1000 parts.

Alkaline Thickening:

125 parts British gum
875 parts soda lye 76½° Tw.,
heated to 158° F.,
1000 parts.

Thickening BRW

100 parts wheat starch,
200 parts British gum,
700 parts water,
1000 parts.

After printing the goods are aged twice for 2½ minutes; further treatment same as with Turkey Red discharge, see page 223.

The coloured discharges by means of Thiogene dyestuffs upon grounds dyed with Dianil Colours are of special interest in combination with hydrosulphite white discharges upon raised materials, particularly owing to their very great fastness and suitability for raising. It is advisable to impregnate the goods before printing with chlorate of soda (5—10 parts per 1000).

Dyebath: 2% Dianil Blue H2G. β-Naphthol development. White: Hydrosulphite NF conc. Thiogene Black MD conc

Dyebath: 3% Dianil Green G, 1% Dianil Black CR, 1% Cresotine Yellow G. White: Hydrosulphite NF conc., Thiogene Yellow GGD conc.

Thiogene Black MD Printing Colour:

80 parts **Thiogene Black MD conc.,**
50 parts glycerine,
105 parts water,
75 parts china clay paste 1:1,
50 parts soda lye 76$^{1}/_{2}$ ° Tw.,
600 parts alkaline thickening,
40 parts Hyprosulphite NF conc. 1:1 (water),
1000 parts.

Thiogene Yellow GGD Printing Colour:

25 parts **Thiogene Yellow GGD conc.,**
50 parts glycerine,
50 parts soda lye 76$^{1}/_{2}$ ° Tw.,
100 parts china clay paste 1:1,
120 parts Hydrosulphite NF conc.
75 parts water,
580 parts alkaline thickening,
1000 parts.

Hydrosulphite Discharge White (for Dianil Colours):

80 parts wheat starch,
520 parts water,
300 parts china clay paste 1:1
are well boiled, then,
100 parts Hydrosulphite NF conc.,
added,
1000 parts.

Aged twice for 2$^{1}/_{2}$ minutes, and washed.

In Azo Colours styles the Thiogene Colours can be very well used for coloured discharges, owing to their being well fixed by means of hydrosulphite. Although the shades obtained in this manner are not as bright as those with basic dyestuffs, they are considerably faster. Thiogenc Black, printed with or without white discharges, presents a good substitute for Logwood Black, especially on raised goods. For obtaining coloured discharges on Alphanaphtylamine Claret and Benzidine Brown an addition to the printing colour of 30—50 parts Anthraquinone paste per 1000 is advantageous, as these Azo-colours are discharged to a pure white by Hydrosulphite and Anthraquinone even in the presence of strong alkalies.

Para Red.
White: Hydrosulphite NF conc.
Thiogene Black MD conc.

Alphanaphtylamine Claret.
White: Hydrosulphite NF conc.
Thiogene Cyanine GD conc.

Thiogene Black MD conc.
Discharge.

80 parts	**Thiogene Black MD conc.,**
50 parts	glycerine,
50 parts	soda lye $76^{1}/_{2}{}^{0}$ Tw.,
80 parts	china clay paste 1:1, dissolved by heating, then added,
20 parts	Hydrosulphite conc.
250 parts	thickening BRW,
150 parts	Hydrosulphite NF conc.,
320 parts	soda lye $76^{1}/_{2}{}^{0}$ Tw.,
1000 parts.	

Thiogene Cyanine GD conc.
Discharge.

10 parts	**Thiogene Cyanine GD conc.,**
50 parts	glycerine,
50 parts	water,
50 parts	soda lye $76^{1}/_{2}{}^{0}$ Tw.,
100 parts	china clay 1:1,
250 parts	thickening BRW,
150 parts	Hydrosulphite NF conc., dissolve, cool and add.
270 parts	soda lye $76^{1}/_{2}{}^{0}$ Tw.,
50 parts	anthraquinone paste,
1000 parts.	

Thickening BRW.

100 parts	starch,
200 parts	British gum,
700 parts	water,
1000 parts.	

After printing the goods are aged twice for $2^{1}/_{2}$ minutes; further treatment as with Thiogenc Blue discharge on Para Red, see page 224.

D. DYEING AND PADDING WITH THIOGENE COLOURS.

To the **dyeing** with Thiogene Dyestuffs only a short reference need be made here. For fuller details we refer to our book „The Thiogene Colours", published in 1904.

In order to dissolve the Thiogene Colours, they are made into a paste with water in a wooden vessel. Then the necessary quantity of sodium sulphide is added, and the whole boiled with water whilst being stirred. After that the colour solution is put into the dye-vessel, and the salt added last.

The Thiogene Colour baths are composed of:

1. The dyestuff,
2. Sodium sulphide,
3. Soda or soda lye,
4. Glauber's salt or common salt.

The object of the sodium sulphide is to dissolve the dyestuff. A slight excess of sodium sulphide is not detrimental to the dyebaths; an insufficiency of it causes a precipitation of the dyestuff. Soda and soda lye assist the dissolving action of the sodium sulphide. Common salt and Glauber's salt facilitate the dyeing. The deeper the shade required, and the larger the quantity of liquid in proportion to the material to be dyed, the larger must be the amount of salt used. The composition of the various dyebaths is shown in the table on the following page.

The dyeing with Thiogene Colours usually lasts an hour at the boil. After dyeing the goods are well and evenly squeezed, and then washed until the wash water is clear. In some cases the dyed goods are subjected to one of the following aftertreatments:

1. An aftertreatment with alkaline salts; the same is resorted to when the Thiogene dyestuffs have been treated with acids.

2. An aftertreatment with heavy metal salts, chiefly chrome — and copper-salts the object of which is to enhance the fastness of the colours to light and weather. The aftertreatment with copper, however, requires great caution, as too large quantities of copper are liable to tender the fibre on the goods being stored or, particularly, on steaming.

3. An aftertreatment by steaming is especially advisable for some brands of Thiogene Blue. In that case the goods are steamed for an hour in a suitable apparatus with air and steam.

4. An aftertreatment by hanging or storing the goods in a moist and warm place can be effected in place of steaming.

The dyeing with Thiogene Colours is carried out most frequently on the jigger. The dyeing on the jigger presents no difficulties whatever, if the material is rolled properly, and runs without creasing. In dyeing with Thiogene dyestuffs it must be born in mind that certain metals, especially copper, injuriously affect these dyestuffs, and are very strongly reacted upon by the

Methods of Dyeing with Thiogene Dyestuffs.

(Proportion of dye liquid 1 : 20.)

Dyestuff	% Dyestuff			% sodium sulphide cryst.			% soda calc.			% common salt		
	I	II	III	I	II	III	I	II	III	I	II	III
Thiogene Black M conc. . .	10	8	6	30	16	12	10	3	2	50	10	3
Thiogene Black BRR conc. .	10	8	6	20	8	6	10	3	2	50	10	3
Thiogene Black BB conc. . .	11	9	7	33	18	14	10	3	2	50	10	3
Thiogene Diamond Black V .	15	12	9	30	12	9	10	3	2	20	4	2
Thiogene Diamond Black B .	20	16	12	30	16	12	10	3	2	40	10	3
Thiogene Black 4B conc. . .	10	8	6	30	16	12	10	3	2	50	10	3
Thiogene Black MM conc. . .	10	8	6	30	16	12	10	3	2	50	10	3
Thiogene Black M solution . .	20	16	12	10	5,5	4	10	3	2	50	15	3
Thiogene Padding Black M sol.	22	16	12	10	5,5	4	10	3	2	50	10	3
Thiogene Black BRR solution	20	16	12	10	5,5	4	10	3	2	50	10	3
Thiogene Black BB solution .	20	16	12	10	5,5	4	10	3	2	50	10	3
Thiogene Cyanine G	10	8	6	15	8	6	5	2	2	30	6	3
Thiogene Cyanine O	10	8	6	15	8	6	5	2	2	30	6	3
*Thiogene Blue B	10	8	6	15	8	6	5	2	2	30	6	3
**Thiogene Blue R	10	8	6	20	8	6	5	2	2	30	6	3
**Thiogene Blue RR	10	8	6	20	8	6	5	2	2	30	6	3
*Thiogene Dark Blue BL . .	10	8	6	15	8	6	5	2	2	30	6	3
*Thiogene Dark Blue BTL . .	10	8	6	15	8	6	5	2	2	30	6	3
Thiogene Violet V	20	18	16	10	9	8	—	—	—	—	—	—
Thiogene Violet B	20	18	16	10	9	8	—	—	—	—	—	—
Thiogene Heliotrope O . . .	20	18	16	10	9	8	—	—	—	—	—	—
Thiogene Rubine O	10	9	8	5	4	3	—	—	—	—	—	—
Thiogene Dark Red R . . .	10	8	6	10	8	6	5	3	2	30	6	3
Thiogene Dark Red G . . .	10	8	6	10	8	6	5	3	2	30	6	3
Melanogene Blue B	10	8	6	—	—	—	5	2	2	60	20	5
Melanogene Blue BG . . .	10	8	6	—	—	—	5	2	2	60	20	5
Thiogene Green B	10	8	7,5	15	8	7,5	5	3	1,5	30	10	5
Thiogene Green GG	10	8	7,5	20	12	11	5	3	1,5	30	10	5
Thiogene Green BL extra . .	15	11	9	10	7,5	6	5	3	1,5	30	10	5
Thiogene Green GL extra . .	15	11	9	15	11	9	5	3	1,5	30	10	5
Thiogene Gold Yellow AO .	10	8	6	16	12	9	5	2	2	40	8	3
Thiogene Yellow GG . . .	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Yellow G	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Orange OG . . .	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Orange RG . . .	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Orange R	10	8	6	20	16	12	5	2	2	40	8	3
Thiogene Orange RR . . .	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Brown GC . . .	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Brown GR . . .	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Brown GRR . . .	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Brown R	10	8	6	5	4	3	5	2	2	40	8	3
Thiogene Brown RR . . .	10	8	6	5	4	3	5	3	2	40	8	3
Thiogene Catechu R	10	8	6	15	8	6	5	2	2	40	8	3
Thiogene Brown S	10	8	6	10	8	6	5	2	2	40	8	3
Thiogene Khaki O	10	8	6	—	—	—	—	—	—	20	4	2

* With addition of 2,5% sodium lye 76½° Tw. in the first bath. ** With addition of 10% Glucose in the first bath.

dye liquids. Consequently copper or bronze parts of the dyeing apparatus must be avoided. On the other hand, lead and iron may be employed in the construction of the dyeing apparatus. The boxes of the jigger are made either of wood or iron; the wooden or iron rollers run in sockets of pockwood. As a rule two jiggers are combined, as may be seen from fig. 12 (of the Zittauer Maschinenfabrik und Eisengiesserei, A.-G., at Zittau).

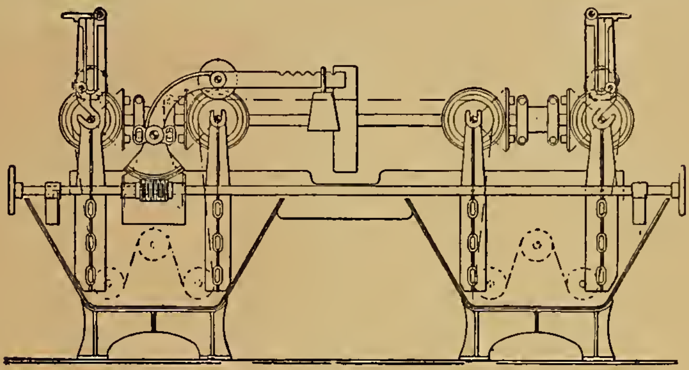


Fig. 12

The first jigger, the dye jigger, is fitted with an iron squeezing roller resting on (curved) levers and covered with Indian rubber. The squeezing roller is, moreover, specially weighted, and fitted with a contrivance for lifting the pressure roller from the winding roller. The squeezing appliance is made use of after dyeing; then the goods pass direct into the second jigger, the rinsing jigger, in which they are washed with cold water until the wash water runs off clear.

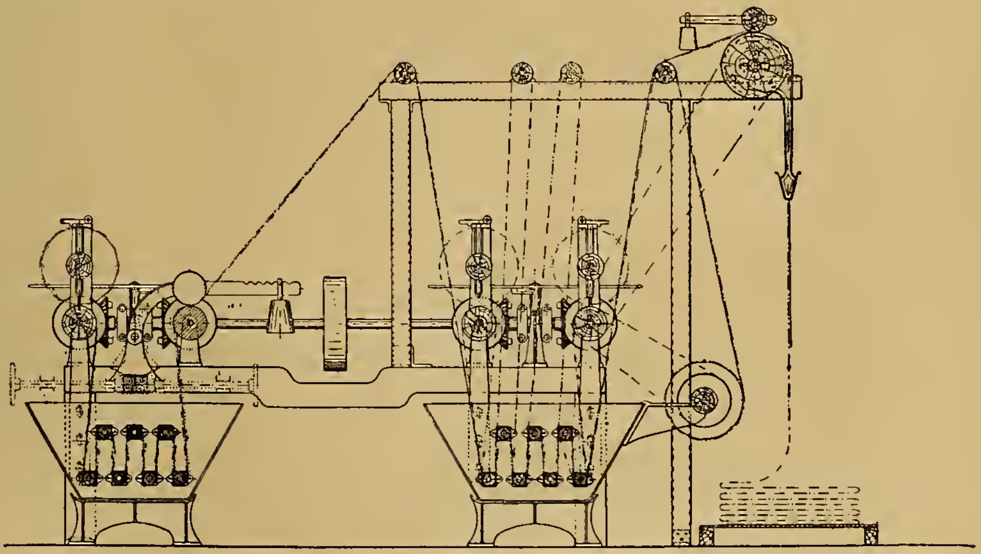


Fig. 13

In large dyehouses one washing jigger is connected with a range of dye jiggers placed one behind the other.

In dyeing with certain Thiogene dyestuffs, especially Thiogene Blue B, the dye jigger must be connected with an airing installation, so that the goods, after being taken out of the hot dyebath, may be perfectly cooled before being folded or rolled up. The above drawing fig. 13, illustrates an arrangement by which two successive jiggers can be used for this kind of blue dyeing.

Padding with Thiogene dyestuffs, which is based upon the great affinity of the Sulphur colours to the vegetable fibres, has, in comparison with the dyeing on the jigger, the advantage of greater efficiency and saving of labour and time. Moreover, it is well within the sphere of almost all print works, as they generally possess the requisite padding installation. Both light and dark shades turn out equally well, if the necessary precautions are observed. The employment of Thiogene Colours is advisable in all cases where fastness to light and washing are the first consideration, and in many cases they can advantageously replace the direct dyeing colours.

The padding of light and medium shades is carried out on a two roller padding machine, whereby the goods pass through the padding liquid in a box of the smallest possible dimensions, fitted with a continuous feeding arrangement. From the padding machine the goods pass directly through an open washing machine.

For dyeing dark shades by padding we recommend the roller cistern installation illustrated by the following sketch, fig. 14, in which the material is seen to run for some time (about $^1/_2 - 1$ minute), in the padding bath at the boil, whereby even heavy goods are dyed perfectly evenly and thoroughly. From the padding box, which is best made of iron, the well-squeezed goods pass direct into a roller cistern filled with water, where it is thoroughly washed; afterwards they are squeezed and dried.

A better utilization of the dyestuff can be obtained by subjecting the strongly squeezed goods to a short steaming after leaving the padding box and before being washed. This can be done best by the following alteration

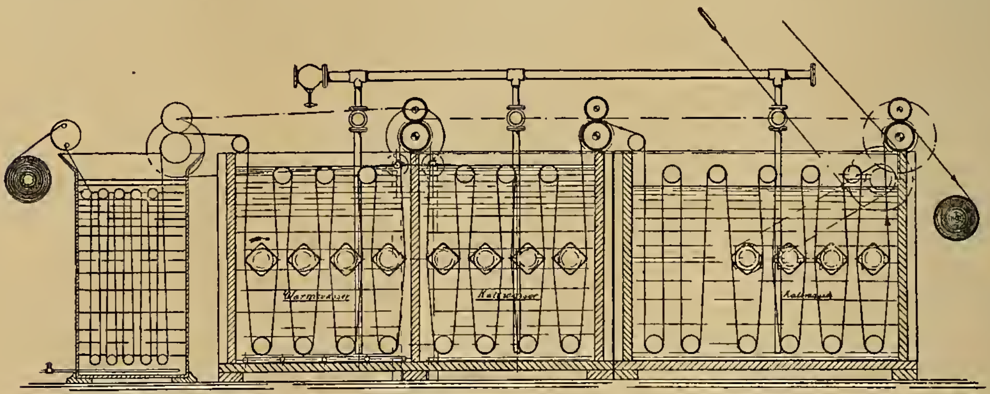


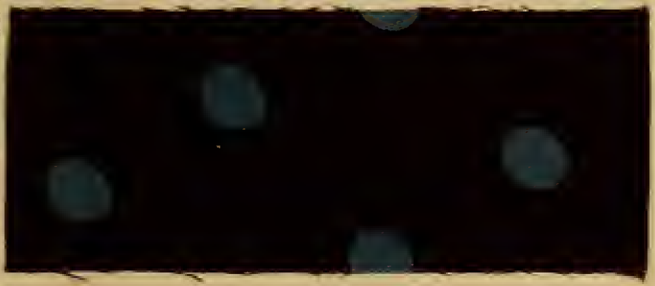
Fig. 14

of the installation: the first washing cistern is covered with a wooden lid having two slits for entry and egress of the goods, and transformed into a steaming chamber by means of a perforated steam pipe affixed to the bottom. By steaming the shades are advantageously developed. If the perfect fixation of the colours necessitates the goods being aired, the padded material must pass through an airing installation before washing.

The liquid brands of Thiogene dyestuffs are especially suitable for padding.

The padding baths contain the Thiogene dyestuff dissolved with sodium sulphide and the prescribed quantity of salts or caustic alkali. The padding liquid must be strained through a fine cloth before use.

By dyeing or padding goods with Thiogene Colours first and then dyeing them with insoluble Azo Colours the latter may be shaded very fast in a most successful manner. Thus, e. g. it is possible to obtain from Para Red, by preparatory dyeing with Thiogene Blue, Thiogene Cyanine, Thiogene Green or Thiogene Black, a series of very fast claret and brown shades. By covering them with a discharge prepared with Hydrosulphite NF conc. and subsequently steaming these combinations, very beautiful effects can be obtained.



Paranitraniline Red, grounded with 4% Thiogene Cyanine G. Discharge White NF (see page 205)

E. DISCHARGING THIOGENE COLOURS.

Although the Thiogene Colours, like all Sulphur Colours, are sensitive to chlorine, very highly concentrated chlorate discharges are necessary in order to produce an adequate discharge effect on them. Thin fabrics, therefore, are easily tendered and the chlorate discharge described below is only to be recommended for heavy fabrics. For light shades the less dangerous chlorate discharge used in Indigo printing can be employed.

An interesting use can be made of the Thiogene Colours by imitating materials for men's wear, in which the cloth dyed with Thiogene Black is discharged in fine one-coloured or multicoloured effects.

In order to obtain even results, the goods are well washed after dyeing, and soured with 3% acetic acid. The chlorate discharged goods are well dried and aged in the Mather-Platt for about 5 minutes at 212° F. If the discharge effect is not perfect, the pieces are steamed for $^1/_2$ hour without pressure in a closed steam box. Afterwards they are passed through a tepid bath (5 parts soda lye $76^1/_4$° Tw. per 1000 parts), at 122—144° F., and finally for 5 minutes through a soap bath at the boil. The chlorate coloured discharges are printed upon the previously white discharged and soaped material, which is then dried and steamed in the Mather-Platt or in a closed steaming box. Washing may be dispensed with in most cases.

The following Thiogene Colours are easily discharged: Thiogene Yellow G, Thiogene Orange OG, Thiogene Khaki O, Thiogene Catechu R, Thiogene Violet B and V, Thiogene Rubine O, Melanogene Blue B and BG, Thiogene Cyanine G and O, Thiogene Blue R, 2R and B, Thiogene Dark Blue BL and BTL, all brands of Thiogene Green, Thiogene Black M conc., MM conc., BRR conc., BB conc. and 4B conc., Thiogene Diamond Black B and V.

Discharge White I:

225 parts British gum powder are heated on the water bath with,
575 parts chlorate of alumina 42° Tw. and then added
150 parts chlorate of soda, powdered, and after cooling
50 parts red prussiate,
1000 parts.

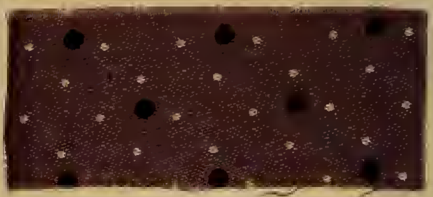
Discharge White II:

375 parts wheat starch-tragacanth thickening,
200 parts chlorate of soda, then added
100 parts china clay,
75 parts water,
100 parts citric acid,
100 parts water, and further added cold
50 parts yellow prussiate,
1000 parts.

Coloured discharges are generally made up as follows:

350 parts discharge lake (Chrome Yellow, Guignet Green etc.),
475 parts discharge white I,
150 parts albumen 1 : 1,
25 parts citrate of ammonia $52^1/_2$° Tw.,
1000 parts.

4% Thiogene Cyanine G
Discharge White I, reduced 2 : 1



10% Thiogene Violet V. Discharge White I, reduced 2 : 1, Logwood Black

6 % Thiogene Blue B
Discharge White I

8 % Thiogene Catechu R
Discharge White I

16 % Thiogene Diamond Black B
Discharge White I

1½ % Thiogene Black BRR conc.
Discharge White I, reduced 2 : 1

Materials for Men's Wear.

8 % Thiogene Black BB conc.
Discharge White I

8 % Thiogene Black M conc.
Discharge White I

V.

INDIGO.

Synthetic Indigo has, owing to its advantages over natural Indigo, almost entirely supplanted the latter in printing. These advantages are: the product remains always alike in strength and shade, it is consequently worked with greater certainty and is more conveniently manipulated, as the troublesome grinding operations are dispensed with; it requires less reducing agents and when discharged gives a purer white than natural Indigo, owing to the impurities of the latter always more or less affecting the white.

The Indigo brands put upon the market by the Farbwerke are:

Indigo MLB paste and powder,

the important Halogene derivatives of Indigo, distinguished for their great brilliancy:

Indigo MLB/R paste and powder,
Indigo MLB/RR paste and powder,

further two brands excelling by their fastness to chlorine:

Indigo MLB/T paste and powder,

and finally:

Indigo MLB vat I 20 %, and Indigo MLB vat II 20 %

which contain the Indigo in an already reduced state.

All the brands of Indigo paste contain 20 % of pure indigotine.

In calico printing Indigo is employed in various ways: the goods are either dyed first with the Indigo, and then white and coloured patterns are produced upon them by means of discharges, or white and coloured resists are printed first and then the goods are dyed in Indigo. Indigo can also be employed in direct printing.

A. INDIGO DYEING.

Cotton dyed with Indigo contains this dyestuff insolubly deposited, partly within, partly on the surface of the fibre.

In dyeing the Indigo dyestuff does not enter into any chemical combination with the cellulose, but is only mechanically affixed to the latter. The dyeing is effected in this manner that the Indigo Blue is first converted, by a process of reduction, into Indigo White, which is soluble in alkalies, and the „vat“ thus obtained is then used for dyeing.

If cotton is brought into a vat with an alkaline solution of Indigo White, the fibre absorbs the Indigo White in consequence of chemical affinity. On subsequent exposure to air the soluble Indigo White is re-oxidized to insoluble Indigo Blue. By repeating the immersion into the vat and subsequent oxidation of the Indigo White in the open air, any required shade can be obtained.

For Indigo dyeing, therefore, two different chemical reactions are of fundamental importance, viz. the process of Reduction which is required for the preparation and manipulation of the vat, and the process of Oxidation which reproduces the Indigo Blue from its „leuco“ state, the Indigo White.

As already stated, the dye vat consists of an alkaline solution of Indigo White. The process of reduction adopted for preparing the vats may vary according to the reducing agents employed:

1. The Sulphate of Iron or Copperas Vat,
2. The Zinc Lime or Zinc Soda Vat,
3. The Hydrosulphite Vat,
4. The Zinc Bisulphite Soda Vat,
5. The Fermentation Vat.

The fermentation process is no longer or scarcely ever resorted to in dyeing goods used for printing.

The processes of reduction taking place in the preparation of the various vats will be understood by the following chemical equations:

1. The Sulphate of Iron or Copperas Vat.

$$FeSO_4 + Ca(OH)_2 = Fe(OH)_2 + CaSO_4$$
$$2Fe(OH)_2 + 2H_2O = Fe_2(OH)_6 + 2H$$
$$\underset{\text{Indigo Blue}}{C_{16}H_{10}N_2O_2} + 2H = \underset{\text{Indigo White}}{C_{16}H_{12}N_2O_2}$$

i. e. the ferrous hydrate precipitated from sulphate of iron by caustic lime decomposes water in the presence of reducible substances (Indigo), and the liberated hydrogen reduces Indigo Blue to Indigo White. The latter dissolves in the excess of caustic lime forming Indigo White calcium.

2. The Zinc Lime or Zinc Soda Vat.

$$Zn + Ca(OH)_2 = ZnO_2Ca + 2H$$
$$\text{or } Zn + 2NaOH = ZnO_2Na_2 + 2H$$
$$\underset{\text{Indigo Blue}}{C_{16}H_{10}N_2O_2} + 2H = \underset{\text{Indigo White}}{C_{16}H_{12}N_2O_2}$$

i. e. zinc dust is converted by caustic lime or caustic soda respectively into calcium zinc oxide or sodium zinc oxide, whilst hydrogen is set free. The liberated hydrogen reduces the Indigo Blue to Indigo White which dissolves in the excess of caustic lime or caustic soda.

3. The Hydrosulphite Vat.

$$\underset{\text{Indigo Blue}}{C_{16}H_{10}N_2O_2} + Na_2S_2O_4 + 2NaOH = \underset{\text{Indigo White}}{C_{16}H_{12}N_2O_2} + 2Na_2SO_3$$

i. e. Indigo Blue is reduced to Indigo White in the presence of sodium hydrosulphite and caustic soda, whilst sodium sulphite is formed.

The Indigo White is dissolved in the excess of caustic soda.

4. The Zinc Bisulphite Soda Vat.

$$4NaHSO_3 + Zn = Na_2S_2O_4 + ZnSO_3 + Na_2SO_3 + 2H_2O$$

i. e. hydrosulphite is produced in the vat itself by interaction of zinc dust and bisulphite, and this, as stated above, reduces the Indigo in the presence of caustic alkali, and renders it soluble.

It is worthy of notice that, in preparing the Indigo vat, the manner of mechanical distribution, i. e. the degree of fineness of the powder has considerable influence upon the completeness and quickness of the reduction, especially in the zinc-lime and sulphate of iron vats. Whilst, however, natural Indigo requires prolonged grinding in order to be properly reduced, the paste brands of the artificial Indigos, as well as their powders, (the latter after being made into paste with warm water), are already quite prepared for this reduction.

The halogene derivatives of Indigo: Indigo MLB/R and MLB/RR powder and paste can be more readily reduced and more conveniently dyed in the hydrosulphite or zinc-bisulphite vat than in the zinc-lime vat, but may also be used in the latter. Their leuco compounds, however, are not so easily soluble as those of natural Indigo.

Indigo MLB/T can be more easily reduced than Indigo MLB, but it also yields a less soluble leuco compound.

The vats of the above-named Indigo brands are set in the same manner as those of Indigo MLB powder and paste.

The process of reduction is almost always accompanied by a greater or smaller loss of dyestuff, the foremost cause of which is the so-called over-reduction. This loss depends partly on the mode of setting the vats, partly on its manipulation, temperature etc., and amounts on an average:

1. in the copperas vat to about 20—24 %,
2. in the zinc lime vat to about 10—12 %,
3. in the hydrosulphite vat to about 2— 3 %.

The solution of the reduced Indigo, called the **Standard Solution** should be prepared fresh for daily requirements, because a prolonged standing of the standard solution makes further losses of Indigo inevitable.

In setting the vats it is advisable to follow exactly the directions given below, as otherwise greater losses of Indigo might occur. Indigo MLB Hoechst excels all other Indigos by being comparatively more easily reduced, this property also distinguishes it advantageously from natural Indigo. Moreover, if it is borne in mind that Indigo MLB represents a chemically pure product, whereas natural Indigo contains on an average 40—50 % of impurities which of necessity burden the vats, it is easily seen that working with artificial Indigo offers essential advantages.

The method of reducing the Indigo in the dye vat itself is not to be recommended; it is preferable to effect the reduction in a separate vessel, i. e. to prepare so-called **Standard Solutions.**

The time required for reduction is:

for the copperas vat about 2—3 hours,
for the zinc lime vat about 4—5 hours,
for the hydrosulphite vat about $^1/_2$—1 hour.

The proportions for the setting of the various vats are as follows:

1. COPPERAS VAT.

The copperas vat is still sometimes used as an immersion vat, for the production of resist styles.

The standard solution is advantageously prepared in the evening, and allowed to stand overnight so that it is ready for dyeing in the morning.

A) Standard Solution.

5 lbs Indigo MLB powder or 25 lbs Indigo MLB paste 20 %,
20 lbs sulphate of iron,
25 lbs lime.

The stated quantity of sulphate of iron is dissolved in hot water, then mixed with the Indigo paste, well stirred, and the slaked lime and as much water added so that the whole has the consistency of thick pea soup. The temperature of the standard vat is kept between 113—122° F., the mixture is well stirred and then left to itself until a thorough reduction has taken place.

In mixing the Indigo powder the stated quantity must be brought into the vessel intended for the preparation of the standard solution, and five times its weight of boiling water poured over it. Then, by continual careful stirring, preferably with a whisk broom, the mixture is made into an even pulp and diluted with warm water.

B) Dye Vat.

For more convenient working the vats are mostly let into the floor. Before adding the standard solution to the dye liquid, the oxygen contained in the latter must be counteracted. To effect this, 1 lb iron sulphate and 2 lbs lime are added to each 100 gallons water, the lime having previously been slaked to a milk; the liquid is then well stirred and left to stand for about one hour. After that the standard solution or, for lighter shades part of it only, is added, and after being well stirred, the vat is left to itself for 2—3 hours; then dyeing may be proceeded with. When the sediment has settled at the bottom, the surface dye liquid should have a brownish yellow appearance and on being lightly stirred, should show numerous dark blue veins. On the surface a blue coppery froth will settle which must be skimmed off before dyeing and added to the standard solution.

If the liquid looks greenish, it contains some Indigo not properly reduced, in which case some iron sulphate must be added. If, on the other hand, the appearance of the vat is dark, it is not sufficiently alkaline and more lime is required. It is impossible to determine the exact quantities of iron sulphate or lime, as these depend more or less on the state of the vat. An excess of both ingredients is to be avoided, as a vat containing too much lime will dye too slowly, whilst a vat containing too much iron sulphate will not dye sufficiently fast.

The dye liquid must always be well stirred up at night, and the requisite quantity of the standard solution must be added, unless it be preferred, as is mostly the custom in yarn dyeing, to exhaust the vats.

II. ZINC LIME VAT.

Compared with the copperas vat the zinc lime vat has this advantage that it shows less sediment and loses less Indigo in reducing. The vessels and mode of operation are identical. The vat is set as follows:

A) Standard Solution.

10 lbs Indigo MLB powder, or 50 lbs Indigo MLB paste 20 %,
6 lbs zinc dust,
20 lbs lime.

At first the slaked lime, then the zinc dust mixed with 4 gallons of water of 122° F. are added to the Indigo which has previously been made into a smooth paste. The standard solution, which must have an initial temperature of 113° F., must be allowed to stand for 5—6 hours, whilst being frequently stirred.

B) Dye Vat.

Before adding the standard solution to the dye vat, 5 oz zinc dust and 1 lb lime per 100 gallons water are added to the latter in order to counteract the oxygen contained in the water.

Sometimes iron filings are added to this vat, in order to effect, by contact action, a quicker liberation of the hydrogen retained in the sediment, and thus to accelerate the clearing of the vat.

If the latter contains too great an excess of zinc dust, however, hydrogen gas is constantly generated which prevents the sediment from settling and makes the liquid turbid and frothy. If this cannot be prevented by continuous stirring, Indigo must be added in order to bind the generating hydrogen gas.

The zinc dust vat, when in proper condition, closely resembles the iron sulphate vat. Its appearance is transparent and amber yellow; it has a bright coppery froth on the surface and shows blue streaky veins when lightly stirred.

The zinc lime vat is not only used in the continuous dyeing machines, but is also employed as on immersion vat for producing resist styles.

By substituting caustic soda for caustic lime in this vat, the more rarely employed **Zinc Soda Vat** is obtained.

III. HYDROSULPHITE VAT.

This vat has the advantage over the copperas and zinc dust vats of being free from sediment. It is, therefore, used wherever it is essential to have a perfectly clear Indigo solution, especially for dyeing goods in continuous machines. Dark shades dyed in the hydrosulphite vat turn out rather more greenish than those produced in the zinc lime or copperas vats. Compared with the other vats the hydrosulphite vat offers great advantages. It is therefore being more and more adopted in print works, instead of the zinc lime vat, notwithstanding its somewhat greater cost.

These advantages are:

1. Very little Indigo, only 2—3 %, is lost by over-reduction.
2. No sediment, consequently the vats may be kept and worked for on almost unlimited time.
3. Possibility of uninterrupted working, as, contrary to the zinc lime and copperas vats, which for their restoration must be allowed frequent rest, the hydrosulphite vat is always ready for immediate use.
4. Saving of acid, as the souring of the goods after dyeing can in most cases be entirely dispensed with.

A) Standard Solution.

10 lbs Indigo MLB powder, or 50 lbs Indigo MLB paste 20 %
are mixed with
2 gallons warm water, and stirred together with
3 gallons soda lye 77° Tw. The mixture is heated to 122° F., and
7 gallons Hydrosulphite O Hoechst are added.

The temperature is maintained at 113—122° F., and, if after $^1/_2$—1 hour the liquid is not quite yellow, then $^3/_4$—1 gallon Hydrosulphite O Hoechst are added.

B) Dye Vat.

The dye vat of about 200 gallons capacity, is first filled with water, and the oxygen contained therein neutralized with 14 noggins Hydrosulphite O Hoechst. The liquid is left to stand for some hours after being well stirred, and then the standard solution or part of it is added. It is again well stirred, then left to itself for some hours, after which dyeing may be proceeded with.

Simpler and safer is another kind of hydrosulphite vat in which Indigo MLB powder or MLB paste is replaced by a product put by us upon the market under the name of Indigo MLB Vat II. This vat is a 20 % solution of reduced Indigo.

The process of dyeing with Indigo MLB Vat II 20 % is similar to that with Indigo MLB paste 20 %. Whilst, however, with Indigo MLB paste 20 % a standard solution has first to be prepared and the process of reduction has to be carefully watched, the manipulation with Indigo MLB Vat II 20 % is considerably simpler, inasmuch as it is only necessary to add the required quantities of caustic soda and Hydrosulphite O Hoechst. The mixing can take place either in the dye vat itself, or a still simpler way is to mix the quantity of Indigo MLB Vat II 20 % necessary for the daily requirement in a tub with the ingredients above mentioned, and to use this solution for making up the dye vat.

Hydrosulphite is put upon the market by the Farbwerke as:

Hydrosulphite O Hoechst
Hydrosulphite conc. powder.

Hydrosulphite O Hoechst is comparatively stable, and, consequently, offers a certain safety in working the vat. Practical experience enables the dyer to gauge the consumption very accurately. Yet it is advisable, especially during the summer months, to fix the stock of Hydrosulphite according to the weekly requirements only, and to keep the product in a cool place.

Hydrosulphite conc. powder is about seven times as strong as Hydrosulphite O Hoechst. It is, therefore, necessary to take of this stable product only the seventh part of the quantities stated for Hydrosulphite O Hoechst. Hydrosulphite conc. powder is easily soluble; it may be stirred into the vat without being previously dissolved.

The Hydrosulphite solution can also be prepared by the dyer himself; this is advisable in hot countries where the product decomposes more easily; likewise for very remote places, as it is liable to be damaged by transport. For a rational preparation a filterpress is indispensable.

Hydrosulphite 23° Tw.

A petroleum cask is filled with 20 gallons water of 86° F., to which are added 8 gallons bisulphite 71 $^1/_2$° Tw., and afterwards 12 lbs zinc dust, made into a paste with 1 $^1/_4$ gallons warm water, mixed into it, the whole stirred slowly for $^1/_2$ hour, then left to stand for an hour, after which are added 1 $^1/_4$ gallons caustic soda, stirred again several times, and left to stand for another hour.

The clear hydrosulphite solution thus obtained is drawn off, and finally 10 noggins caustic soda 76 $^1/_2$° Tw. added.

IV. ZINC-BISULPHITE-SODA VAT.

This vat is also a hydrosulphite vat, but is distinguished from the latter by the fact that no ready made hydrosulphite is used, and that the same is formed in the vat itself. As the liquid does not oxidise quickly, and the condition of the vat does not depend on the quality of the ready made hydrosulphite which is liable to decompose, this vat is easily worked and controlled. Also in respect of cost it has advantages over the ordinary hydrosulphite vat, but has this disadvantage that it is not free from sediment.

In the zinc-bisulphite-soda vat the hydrosulphite is formed in the presence of the Indigo which it can at once reduce. The Indigo white produced is then dissolved by the addition of caustic soda or lime.

This vat is also used with advantage, not only for Indigo MLB powder or paste, but also for reducing the powder and paste brands of Indigo MLB/R, MLB/RR and MLB/T.

A) Standard Solution.

10 lbs Indigo MLB, or 50 lbs Indigo MLB paste 20 %
are made into a paste with
8, or 4 gallons water, then
$2^1/_2$ gallons sodium bisulphite $71^1/_2$—$76^1/_2{}^0$ Tw. are added,
and after the solution is well stirred,
5 lbs zinc dust which have been made into a paste with
warm water, are added.

The solution is stirred for another $^1/_2$ hour and left to stand about $^1/_2$ hour. Then $2^1/_2$ gallons caustic soda $76^1/_2{}^0$ Tw. are added under continuous stirring, and made up with water to about 30 gallons. The above stated quantity of caustic soda may be replaced by 16 lbs of lime which must previously have been well slaked with water.

The standard solution must have an initial temperature of 113—122° F. The reduction is complete as soon as the colour of the standard solution has turned to a golden yellow, which takes place in about $^1/_2$ hour after the caustic soda or the lime has been added.

B) Dye Vat.

A vat containing about 200 gallons is first filled with water, then are added:
$1^1/_2$ nog. sodium bisulphite $71^1/_2$—$76^1/_2{}^0$ Tw., mixed with
5 nog. cold water, to which are added
1 oz zinc dust.

The whole is stirred for 10 minutes and left to stand for about 20 minutes, until the smell of sulphurous acid has disappeared. This mixture having been added to the dye vat, it is well stirred, after which $^3/_4$ nog. more caustic soda $76^1/_2$° Tw., or $2^1/_2$ oz lime are added, the whole stirred again and left to stand for $^1/_2$—1 hour.

The standard solution, or a part of it, is now put into the dye vat, well stirred, and after it has been allowed to stand for about an hour, it is then ready for dyeing.

The Indigo brands MLB/R and MLB/RR can be mixed in any proportion with Indigo MLB or MLB/T, not only in the hydrosulphite vat, but also in the zinc lime vat. The first named brands are reduced either by themselves with hydrosulphite or with zinc dust and bisulphite in the above described manner, and the reduced solution is added to the Indigo vat; or the reduction of the Indigo mixture is carried out in the vat.

In working the vats with Indigo MLB/R and MLB/RR it is to be noted that the alkaline solution of these two brands is considerably redder than that of Indigo MLB.

THE PRACTICAL APPLICATION OF VAT DYEING.

For Indigo piece dyeing two kinds of vats are in general use: the immersion vat and the continuous vat.

The goods, in order to be properly dyed, must previously be well boiled, so as to avoid unevennesses. In most cases boiling in lye or a halfbleach suffice for light blue, but for discharged styles, where great purity of white in the discharged places is demanded, a full bleach is advisable.

The pieces are entered into the dye vats, either dry or wet, but thoroughly squeezed out. In the latter case the drying before dyeing is dispensed with, moreover wet goods bring less air into the vats than dry goods.

Materials which serve for pulp resist styles, are mostly previously prepared with starch solutions either alone or with an addition of glue, Turkey red oil etc. These prepares act favourably upon the resist effect as also upon the blue shade.

In some cases the pieces are first dyed with certain dyestuffs, e. g. with Sulphur colours, or with manganese mordant, this brings about a saving of dyestuff, and cheapens the production.

Also the mercerising action of caustic alkali is often utilized in Indigo dyeing.

For **Immersion Vats** sinking frames are used to which the pieces are spirally attached on hooks; these frames are bodily immersed into the vats for some minutes, according to the strength of the liquid and the depth of shade required. The frame is then lifted and exposed to the action of air until all the Indigo white is completely oxidised. For the second dip the frame is turned top to bottom and so on for further dips.

Mechanically reversible sinking frames are constructed by C. H. Weisbach in Chemnitz.

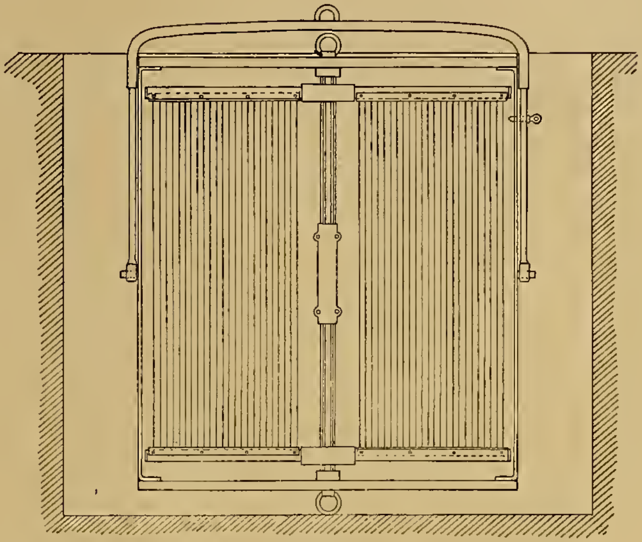


Fig. 15

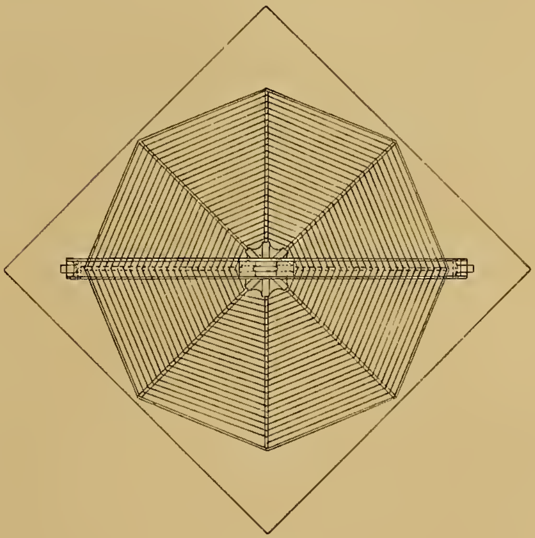


Fig. 16

At first several dips are given in weak vats, then the frame is immersed in a stronger, and finally in a very concentrated vat.

This immersion process is chiefly applied to heavy goods which do not dye through easily, for the frames can be left in the dye liquid for any length of time, whilst the time cannot be varied at will to the same extent in continuous dyeing machines. These sinking frames are further employed with advantage for goods which are to be dyed on one side of the fabric only. In this case two pieces are fixed back to back on to the hooks of the frame and the latter then immersed. On exposing the dyed pieces to the air, only the outer sides are oxidised and the Indigo is chiefly deposited there. For dyeing pieces on sinking frames the zinc lime vat is more suitable than the hydrosulphite vats, as the dye liquid of the latter, which contains the hydrosulphite and caustic soda, is not squeezed out in this case, and uneven results are likely to occur.

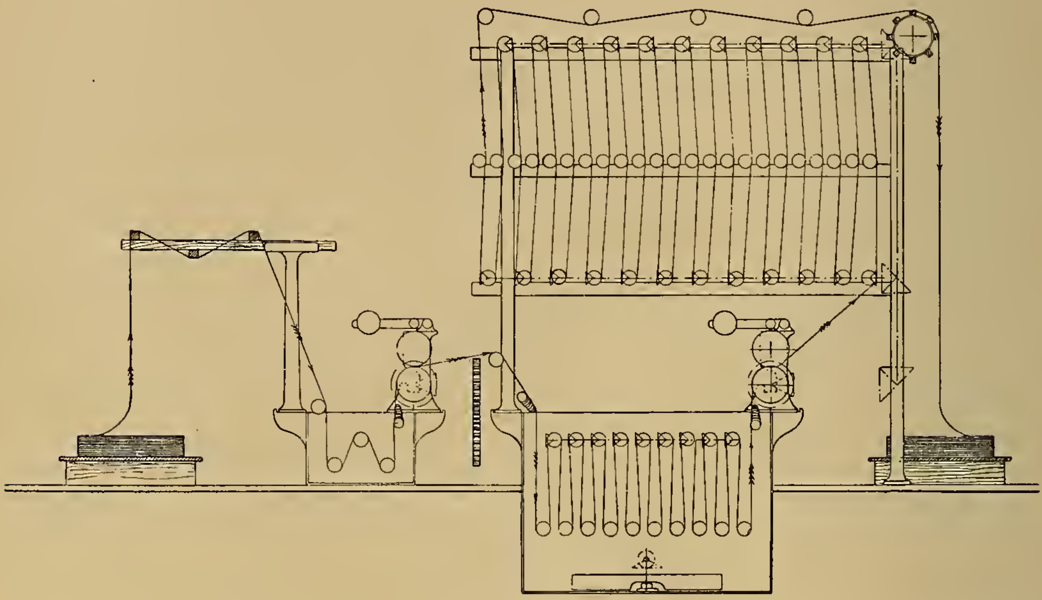


Fig. 17

The output of a **Continuous Dyeing Machine** is infinitely larger than that of immersion vats. The pieces are run through continuous vats over a system of guide and squeezing rollers, and are then oxidised by passing through an airing installation which is generally fixed above the dyeing cisterns.

The dyeing operation may be repeated as often as necessary, the length of each passage varying from $1^1/_2$—3 minutes, and being regulated by means of a friction motion or by a graduated system of driving gear.

The above sketch shows an installation by Mess^rs. Mather and Platt, Limited of Manchester.

In working with the copperas or zinc lime vat which contain larger quantities of sediment, handrakes were formerly used for stirring the liquid.

This operation was afterwards superseded by mechanical apparatus, as illustrated in Fig. 18 by C. G. Haubold jun., in Chemnitz.

As a rule the vat is stirred twice daily for a few minutes, some standard solution being added each time.

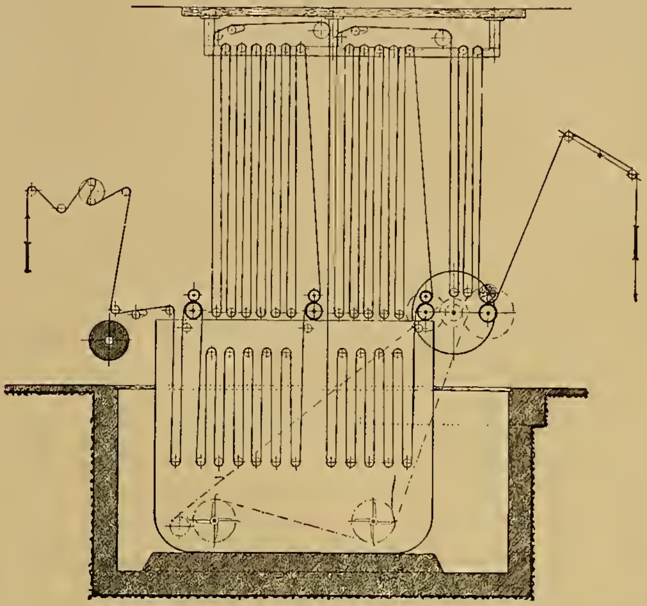


Fig. 18

Although clear vats are generally preferred to muddy ones, still there are dyers who have their vats stirred continually. Their object is to prevent the sediment from increasing too quickly, and not to lose time in waiting for the liquids to clear. A muddy vat, however, is easily subject to irregularities: uneven shades, loss of Indigo etc. Practical dyers differ in their opinion whether the muddy vat or the clear vat is preferable.

Where the dyeing is carried out on a large scale, the goods, instead of being aired by means of guide rollers, are plated down upon an endless band on leaving the vat. Such a plant, illustrated by fig. 19 and 20, is that of Mess^{rs}. Mather & Platt Ltd., Manchester.

The continuous vat is generally prepared with the zinc lime vat, or more recently with the hydrosulphite vat. For dark blue shades the vat contains from $2^1/_2$—$3^1/_2$ oz of Indigo M L B paste per gallon of

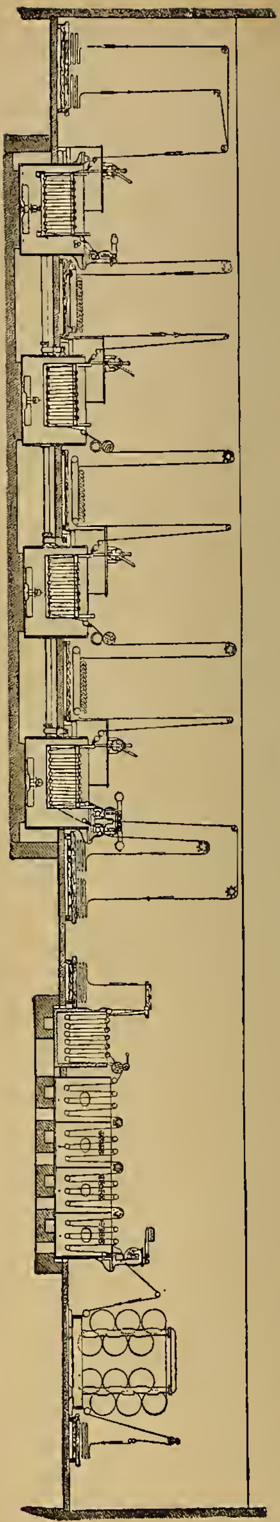


Fig. 19

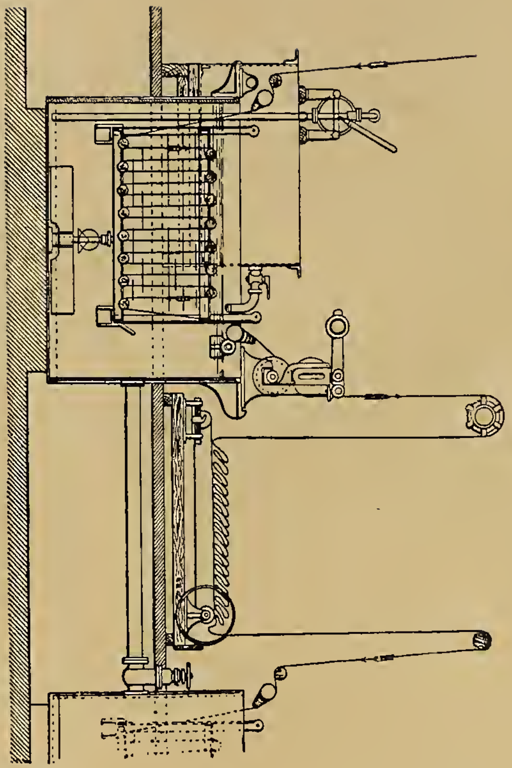


Fig 20

liquid, and for light blue shades $^1/_2$—1 oz of Indigo MLB paste 20 %. Instead of Indigo MLB paste the same quantity of Indigo MLB Vat II 20 % may be used. The vats are kept up to their initial concentration until, for certain reasons, the Indigo has to be exhausted. In some establishments the complete exhaustion is effected in immersion vats into which the contents of the continuous vats are given. A continuous machine of 1200—1600 gallons capacity, containing a concentration of $2^1/_2$—$3^1/_2$ oz Indigo MLB paste 20 % (or Indigo MLB Vat II 20 %) yields the usual dark blue shades in four dips. For medium blue shades the pieces pass through the liquid at a higher speed, or only 2 or 3 dips are given. Light blues are obtained in weaker vats in 2—4 dips, according to depth of shade required.

A vat of 1600 gallons capacity is first neutralized with 2 gallons Hydrosulphite O Hoechst, and then set with:

240 lbs Indigo MLB Vat II 20 % (23 gallons) mixed previously with
12 gallons soda lye 66° Tw.
30 gallons hot water 158° F.
15 gallons Hydrosulphite O Hoechst.

The vat is stirred for some minutes, and as soon as the liquid shows a yellow-olive colour, it is ready for use.

In order to keep this vat in good condition, it is advisable to add at noon and at night 5—7 pints of Hydrosulphite O Hoechst.

To maintain the initial concentration of the dye liquid, Indigo MLB Vat II is best added to the vats in two portions, the second addition being made after the pieces have been through the machine twice. The amount of Indigo depends, of course, on the material and the depth of the shade required, and for an output of 25—30 pieces of 125—140 yards each $^1/_4$—$^1/_3$ of the amount necessary for setting the vat will be sufficient.

For light blues the vats are set and worked in the same manner, but proportionately weaker.

After dyeing the pieces should be thoroughly washed, but for printed goods an acid bath is often necessary.

When the goods are dyed and oxidised, they must be thoroughly cleansed. In certain cases, e. g. for the production of pulp resist styles, they are well dried before souring and washing, whereby also deeper shades are obtained. In plain goods drying after dyeing is usually omitted.

Pieces which have been dyed in a copperas or in a zinc-lime vat, are treated with sulphuric or, preferably, with hydrochloric acid, in order to neutralize the lime salts. They are then well washed. Sometimes the goods are dried first, then soured and finally washed; this method yields somewhat darker blues.

For souring and washing piece goods **Continuous Souring and Open Washing Machines** are used. Those by Mather & Platt Ltd., Manchester are shown in fig. 19 and 20.

In large works the Indigo which comes off in washing, is collected in special tanks. Also the sediment of exausted vats are sometimes treated with acid in order to regain, by means of a filter press, the Indigo which is contained in the muddy deposit.

The **Fastness** of Indigo dyed goods depends greatly on the **method of dyeing.** Well reduced and normally working vats yield faster shades than those which contain an excess of reducing agents or alkali. Short passages in concentrated vats give inferior results than long passages in weak vats. These conditions have a decided effect upon the fastness to washing and rubbing. The latter may however, be improved, though at the expense of the depth of shade, by an aftertreatment with a weak hydrosulphite solution; this draws the Indigo which is deposited superficially into the heart of the fibre.

As already mentioned, the hydrosulphite vat gives generally more greenish shades than the copperas and zinc-lime vats; the more so, the more alkaline and the more reduced the vat is. If it is desired to obtain more reddish shades by means of the hydrosulphite vat, it is necessary to use the smallest possible amount of hydrosulphite. In the hydrosulphite vat the goods oxidise more slowly than in the zinc-lime vat. The former necessitates, therefore, a longer airing or a slower running of the machine.

Coppery shades of Indigo blues are obtained by a final short passage through a very concentrated vat.

In order to improve the **Fastness to Light** of Indigo shades an aftertreatment with copper sulphate in an acetic acid bath is advisable; the shade thereby turns somewhat greener.

Very often the goods are previously treated with glue, (solution of 10—15 parts in 1000). This renders the shade brighter and redder, and faster to rubbing.

The reaction of strong alkalies (mercerisation) enhances the affinity of the cotton fibre for Indigo considerably; shades thus obtained are redder, but they are not dyed through very thoroughly; the Indigo is deposited more on the surface.

The shade is also turned towards red by steaming, but its fastness to rubbing is thereby impaired, nor is it fast to washing.

Sometimes a duller shade is wanted. This is obtained by passing the material through a hot starch solution of 10—15 parts in 1000.

Our trials have proved that the **Fastness of Indigo blues to Washing and Chlorine** can be materially improved by previously treating the cotton with soda Turkey red oil and soda-aluminates.

Our **Indigo MLB/T**, on the other hand, gives also without such treatments shades fast to bleaching, which favourable property is due to its peculiar chemical constitution.

In order to **detect the presence of Indigo on the fibre** it is only necessary to spot the material with concentrated nitric acid. Pure Indigo shades will show a yellow stain with greenish rim; if mixed with other dyestuffs a more brownish stain becomes apparent.

Another safe test is that of sublimation. A small piece of the material is burned in a white porcelain dish: Indigo if present will sublimate on to the cold parts of the dish. By means of boiling glacial acetic acid and phenol Indigo can be stripped quantitatively from the fibre.

The following tables illustrate the effect of the initial preparation and of the various vats upon the intensity of the Indigo shades, and also demonstrate the shades of the various Indigo brands, their dischargeability and suitability for resist effects.

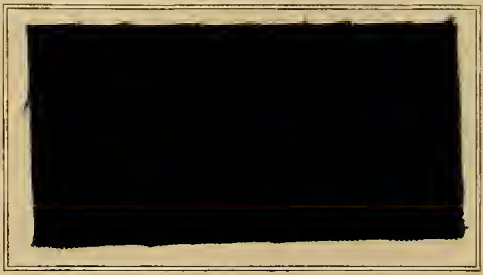
In the next chapter the production of Indigo styles to be considered in calico printing will be discussed at length.

Indigo **MLB** dyed in the zinc lime vat upon various prepares.


No. 1


No. 2


No. 3


No. 4


No. 5


No. 6


No. 7


No. 8

No. 1

Bleached goods.

No. 2

Bleached goods padded with chloride of iron solution 6° Tw., then passed through a boiling solution of soda 30 parts per 1000, washed, dried and starched.

No. 3

Bleached goods previously prepared with 3 parts glue per 1000.

No. 4

Bleached goods mercerised with soda lye 30° Tw.

No. 5

Bleached goods previously prepared with
50 parts potato starch
15 parts glue
1000 parts water

No. 6

Bleached goods previously prepared with
25 parts potato starch
25 parts glue
5 parts nitrate of ammonia
per 1000 parts.

No. 7

Bleached goods previously prepared with
25 parts potato starch
25 parts glue
5 parts sulphate of copper
per 1000 parts.

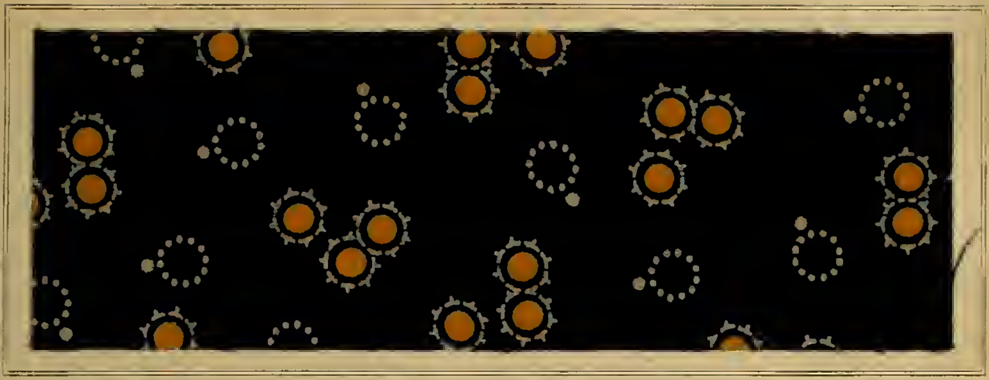
No. 8

Bleached goods previously prepared with
25 parts potato starch
25 parts glue
5 parts sulphate of manganese
per 1000 parts.

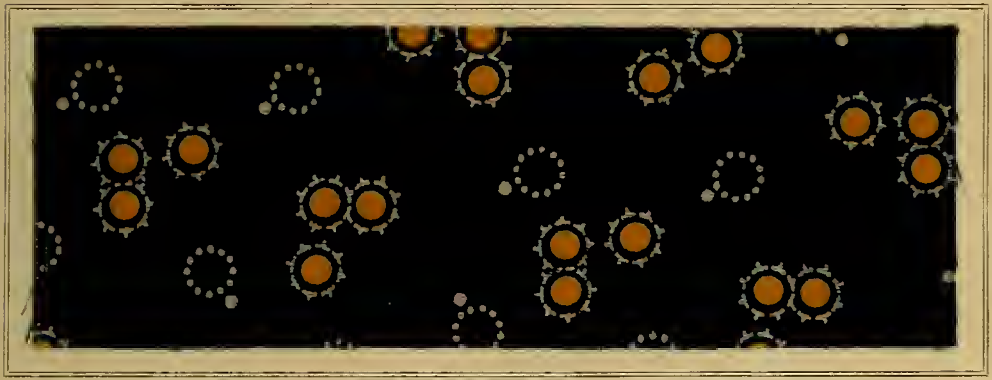
Indigo MLB dyed in the hydrosulphite vat.

Indigo MLB dyed in the copperas vat.

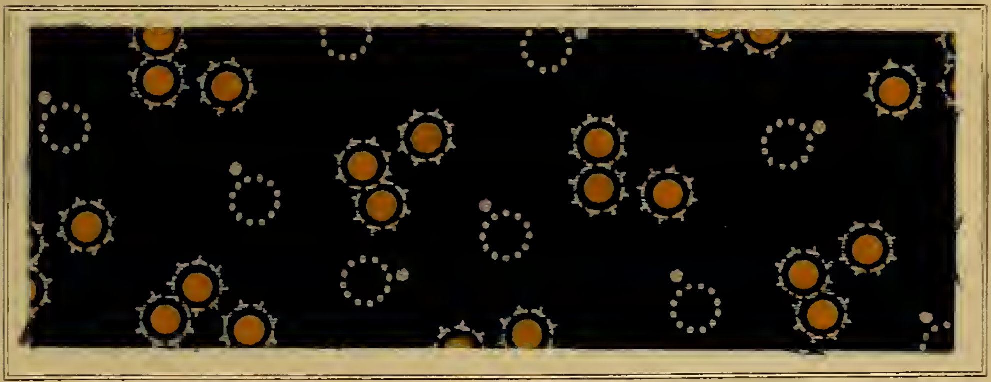
Indigo MLB dyed in the zinc lime vat.



Indigo MLB dyed in the hydrosulphite vat, and discharged with chromate discharges.

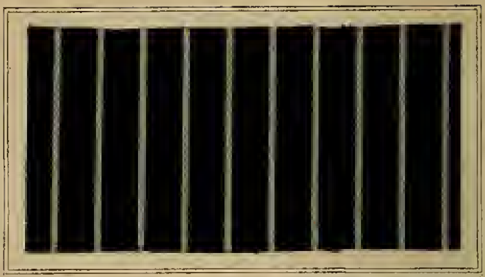


Indigo MLB dyed in the copperas vat, and discharged with chromate discharges.



Indigo MLB dyed in the zinc lime vat, and discharged with chromate discharges.

Indigo MLB.

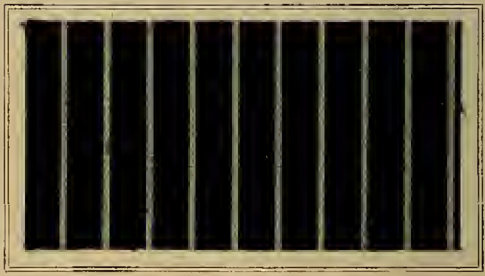


Indigo MLB discharged with chlorate.

Indigo MLB/R.

Indigo MLB/R discharged with chlorate.

Indigo MLB/RR.



Indigo MLB/RR discharged with chlorate.

Indigo MLB/T.

Indigo MLB/T cannot be discharged to a pure white with chlorate.

White resist under Indigo MLB.

White and Orange resists under Indigo MLB.

White resist under Indigo MLB/R.

White and Orange resists under Indigo MLB/R.

White resist under Indigo MLB/RR.

White and Orange resists under Indigo MLB/RR.

White resist under Indigo MLB/T.

White and Orange resists under Indigo MLB/T.

B. INDIGO DISCHARGE PRINTING.

Indigo has the property of being converted by oxidation into colourless and easily removable isatine. This makes the production of Indigo discharge styles possible in a sure and expeditious manner. The most important discharging agents for Indigo are chromates and chlorates (bromates), also alkaline ferricyanides, in combination with caustic alkalies. Latterly it has been found that certain reducing agents e. g. Hydrosulphite NF conc. with the addition of Anthraquinone reduce Indigo on steaming and form a fairly stable Indigowhite compound which can then be removed from the cloth by passing the goods through a hot solution of caustic soda at 3° Tw.

The Indigo dyed goods to be discharged must be clean and without stains; above all lime stains or grease stains are to be avoided, as they counteract and resist the discharges. It is therefore advisable after dyeing to thoroughly wash and sour the goods to be discharged.

1. CHROMATE DISCHARGE.

In discharging by this method, chromic acid, which oxidizes the Indigo into isatine, is liberated by means of a passage through hot acids. This method of discharging Indigo is indispensable for multicoloured Indigo styles; insoluble pigments (vermilion, chrome yellow, Guignet green, smalt blue, lakes, artificial dyestuffs etc.) are printed thogether with chromates and albumen solution; then the lakes are fixed in the hot acid bath which coagulates the albumen. By the reaction of chromic acid upon cellulose, however, oxycellulose is formed which always impairs the fibre. In order to obviate this, organic substances, such as glycerine, alcohol, leiogomme etc., are added to the hot acid bath, which mitigate the chromic acid reaction to a certain extent. Oxalic acid seems to act in a similar manner; it is, therefore, almost always added to the acid bath. It regulates the discharging and counteracts the superfluous chromic acid.

The albumen used is dissolved with advantage by the addition of some borax. Ammonia and turpentine are added to the colour pastes, as they enhance the consistency of the printing colours and avoid frothing. These albumen colours are liable to clog the engraving of the rollers; therefore the colours must be well ground and strained before printing, and brush furnishers must be used. The amount of chromate in the discharges is regulated by the depth of the engraving, and by the depth of the original blue shades. For very strong discharges bichromate of sodium, which is very soluble, is used with advantage. In order to neutralize the chromic acid, it is usual to add to the chromate discharges soda or ammonia; this is especially important for coloured discharges containing albumen. The chromate discharge method is sometimes combined with that of the chlorate discharge which will be discussed further on, e. g. in multicoloured discharge styles the white discharge can be effected with chlorate and the coloured discharges with chromate. In this case the passage through the discharge bath is preceded by steaming in the Mather-Platt.

Standard White Discharge I.

180 parts potassium bichromate
276 parts hot water, neutralized with
64 parts soda calc., then
280 parts burnt starch
200 parts water added

1000 parts

heated to 140° F., cooled and strained. Before use slightly warmed.

For discharging the darkest blue shades sodium bichromate is used with advantage.

Standard White Discharge II.

250 parts sodium bichromate
430 parts water
70 parts soda lye 76$^1/_2$° Tw.
250 parts burnt starch

1000 parts.

An addition of small quantities of albumen to the white discharge causes the outlines to appear sharper and prevents the colour from marking off. In this case it is advisable to steam the printed goods for 15—30 seconds in the Mather-Platt, before passing them through the acid bath; this also obviates the blurring and marking off. By means of this strongest discharge even the halogen derivatives of indigo, i. e. Indigo MLB/R and MLB/RR can also be discharged.

Standard White Discharge III.

200—300 parts sodium bichromate
470—350 parts water
300 parts burnt starch
heated, cooled, then added:
30—50 parts blood albumen 1:1

1000 parts.

For coloured discharges may be used: Chrome Yellow, Vermilion, Ochre, Guignet green and other commercial pigments.

Of the Lakes supplied by the Farbwerke, Hoechst, the following are especially suitable for coloured discharges upon Indigo: Pigment Chlorine GG, Pigment Chrome Yellow L, Pigment Orange R, Pigment Red B, and Lake Red P.

	Discharge Yellow,	Discharge Red,	Discharge Green
Chrome Yellow Lake	400	—	—
Red Lake	—	400	—
Vermilion	—	135	—
Olive Lake	—	—	400
Tragacanth (60:1000)	—	—	200
Albumen 1:1	400	320	250
Ammonia	60	35	—
Olive Oil	15	—	40
Turpentine	15	—	—
Sodium Bichromate	110	110	110
		1000 parts	

The discharge colours are finely ground and then strained.

After being printed with the discharge colours, the goods are well dried, and then passed in the roller cistern for about $^1/_2$ minute through an acid bath about 140° F., containing:

50 parts sulphuric acid 168° Tw.
50 parts oxalic acid
1000 parts water.

The chromic acid liberated in the acid bath is liable to convert the cotton into oxycellulose. In order to obviate this, as has been mentioned before, certain organic substances are added, e. g. glycerine, leiogomme, starch sugar etc. The addition of Diamalt thickening acts very advantageously; it contains chiefly maltose, and can be easily and cheaply prepared as follows:

20 gallons water and
100 lbs potato starch are heated, whilst being stirred, to 131° F., then are added
2 lbs Diastaphor, the paste well stirred for about 20 minutes, and the temperature raised to 149° F.
The mixture is then cooled, after which are added
100 lbs potato starch, heated to 122° F., then again
4 lbs Diastaphor, are added, and the whole left to stand for an hour at 149° F, and finally heated to the boil.

This concentrated starch-sugar solution is a very good and cheap substitute for glucose. It contains about 70—75 % maltose, 10—20 % maltose dextrine, besides some unconverted starch.

Of this solution 5 parts per 1000 are added to the acid bath.

After souring the goods must be well washed, in order to prevent the fibre from being impaired, when dried.

In several print works the chromate discharge process has been considerably improved by leaving the oxalic acid out of the discharge bath, and by adding instead oxalate of potassium, or oxalate of lime to the discharge colours.

Pattern produced on a large scale.

Standard White Discharge II: reduced 2:1,
Discharge Yellow, Discharge Red, Discharge Green.

For illuminating Indigo discharged styles direct dyeing cotton dyestuffs fast to acid and insoluble Azo colours can also be used, by printing chromate discharge upon the Indigo dyed goods prepared with β-Naphthol. To these chromate discharges the Diazo compounds necessary for the production of Azo colours are added. After souring very bright red or orange discharge effects are obtained by the destruction of the Indigo in the printed places. These discharge effects are considerably faster to washing than the lakes fixed with albumen. Of the Diazo compounds that of the Amido-azo-benzine, Paranitraniline, Metanitraniline, are suitable for this purpose, the latter also in their stable forms as Azophor Red PN and Azophor Orange MN. The production of pure white discharges next to insoluble Azo colours presents some difficulties which can only be overcome by the employment of insoluble or not easily soluble chromates, as e. g. barium chromates. This method has, however, been superseded by the process described on page 273.

Naphthol Prepare.
25 parts β-Naphthol R.
50 parts soda lye 36° Tw.
25 parts Para soap PN
made up to 1000 parts.

Discharge Red Printing Colour A.
270 parts tragacanth (60:1000)
180 parts sodium bichromate
550 parts Azophor Red solution 224:1000
1000 parts.

Azophor Red solution 224:1000.
224 parts Azophor Red PN
600 parts water. After filtering:
100 parts soda lye 36° Tw.
300 parts water are added
1000 parts.

Discharge Red Printing Colour A.

The chromate discharge method has also been applied for the production of Alizarine Red dyed styles upon Indigo grounds. For this purpose the material is impregnated with chromate, and after drying printed with a colour containing aluminium sulphate or aluminium chloride mixed with oxalic acid, whereby the discharge and a topical mordanting with alumina is effected. After fixing and washing the goods are dyed with Alizarine Red in the usual way.

2. CHLORATE DISCHARGE.

The Chlorate Discharge has recently found more favour than the chromate discharge, as it is less liable to form oxycellulose and to impair the fibre. Moreover, the present fashion prefers simply white discharged to coloured discharged styles. For large designs (stripes, checks or spots) the chromate discharge must be replaced by chlorate discharge, because the former would weaken the fibre too much, and the white would not be as pure as with the chlorate discharge.

The Chlorate discharge is a so-called steam discharge, and contains — besides alkali chlorate which can also be replaced by certain metal chlorates, as e. g. aluminium chlorate, and by bromates — yellow and red prussiate compounds, as well as free organic acids or their ammonia salts, The yellow and red prussiate compounds act as carriers of oxygen, and regulate the decomposition of the chlorate; they act in a similar manner to that of certain metal compounds, e. g. copper-, vanadium-, or cerium-salts, in other oxidising colours.

Particularly energetic chlorate discharges are obtained by substituting for the alkali chlorate the aluminium or zinc chlorates, which dissociate very easily. These can be prepared either separately and then added to the discharge, or by double decomposion within the printing colour itself, e. g. with sulphate of alumina and chromate of barium or chromate of soda. These aluminium chlorate discharges are, however, dangerous, as their action is too energetic and corrosion of the fibre is difficult to avoid. Their employment, therefore, is only advisable for discharging small designs upon heavy fabrics dyed in dark colours

As already mentioned, bromates, e. g. ammonium bromate, are sometimes added to the chlorate discharge, for experience shows that both bromine compounds and free bromine weaken the fibre less than chlorine and chlorates. But the discharges containing bromine are liable to produce a yellowish white. They may be used in combination with alumina mordants, by which the production of bright Alizarine red discharges on Indigo (F. Brandt) is made possible. As the chlorate discharges which contain organic acids are only stable to a limited degree, it is necessary to prepare two standard colours separately, one solution containing the organic acids, the other the chlorate. These standard pastes are mixed immediately before use. It is to be noted that concentrated chlorate discharges greatly tend to crystallize if kept in a cool place. These small crystals blunt the doctors, and are apt to produce doctor-streaks; for that reason it is advisable to keep the chlorate discharges or their standard pastes in places with a temperature of not less than 59° F.

The following precautions are important for the succesful production of chlorate discharged styles:

1. The Indigo dyed goods must be well soured after dyeing; they must show no lime- or alkali stains which would considerably interfere with the final results.
2. The engraving of the printing rollers must be deep and sharp, so as to ensure perfect outlines.
3. The goods are usually steamed in the Mather-Platt for 1—3 minutes at a temperature of nearly 212° F. with dry and powerful steam. The vapours which contain chlorine and might easily affect the Indigo, must be drawn off.

In order to protect the ground, the goods are sometimes impregnated before printing with diluted solutions of sulphides, thiosulphates or sulphocyanides. By that means fine doctor streaks and the often unavoidable scumming (caused by traces of discharge) upon the surface of the material are prevented. Very serviceable also is an initial preparation of the goods with a solution of glue (1 %) which, on the one hand, protects the cotton fibre and, on the other hand, prevents the shade from being changed in steaming.

The steamed goods are then passed at full width for 1—2 minutes at 140° F. through water, and afterwards through caustic soda 4½° Tw., or through a bath containing 10 parts soda lye 76½° Tw. per 1000, and 10 parts silicate of soda of 72° Tw. If necessary, the white can be improved by a short soaping.

Standard White A.

800 parts standard colour I
200 parts standard colour II
1000 parts.

Thickening for Reducing Pastes.

90 parts wheat starch
910 parts water
1000 parts, boiled, then cooled.

Standard Colour I.

100 parts wheat starch
600 parts water
240 parts sodium chlorate, boiled, cooled, then added at 113° F.
60 parts yellow prussiate
1000 parts.

Standard Colour II.

250 parts tartaric acid
250 parts citric acid
500 parts water
1000 parts.

The following chlorate discharge yields very sharp outlines. Owing to the addition of china clay:

Standard White B.

200 parts sodium chlorate are dissolved in
250 parts wheat starch-tragacanth thickening, then added
200 parts china clay paste 1:1, and sligthly heated. Then cooled to 86° F., and again added
200 parts wheat starch-tragacanth thickening, previously well mixed with
50 parts yellow prussiate powder. After the liquid is well stirred,
100 parts citric acid, finely ground, are added before use.
1000 parts.

Thickening for Reducing Pastes.

550 parts wheat starch-tragacanth thickening
150 parts china clay paste 1:1
300 parts water
1000 parts.

Wheat Starch-Tragacanth Thickening.

75 parts wheat starch
225 parts water
100 parts tragacanth (60:1000)
600 parts water
1000 parts.

Note: Instead of starch, gum solutions may also be used for thickening

Standard White A

Standard White A, reduced 2:1

Standard White A, reduced 2:1, Logwood Black

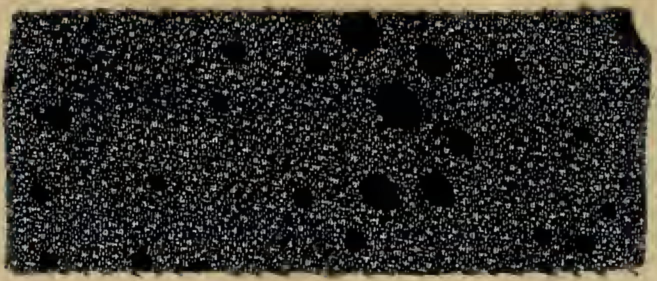
The chlorate discharge method is seldom employed for producing multicoloured effects. F. e., a yellow, is obtained by a combination of chlorate of chrome with lead salts, other coloured discharges by the addition of such dyestuffs as withstand the chlorate, e. g., Methylene Blue, Safranine etc., to the chlorate discharge. The dyestuffs are then fixed by the prussiate contained in the discharge colour.

The chromate and chlorate discharges upon Indigo can be resisted by oxidisable substances, e. g. sulphites, sulphocyanides, acetates.

Resist S under Chromate and Chlorate Discharges.

250 parts British gum powder
150 parts water
500 parts potassium sulphite 90° Tw.
100 parts potassium sulphocyanide
1000 parts.

The effect of the Resist S is materially enhanced by the addition of some aequeous tannin solution and keeping it alkaline.



Resist S Cover: Standard White A reduced 1 : 1.

3. PRUSSIATE DISCHARGE.

This rarely employed method is based upon printing a thickened solution of red prussiate upon the material and then passing it through soda lye; it is only applicable for light and medium Indigo blues. If this method is combined with insoluble Azo colours, very brilliant and fast coloured discharges are obtained on Indigo grounds. For this purpose the diazo compounds of p-Nitraniline, m-Nitraniline, Nitrotoluidine, Ortho-Anisidine, Chloranisidine and α-Naphthylamine are suitable. The Indigo dyed material is padded with naphthol prepare, dried, printed with the discharge, passed for 10 seconds through a cold discharging bath, and finally washed and dried.

Naphthol Prepare.

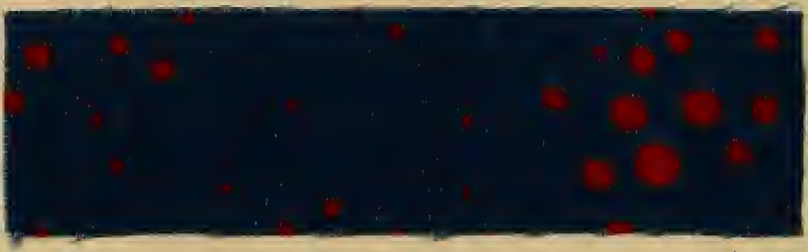
25 parts	β-Naphthol
50 parts	soda lye 36° Tw.
25 parts	Para soap PN
1000 parts.	

Discharging Bath.

10,000 parts	soda lye 22° Tw.
100 parts	Solvay soda.

Discharge Red P.

400 parts	p-Nitraniline Diazo Solution (28 : 1000)
400 parts	wheat starch-tragacanth thickening
160 parts	red prussiate, finely powdered
40 parts	sodium acetate crystals.
1000 parts.	



Discharge Red P.

C. INDIGO RESIST STYLES.

The so-called Indigo Resist styles are produced by first printing upon the cotton material resists or pulps, which act both mechanically and chemically, and then dyeing the goods in the Indigo vat.

These pulp resists contain besides the thickening (mostly gum, more rarely flour thickening or burnt starch) certain inert salts of great covering power, e. g. sulphate of lead or barium, pipe clay, also fats etc., and certain metal salts which act as oxidizers (e. g. copper salts, lead salts etc.) — and by whose aid an almost impenetrable protecting film is precipitatad on the surface of the resist. In addition to the above other salts are used, such as potassium, aluminium, manganese salts, also acids, such as tartaric acid, phosphoric acid, arsenic acid, sulphuric acid, and their salts. The alkaline condition of the dye vat effects also the precipitation of the soluble metal salts present in the resist. The precipitated voluminous metal oxides improve most materially the protecting power of the resists.

Besides white resists also yellow and orange resists are obtained by means of lead salts and subsequent chroming, or also by direct dyeing yellow dyestuffs, such as Aurophenine and Toluylene Orange; red resists are obtained by combination of Para Red produced on the fibre with the white resist. If the resists are printed on light Indigo goods, the ordinary white resist will produce a light blue, the yellow resist a green effect, the orange resist an olive effect upon a dark blue ground. If, however, to these resists is added a suitable chromate (chromate of zinc) which in the subsequent souring of the goods destroys the lightblue ground by chromic acid being liberated, the shading effect of the original ground can be nullified. In this way the most varied multicoloured resist and discharged resist effects on Indigo dyed goods can be obtained.

The goods, after being steeped in a solution of diastaphor, are either printed direct, or first well boiled. A treatment in the open with caustic soda of 3° Tw. for 1 hour without subsequent chemicking is sufficient.

The well washed and dried material is then starched with a solution of 15 parts wheat starch and 15 parts glue per 1000. In order to facilitate an even wetting of the goods, a small addition of Turkey red oil to the starch solution may be made. An addition of 1—2 parts nitrate of ammonia, sulphate of copper or sulphate of manganese is favourable to the production of dark-blue shades. After starching the unprinted goods are also calandered cold. The calandering acts as a beneficial preparation for the resists by flattening the cotton thread.

The Indigo resists are printed upon previously starched goods either by hand or with the perrotine, or also by means of a roller printing machine. Both hand and perrotine printing permit the laying on of a sufficient amount of resist, as the process of printing can be repeated at will, whereas roller printing or also the rotary perrotine will only allow one application. For this reason the printing rollers for Indigo resists must be engraved especially deeply; small delicate designs are therefore more often produced by roller printing than by hand or perrotine printing. The printing paste must be kept thin and, particularly for roller printing, must be finely ground and strained; also the use of brush furnishers is advisable.

After printing the goods are hung for some time in a warm place, in order to harden the pulps.

Usually the goods are dyed in the zinc-lime vat on sinking frames; 2 pieces are very often hooked on to the frame back to back in order to effect a saving of Indigo. Latterly methods have been introduced whereby pulp styles can be dyed in continuous machines by subjecting the printed goods to such treatment as will harden or protect the resist (padding with strong alkaline solutions, e. g. soda, caustic soda etc.), or by applying a protecting layer of starch thickenings, see page 277. By combining this preparatory treatment with a process of padding with suitable dyestuffs, such as the Thiogene Colours, a material saving of Indigo can also be affected. Steaming will also sufficiently harden the resists. The goods are first entered into a vat containing only lime water, in order to swell and harden the pulp well, and are then passed from weaker to stronger vats. The wetting vat contains per 1000 gallons 60 lbs caustic lime and 20 lbs calcined soda and is daily made up with 4—6 lbs caustic lime to which now and then 4—10 lbs calcined soda are added.

The vat liquid must be well reduced and have a yellowish appearance. The froth should be removed from the surface before each passage. The liquid is replenished, sharpened and stirred in the usual manner.

Vat Liquid.

50 lbs Indigo MLB paste 20 %, or 10 lbs Indigo MLB
powder are well mixed with
6 lbs zinc dust and
4 gallons water, then are added
20 lbs burnt lime slaked with
8—10 gallons water.

The temperature of the standard vat must be about 104° F.; it is stirred several times, allowed to rest for 4—6 hours. and then poured into the dye vat which has previously been made up with zinc dust and lime, viz:

200 gallons water,
10 oz zinc dust made into a paste with water,
2 lbs caustic lime slaked with water.

In dyeing care must be taken that the mud is not raked up, as this would cause stains.

The more dips are applied, the faster becomes the colour. After dyeing the goods are dried on the sinking frames, then soured in the open for 2 minutes at 104° F. (with 30 parts sulphuric acid 168° Tw. per 1000 parts) if dyed on a white ground, and for 2 minutes at 122° F. (with 50 parts sulphuric acid 168° Tw. and 20 parts oxalic acid per 1000 parts) if printed on a light blue ground, and in all cases where the resists contain chromate of zinc.

The goods are then thoroughly washed in the open. In case yellow or orange resists have been printed upon the goods, they are passed after souring and washing for 2 minutes through a cold bath of 2 parts caustic lime per 1000, then washed and treated for 5 minutes at 104° F. with 5 parts potassium bichromate and $2^{1}/_{2}$ parts of hydrochloric acid 33° Tw., (1:10) per 1000 parts, and afterwards well washed again. If the yellow is to be made orange, the goods must be passed in the open for $^{3}/_{4}$ minutes through a boiling bath of the clear solution of 10 parts potassium bichromate and 40 parts caustic potash per 1000 parts. After that they are washed in the open. The sulphuric acid used for souring must be perfectly free from hydrochloric acid, as even small quantities thereof will impair and dissolve the resists containing lead.

Standard Resist I.

255 parts	china clay are made into paste with
275 parts	water, then are added
225 parts	gum solution 1:1
80 parts	finely powdered verdigris and
80 parts	powdered copper sulphate.
	The mixture is left to stand for 12—24 hours, being frequently stirred; then are added
35 parts	tallow; it is then boiled for 1—2 hours, the evaporated water being replenished, then added
50 parts	powdered alum, the mixture ground in a stone or porcelain grinding mill for 2—3 days, and finally passed through a fine sieve.
1000 parts	

Standard Resist I is mostly used next to Standard Resist II, i. e. in all those cases where white occurs together with yellow or orange. On a light blue ground it also serves as resist for light blue.

Standard Resist II.

60 parts	china clay are mixed with
235 parts	sulphate of lead 50 % paste
250 parts	water
175 parts	gum solution, then are added
70 parts	verdigris finely powdered
70 parts	copper vitriol finely powdered
35 parts	acetate of lead
35 parts	nitrate of lead, after being left to soak for 12—24 hours, there are added
30 parts	tallow, then boiled for 1—2 hours, the evaporated water to be replenished, then are added
40 parts	alum, and the whole well ground and strained, like the standard resist I.
1000 parts.	

White Pulp F.

100 parts	gum powder
170 parts	water
330 parts	sulphate of lead powder
180 parts	sulphate of zinc
220 parts	nitrate of lead
100 parts,	boiled, ground and strained.

Standard Resist II and White Pulp F may be used as Yellow or Orange resists, if the goods are subsequently chromed. By themselves they give a very sharp white resist. By means of chroming or orangeing a green or olive is obtained on a light blue ground. In order to obtain very bright orange resists, 5—10 parts Dianil Red R or 4 B are to be added to the standard resist.

Discharge Resist III.

850 parts	standard resist I
150 parts	chromate of zinc
1000 parts.	

Discharge Resist III serves as Discharge White Resist on a light blue ground, for combinations of white-light blue resist, white-green, white-yellow, white-olive.

The goods are soured in a mixture of sulphuric and oxalic acid, as above mentioned.

Discharge Resist IV.

850 parts	standard resist II
150 parts	chromate of zinc
1000 parts.	

Discharge Resist IV is only used on a light blue ground, for combinations: white-green-yellow, or white-olive-orange.

Discharge Resist V.

40 parts	Aurophenine O
110 parts	thin gum solution
700 parts	standard resist I, are boiled till the dyestuff is dissolved, then are added cold
150 parts	chromate of zinc
1000 parts.	

Discharge Resist V is used on a white or light blue ground when a yellow is desired next to the orange. If Toluylene Orange R is added instead of Aurophenine O, an orange can be obtained next to the yellow; in that case, however, no orangeing is required.

Patterns produced on a large scale.

The following three patterns, placed side by side, show Standard Resist II as white, yellow (chromed) and orange (chromed and oranged).

Standard Resist II

White

Yellow (chromed)

Orange
chromed and oranged

The following pattern shows resists on goods dyed light blue:

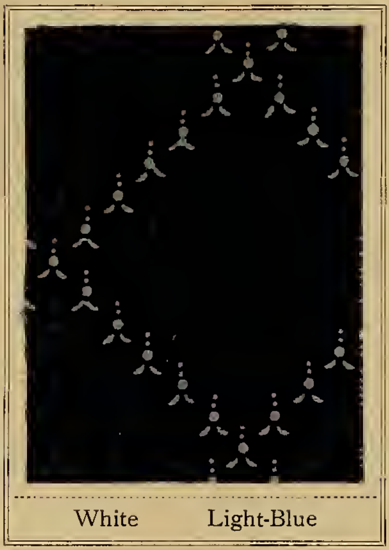
Light-blue = Standard Resist I
Brown = Standard Resist II
Yellow = Discharge Resist V
Orange = Discharge Resist IV
chromed and oranged

Employment of dyestuffs as additions to resists:

White = **Standard Resist I**
Yellow = **Standard Resist II** with
Aurophenine O
Orange = **Standard Resist II**
chromed and oranged.

White = **Standard Resist I**
Pink = **Standard Resist I** with
Dianil Red R
Yellow = **Standard Resist II**
chromed and oranged.

Resist styles, produced on light-blue goods:



White = **Discharge Resist III**
Light-Blue = **Standard Resist I**
soured.

White = **Discharge Resist III**
Light-Blue = **Standard Resist I**
Green = **Standard Resist II**
soured and chromed.

By combining insoluble **Azo Colours** (Para Red) with the Indigo resists bright and fast red resist styles upon Indigo grounds can be obtained. For their production **Azophor Red PN,** distinguished for its great stability, is to be especially recommended. If, in the recipe below, Azophor Red is replaced by Azophor Orange MN, bright orange resist styles are obtained, see patterns on page 274. Azophor Pink A in concentrated colours, even on ordinary naphthol prepare which does not contain any Para soap PN yields a bright red. The previously starched material is padded with hot naphthol prepare, dried in the hotflue or on the drying cylinders (the first two drums of which are covered with calico), then printed with the red pulp resist, dyed in the Indigo vat, quickly washed without having been dried, and finally soured. The souring is effected at 104° F. in a bath of 5 parts hydrochloric acid 36° Tw. per 1000 parts for 5 minutes. The hydrochloric acid will remove the lead salts completely from the red pulp. This acid bath may be preceded with advantage by a weak alkaline passage.

Naphthol Prepare.

25 parts β-Naphthol R
50 parts soda lye 36° Tw.
20 parts Para soap PN
50 parts tragacanth 60:1000, make up to
1000 parts.

The above process can be considerably simplified by combining the previous starching operation with the naphthol prepare:

Initial Prepare I.

175—200 parts potato starch
10 000 parts water
5 parts diastaphor
} are heated to 149° F., and brought to the boil after 10 minutes. After cooling to 122—140° F. are added:
500 parts tragacanth (60:1000)
100 parts Para soap PN
250 parts soda lye 36° Tw.
250 parts β-Naphthol. Then is added the mixture of
30 parts tartar emetic
15 parts glycerine
250 parts soda lye 66° Tw.

Another advantageous prepare is the following:

Initial Prepare II.

150 parts potato starch boiled with
5000 parts water, cooled, then added lukewarm the solution of:
250 parts β-Naphthol R
250 parts soda lye 76° Tw.
150 parts Monopol soap
4290 parts water
60 parts potassium sulphite 90° Tw.

Red Pulp Resist.

80 parts	Azophor Red PN made into a paste with
40 parts	water, and added to
840 parts	Standard White A Z
40 parts	sodium acetate cryst
1000 parts.	

Standard White AZ.

(must be free from copper salts.)

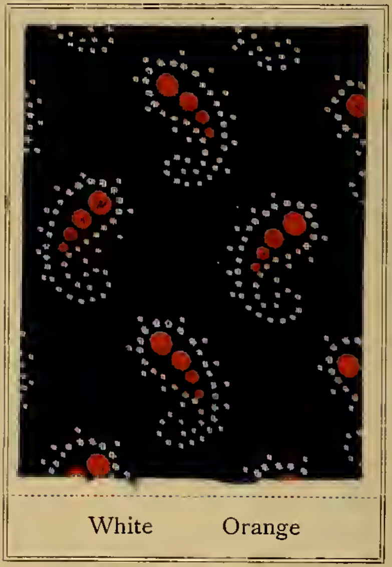
200 parts	Senegal gum 1:1
70 parts	water
220 parts	nitrate of lead, well heated till dissolved; then are added
330 parts	sulphate of lead powder
180 parts	sulphate of zinc, heated and reduced to
1000 parts.	

The standard white must be well ground before the Azophor Red solution and the sodium acetate are added. The coloured printing paste must be kept cool and never be heated. It is distinguished for its great stability.

There are also other more rarely used methods for the production of coloured resist styles, viz. by means of basic dyestuffs which can be fixed partly with tannin partly with prussiate.

All the following patterns were produced on a large scale, and dyed in immersion vats.

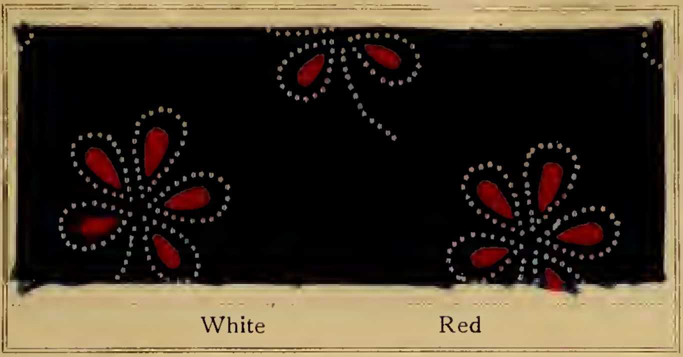
White = **Standard Resist II**
Red = **Red Pulp Resist**
(Azophor Red PN)



White = **Standard Resist II**
Orange = **Orange Pulp Resist**
(Azophor Orange MN)

Dyed with: **Indigo MLB/RR paste.**

Printed on Initial Prepare I, dyed, soured and washed.



White = **Standard Resist II.** Red = **Red Pulp Resist** with **Azophor Pink A.**
Dyed with: **Indigo MLB RR paste.**

INDIGO MERCERISED STYLES.

It is a well-known fact that mercerisation intensifies to an extraordinary degree the affinity of cotton for Indigo White or Indigo. This experience has been diversely utilized in vat dyeing; the mercerisation of cotton has a decisive influence upon the success and the fastness of Indigo printing.

The effect of caustic alkalies to deepen the Indigo shades is especially utilized for two styles.

1. In order to produce solid shades with lighter backs soda lye of 53—64° Tw. is printed on to the one side of the material by means of finely engraved pin rollers, and subsequently the pieces dyed in the Indigo vat. This process has been patented by G. Tagliani (German patent No. 107916).

2. In order to obtain darker designs on a light ground the material is printed with thickened soda lye 53—64° Tw. by means of finely engraved rollers, and subsequently dyed in the Indigo vat.

In both cases the soda lye may be replaced by an alkaline Indigo printing colour (after the two methods of Indigo printing described further on), and the goods, after steaming, are then dyed immediately without being washed. In this manner a considerable difference in depth between the printed and ground shades is obtained (German patent No. 163276).

The process of mercerisation is not only used for the production of discharged, but also of resist styles. For if by means of finely engraved rollers soda lye is printed on white goods, which have been printed resists, it is possible to dye the so-prepared material not only in the immersion vat, but by observing great precautions and under certain circumstances also in the continuous vat, without impairing the hardened resist colours by the reaction of the soda lye. The following pattern has been dyed in the immersion vat and illustrates the intensifying effect of mercerisation.

Pattern produced on a large scale,

Standard Resist II

Printed with alkaline thickening, and dyed in three dips of 15, 10 and 10 minutes.

	I vat	II vat	III vat
Water	4000 gallons	4000 gallons	4000 gallons
Indigo MLB powder	20 lbs	30 lbs	50 lbs
Zinc dust	18 lbs	27 lbs	45 lbs
Lime	40 lbs	60 lbs	100 lbs

Local mercerising effects in combination with the resist style are shown by the following:

Pattern produced on a large scale.

Standard Resist II. Printed with
Soda lye 64° Tw.. Immersion vat.

In connection with the Indigo Mercerised styles which, as has been shown above, are important for blue goods containing resists, the dyeing of resist styles in the continuous vat may also be discussed here.

To dye **Resist styles** in the **Continuous Vat** offers great advantage. saving of wages, doing away with the immersion vats, and increased production.

On the other hand, the process of mercerisation as illustrated by the patterns on page 276 has this drawback, that a more lengthy dyeing operation renders the vat liquid too alkaline, and thus partly impairs the stability and efficiency of the resists and partly deteriorates the condition of the vat.

According to the German patent No. 144286 the resists can also be hardened by alkaline carbonates e. g. by potash. This method moreover makes it possible to combine Sulphur colours with Indigo, in which case the former are padded as a bottom.

According to the method proposed by Tagliani, German patent No. T8846 IV/8n, a perfect protection of the printed resists when dyeing the pieces in the continuous vat is obtained by covering them with a protecting layer of thickening ingredients which, if need be, may be mixed with Sulphur colours.

The application of this neutral or slightly alkaline protecting layer has this advantage that, on the one hand, the vat is not injured, and, on the other hand, the resists retain their acid character and, consequently, their resisting power better than when employing a strongly alkaline cover.

Pattern produced on a large scale according to this method:

Standard resist II.

Dyed in four dips in a continuous vat containing only one division. German patent No. T8846IV/8n. Vat = 2000 gallons made up with 40 lbs Indigo MLB powder, 36 lbs zinc dust and 80 lbs lime.

E. INDIGO STEAM PRINTING.

The most important methods for fixing Indigo in steam printing are:

1. The so-called Glucose Printing method by Schlieper and Baum.
2. The alkaline Indigo Printing method with Hydrosulphite NF conc. Hoechst. German patent No. 173878.

Both methods are characterized by the employment of very strongly alkaline colours which, by mercerising the cotton fibre (its shrinking must be avoided) cause the Indigo to become firmly united with the fibre. It is well known that the Indigo fixed by this method is distinguished for very great fastness to washing, soap and rubbing, in comparison with the Indigo fixed by dyeing. In both processes the reaction of the Indigo and of the reducing agents upon the cloth is brought about by steaming with steam which must be entirely free from air. In this manner an almost complete utilization of the dyestuff is effected.

1. GLUCOSE PRINTING.

Since Glucose reduces Indigo at the ordinary temperature in the presence of strong alkalies, the cotton material is prepared before printing with a solution of $2^3/_4$—3 lbs glucose per gallon. After drying the pieces are printed with little pressure with a strongly alkaline Indigo colour (thickened with British gum and starch) so that it forms an even layer over the prepare. The printed goods must be steamed in a steaming apparatus specially constructed for that purpose (see the following sketch by Soeding and v. d. Heyde of Hoerde) and containing a certain uniform degree of humidity, which has to be determined by trial. This apparatus contains a vessel with boiling water. The goods are steamed in this apparatus for 45 seconds.

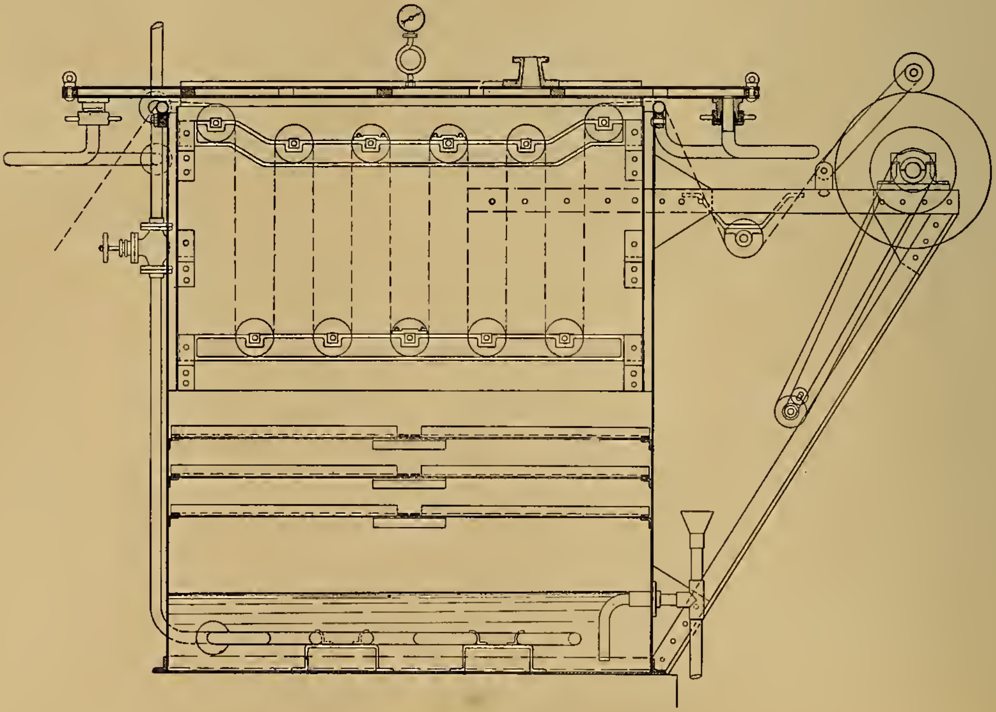


Fig. 21

If the reduction has succeeded well, the material, when coming out, must have a brownish olive, but not a pure yellow nor a greenish colour. After leaving the steam box, the goods are well cooled, in order to prevent any destruction of Indigo; they are then allowed to lie until the subsequent washing souring and soaping operations are commenced.

The goods are washed and soured in the open in running water, whereby the Indigo White is converted into Indigo Blue by oxidation. They are then finally washed in a rope washing machine, and, if necessary, soaped and again washed.

Indigo Printing Colour.

Glucose Prepare.

$1^{3}/_{4}$—$2^{3}/_{4}$ lbs Glucose dissolved and diluted with water to 1 gallon.

Printing Paste:

	Light	Medium	Dark
Alkaline Thickening	800 parts	800 parts	750 parts
Soda Lye 36° Tw.	175 parts	125 parts	100 parts
Indigo MLB paste 20 %	25 parts	75 parts	150 parts
	1000 parts	1000 parts	1000 parts.

In order to obtain white and coloured resists under alkaline Indigo prints, the goods after being prepared with glucose, are printed with resists which contain, as resisting agent flower of sulphur or lactic acid in combination with acid salts (e. g. aluminium sulphate). Other metal salts, notably those used in the usual pulp resists, also nitrate of ammonia, produce the same effects. In employing pulp resists identical results are obtained both in glucose-indigo printing and in hydrosulphite-indigo printing. They give very sharp outlines. This resisting method is applicable to every vat dyestuff. Coloured resists of great fastness and beauty under Indigo are obtained by the addition of β-naphthol and a suitable fatty mordant (Para soap PN) to the glucose prepare, and of Diazo solution (e. g. Azophor Red PN, Azophor Pink A, Azophor Orange MN) to the resists prepared with lactic acid and sulphate of alumina.

Sulphur Resist S.

240 parts flower of sulphur, are made into a paste with
240 parts gum solution 1:1, then is added the hot solution of
240 parts sulphate of alumina
240 parts water, and finally
40 parts acetate of soda cryst.

1000 parts.

Dark Indigo Printing Paste upon Glucose

Sulphur Resist S Medium Indigo Printing Paste upon Glucose

2. ALKALINE INDIGO PRINTING WITH HYDROSULPHITE NF CONC.

This process, which also yields good results, is characterized by the simultaneous employment of Indigo and Hydrosulphite NF conc. Hoechst, in the presence of strong caustic soda in the printing colour. Hydrosulphite NF conc. Hoechst is the stable formaldehyde compound of sodium hydrosulphite. Easily soluble in very little water, this compound can be added, whilst cooling, to the alkaline Indigo paste. The printing colour is stable; the partial reduction taking place after standing for some time is of no consequence. This method, compared to that of Schlieper and Baum, presents the following advantages, in addition to an almost as complete an exhaustion of the Indigo used:

1. The preparation of the material can be dispensed with, as the reducing agent is added direct to the printing paste.

2. The result is less dependent on the degree of moisture of the printed material and of the duration of steaming.

Turkey Red and Paranitraniline Red are easily discharged with the alkaline Indigo-hydrosulphite NF printing paste. If, however, goods prepared with β-naphthol are printed with this paste, the insoluble Azo colours, distinguished for their beauty and fastness may be combined with steam Indigo Blue.

The thickenings usually employed in glucose printing are also used for this process, viz. British gum, alone or mixed with starch, also gum solution. The latter is to be recommended for light printing shades.

The percentage of caustic soda in the printing paste must be relatively high, in order to ensure the most perfect and fast fixation of the Indigo dyestuff. Moreover the concentration of the soda lye used in preparing the printing colour is such that, although its action may cause mercerisation, which facilitates the fixation of the dyestuff, no permanent shrinking of the fibre can take place. In those cases where for certain reasons the strong alkalinity of the printing colour is to be avoided, and where the total exhaustion of the Indigo is of little moment, the caustic alkali can be omitted from the colour, whilst the quantity of the reducing agent is increased.

Experience has shown that the following conditions must be fulfilled if a good reduction is to be obtained:

1. The printed goods must be dried evenly, but not too much, in a slightly warmed drying chamber; they must not enter the steaming apparatus too dry.

2. The steaming operation must be carried out for 2—3 minutes at 212—216° F. in a suitable steaming apparatus which must be free from air and which must be heated with plenty of steam.

An ordinary Mather-Platt with some alterations will serve as a suitable steaming apparatus. The required minimum temperature of 212—216° F. is obtained by insulating the steam box (insulating material, air space, wood lining), reducing the slot for the entrance and exit of the goods to $^{1}/_{4}$—$^{1}/_{3}$ inch in width and, if necessary, fitting the interior of the apparatus with a system of heating pipes.

Heavy blotch patterns require a fairly large amount of moisture for a complete reduction. In such cases it is advisable to fix a steam damper or a vessel containing water in the bottom of the steaming apparatus, or to dry the goods only very slightly after printing.

The washing and finishing operations of the steamed goods are the same as for the glucose process; care must be taken to remove all the soda lye by washing the goods in plenty of running water. Squirting pipes are not suitable before the greater part of the soda lye is removed, or whilst the Indigo White is still imperfectly oxidised, as the squirted water might partly wash off the Indigo (as Indigo White), which is not yet sufficiently fixed, and thus cause unevennesses. The alkaline Indigo printing colours can also be printed next to Diazo printing colours on naphthol prepare, also together with Sulphur colours. By this means many effects can by obtained (see patterns on page 284).

Steam Indigo Blue 150.

$\left\{\begin{array}{l}\text{60 parts Hydrosulphite NF conc. Hoechst are dissolved in}\\ \text{40 parts hot water, then cooled down and, whilst cooling, added in several portions to}\end{array}\right.$

650 parts alkaline British gum thickening 40 (I or II). Then mixed with
100 parts soda lye 77° Tw., and, when cold,
150 parts **Indigo MLB** paste 20 % added

1000 parts.

In all cases where even blotches are most essential, as in light shades, British gum thickening can be replaced by alkaline gum thickening. Lighter colours are prepared from the standard colours by means of alkaline thickenings, which contain also Hydrosulphite NF conc.

Alkaline British Gum Thickening 40I.

100 parts	British gum powder
900 parts	soda lye 77° Tw., heated to 122—140° F., until completely dissolved
1000 parts.	

Alkaline British Gum Thickening 40 II.

26 parts	wheat starch or maize starch
54 parts	British gum
120 parts	water, slowly mixed with
10 parts	soda lye 91° Tw.
30 parts	water, allowed to stand overnight, then added in portions
760 parts	soda lye 91° Tw., then heated to 140° F., cooled and strained
1000 parts.	

Alkaline Gum Thickening 40.

400 parts	Gum solution 1:2 (commercial gum)
600 parts	soda lye 100° Tw.
1000 parts.	

Reducing Paste for Gum Colours.

400 parts	gum solution 1:2 (commercial gum)
500 parts	soda lye 77° Tw., then added cold
15 parts	glycerine
5 parts	Hydrosulphite NF conc. Hoechst
80 parts	water
1000 parts.	

The above Indigo colour can be used for discharging Turkey red; for Para red it is advisable to increase somewhat the quantity of the discharging ingredients. It is advisable to treat the goods to be discharged (Turkey red or Para red) with alkalies. (Soda or still better waterglass, $1^2/_3$ oz per gallon).

The following is the composition of an Indigo blue discharge on Para red ($2^3/_4$ oz β-Naphthol per gallon).

Steam Indigo Blue P.

115 parts Hydrosulphite NF conc. are dissolved in
160 parts hot water and
25 parts British gum powder, then cooled down, and added whilst cooling to
550 parts alkaline British gum thickening, then added
150 parts **Indigo MLB paste** 20 %
1000 parts.

Halogene Indigo, Indigo MLB/R paste 20 % and Indigo MLB/RR paste 20 % require considerably less reducing agents; 40 parts Hydrosulphite NF conc. are amply sufficient for the reduction of 200 parts of each of these Indigo brands.

As already mentioned, neutral Indigo pastes may also be used where printing with very alkaline colours is to be avoided, and the complete exhaustion of the Indigo is not essential, as e. g. for very light blotch designs.

Neutral Indigo Paste:

75 parts Indigo MLB paste 20 %
600 parts British gum thickening 1:1
100 parts Hydrosulphite NF conc.
225 parts hot water
1000 parts.

Reducing Paste for Neutral Indigo:

50 parts Hydrosulphite NF conc.
350 parts water
600 parts British gum thickening 1:1
1000 parts.


Steam Indigo Blue 150
(see page 281)


Steam Indigo Blue 150
pure and reduced 1:4

Dark Blue Printing paste:
20 % **Indigo MLB/RR paste 20 %.**
Light Blue Printing paste:
Dark Blue Printing paste, reduced 1:3

Red Printing paste:
Paranitraniline Red.
Claret Printing Paste:
Alphanaphthylamine Claret.
Dark Blue Printing paste:
Steam Indigo Blue 150.

Indigo Z (see page 170) on Turkey Red.

Steam Indigo Blue P (see page 283) on Paranitraniline Red.

VI.

COLOURS PRODUCED ON THE FIBRE BY A PROCESS OF OXIDATION.

Certain aromatic bases can be converted into insoluble coloured compounds by a process of oxidation with chlorates or chromates.

These dyestuffs, having no affinity to the fibre, can only be used for the production of coloured effects on the textile fibre by developing them on the fibre itself.

The most important of this group of dyestuffs, mostly blacks and browns, are **Aniline Black** and **Diphenyl Black,** which are produced from Aniline and its homologues and from p-Amidodiphenylamine; also brown shades, for the production of which Phenylendiamine or Metaxylidine are used.

A. ANILINE BLACK.

Aniline Black is a very important colour, on account of its great beauty, fastness and cheapness, and is therefore extensively used in calico printing. Owing to its great fastness to light and washing it is far superior to Logwood Black, which it has superseded in a large measure. These advantages are, however, partly counterbalanced by its more or less strongly pronounced tendency, according to its mode of preparation, to turn greenish, also by its sensitiveness to chlorine and the weakening of the fibre.

The most beautiful blueblack is obtained by the sole employment of aniline. Toluidine and xylidine yield brownish blacks which, however, are much less liable to turn greenish by acid than the black produced from pure aniline. This circumstance is taken advantage of for obtaining a black with relatively little tendency to turn green by adding certain quantities of toluidine (especially m-toluidine) to the Aniline Black.

Aniline $C_6H_5NH_2$, molec. weight 93, is in its pure state a colourless oily liquid; specific gravity 1,0265 at 59° F.; boiling point 378° F. It has a characteristic aromatic smell, possesses poisonous properties, and prolonged action of even very small quantities of it, produces cyanose. Exposure to air and light, turns aniline brown.

As an aromatic base aniline forms a series of salts of a distinctive character, the most frequently used being the hydrochloric acid salt (Aniline salt). Besides the latter also the salts of nitric, sulphuric, tartaric acids and the ferro-cyanide compound are still occasionally used.

Aniline is put on the market as an almost chemically pure substance. The test for purity and fitness for use is made by means of distillation, at which the distillate between 358^0 and 360^0 F. is determined; also by dyeing and printing of a sample.

Aniline Salt or Hydrochloride of Aniline, $C_6H_5NH_2 \cdot HCl$, is a colourless substance, which crystallizes mostly in large leaves. It is very soluble in water and alcohol, and melts at 378^0 F. It is put upon the market in the form of leafy and lumpy aggregates which, on prolonged exposure to damp air and light, turn darkgreen.

Aniline salt often contains some free hydrochloric acid from the process of manufacture. To test the presence of free hydrochloric acid, Magenta paper or, still better, Methyl Violet paper, which turn green in presence of free mineral acids, are used.

The sulphate of aniline is also an easily crystallizing salt which, however, contrary to Aniline salt, is not very soluble in water and alcohol.

Aniline salts are tested partly by dyeing or printing of samples, partly by separating the Aniline by means of soda lye. The separated oil can then be either measured, weighed after being well dried, or subjected to a distillation.

Orthotoluidine and Metatoluidine are, like aniline, oily liquids which boil at 387^0 F. and resemble aniline in their chemical properties.

Paratoluidine is a solid substance which melts at 113^0 F. and boils at 389^0 F,

1. DIRECT PRINTING WITH ANILINE BLACK.

Generally speaking, two Aniline Blacks are to be distinguished according to the composition and development of the black. The so-called **Oxidation Black** is used for the production of blacks on pieces. The particulars of this application are fully described in our work on Cotton dyeing. It may be mentioned here, that recently successful trials have been made to prevent the corrosion of the cotton fibre by the addition of certain quantities of Diphenil Black Base I to the padding bath. As carriers of oxygen for Oxidation Black copper salts or vanadium salts, sometimes also cerium salts, are employed.

The so-called Steam Aniline Black, on the other hand, is characterized by the use of ferro- and ferricyanide compounds, wich protect the fibre from corrosion and greatly lessen the tendency of the black to turn greenish. Oxidation Black is developed either in a warm chamber (the temperature of which must not be above 104^0 F.) or by a short passage in the Mather-Platt at a temperature of 149^0 F. In order to develop it fully and prevent it from turning green, it must be chromed. According to requirements and to the nature of the accompanying colours the chroming is carried out with or without the addition of weak alkaline salts. An almost ungreenable black is obtained by an aftertreatment of the well developed Aniline Black with strongly oxidising agents in the presence of small quantities of Aniline salt at a higher temperature.

Contrary to Oxidation Black the development of the black in the Steam Aniline Black process is brought about at a higher temperature, by means of longer or shorter steaming. By this method a black is obtained that is less liable to turn green than a slightly chromed Oxidation Black. The employment of chlorates, — chlorates of alkalies, of alumina etc., — is common to both kinds of Aniline Black, and the oxidising action of the chlorates is transmitted to the aniline and its salts by means of copper compounds (copper sulphide, copper sulphocyanide), vanadium salts, cerium salts, ferrocyanide, or ferricyanide salts, or also by means of chromate of lead.

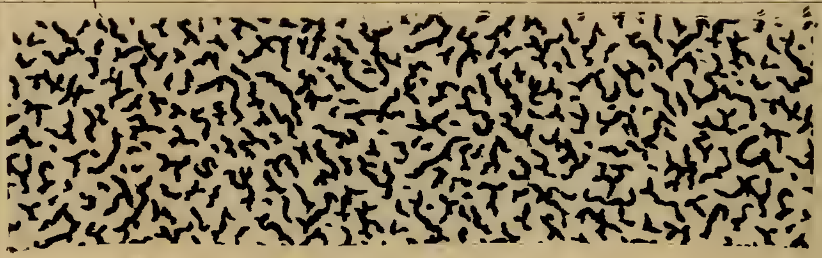
Aniline Oxidation Black I.

80 parts	wheat starch
65 parts	burnt starch
692 parts	water, boiled, then added lukewarm
35 parts	chlorate of soda
5 parts	Aniline oil
93 parts	Aniline salt, then added before printing
30 parts	copper sulphide paste 30%
1000 parts.	

Aniline Oxidation Black II.

100 parts	wheat starch
600 parts	water, boiled, then added hot
35 parts	chlorate of soda, then added cold
75 parts	Aniline oil
70 parts	hydrochloric acid 36° Tw.
110 parts	water, then added before use
10 parts	vanadium solution 1:1000
1000 parts.	

This Oxidation Black is printed either by itself or in combination with mordant printing colours, developed after slight drying in the oxidation chamber (temperature 97° F. and 90° F. humidity) within about 18—24 hours, and then made ready for use in the requisite manner. Material which dyes well need not be chromed. Single colour Aniline Oxidation Black, which on account of its sharp outlines and also on account of cheapness, is still often printed, is always chromed in order to increase its fastness. The goods are chromed at about 122° F. with $^{3}/_{4}$—1 oz of bichromate of potassium per gallon, then washed and well soaped.



Aniline Oxidation Black II

Steam Aniline Black with Prussiate.

500 parts	tragacanth (60:1000)
94 parts	Aniline salt
5 parts	Aniline oil
25 parts	chlorate of soda
150 parts	water
50 parts	yellow prussiate
176 parts	water
1000 parts.	

Steam Aniline Black with Chromate of Lead.

60 parts	wheat starch
545 parts	water
120 parts	Chrome Yellow 40% paste are mixed, boiled, then added lukewarm
125 parts	ammonium chloride
25 parts	chlorate of soda, and after cooling
125 parts	Aniline salt.
1000 parts.	

The development of Steam Aniline Black takes place by short steaming in the Mather-Platt. If printed in combination with other steam colours, a passage of ammonia is given after the steaming in the Mather-Platt; the pieces may then be steamed for some longer time in the steam box with the object of fixing the accompanying steam printing colours. The fastness of Steam Aniline Black is always greatly enhanced by subsequent chroming.

Steam Aniline Black with Prussiate

2. PADDING WITH ANILINE BLACK.

The bleached or only boiled goods are padded on the padding machine, dried in the hotflue (see the sketch below), steamed for 2 minutes in the Mather-Platt, passed through a chrome bath ($^3/_4$—1 oz of bichromate of potash per gallon) at 122° F. for 1—1$^1/_2$ minutes, washed and soaped. Very often a silicate of soda bath is used instead of the chrome bath, as by this means the black gets a more blueish hue than by chroming.

Padding Colour.

84 parts	Aniline salt
40 parts	tragacanth (60:1000)
5 parts	Aniline oil
220 parts	water
54 parts	yellow prussiate
200 parts	water
30 parts	chlorate of soda
320 parts	water
made up to 1000 parts.	

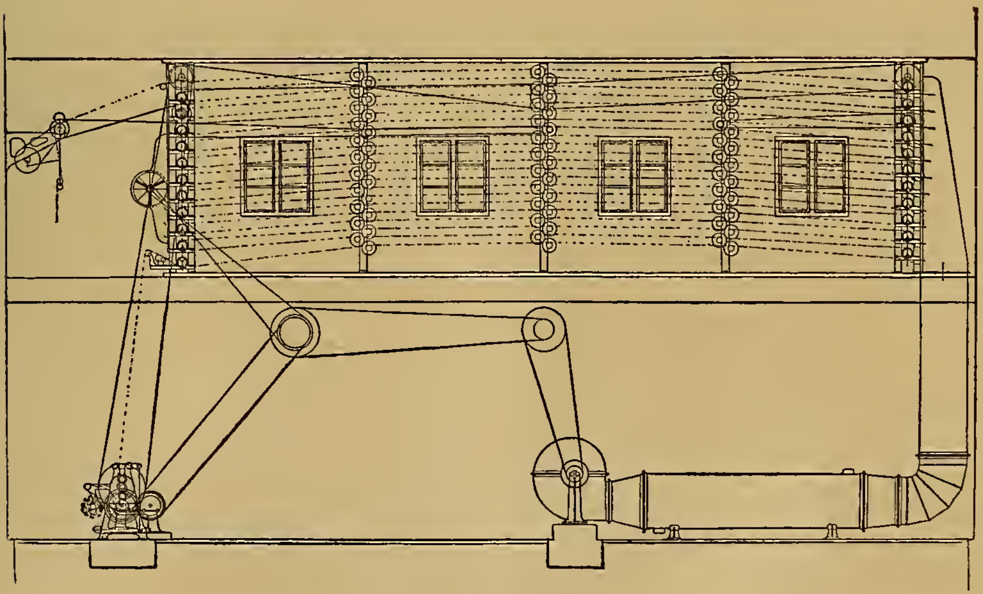


Fig. 22.

Hotflue with horizontal run of goods, by the Elsässische Maschinenbau-Gesellschaft, Mülhausen.

3. RESISTS FOR ANILINE BLACK.

The employment of Aniline Black has made enormous strides since a method was discovered to produce white and coloured resists under steam Aniline Black. The composition of this so-called Prud'homme Black is similar to that of the Steam Black, having also this advantage that the padding liquid can be padded and dried on the white material, without the Prussiate black beginning to develop at the ordinary temperature. If goods previously prepared with Turkey red oil are used for padding, the coloured resists turn out much fuller and brighter, but the black loses some of its fulness. The white and coloured resists are then printed on the goods; these are passed through the Mather-Platt short ager, in order to develop the black, and are finally washed, chromed etc. The resists can also be printed first on the white goods, and the latter then padded afterwards with Aniline Black; this method of working is used in many works to-day on account of its undeniable advantages.

For resisting Aniline Black, alkaline and reducing agents are used, chiefly caustic and alkaline carbonates: silicate of soda, sulphites, oxide of zinc, magnesium carbonate, sulphocyanides and stable hydrosulphites (Hydrosulphite NF conc.).

For coloured resists the following colours are used:

1. Basic dyestuffs fixed either with tannin, or with the addition of acetate of zinc or oxide of zinc and albumen.
2. Direct dyestuffs.
3. Colour lakes and pigments fixed with albumen.
4. Sulphur colours printed with alkali and hydrosulphite.

The white and coloured resists are printed either upon the undeveloped Aniline padding black (see page 289) or, on the white goods previous to padding.

With a view to the better fixing of the coloured discharges prepared with basic dyestuffs, about $^3/_4$—1 oz tannin 1 : 1 per gallon are sometimes added to the padding liquid. A small addition of Hydrosulphite NF conc. (about $^1/_2$—$^3/_4$ oz per gallon) acts very favourably, as it prevents the black from prematurely turning green.

The bleached or only boiled goods are padded on the padding machine, dried in the hotflue, printed with the resists, steamed for 2 minutes in the Mather-Platt, passed through a chrome bath ($^3/_4$ oz bichromate of potash per gallon) for 1—1$^1/_2$ minutes at 122° F., washed and dried. A silicate of soda bath may be used instead of the chrome bath, to which some soda is usually added. Whilst the chrome bath is liable to yield a brownish black, the silicate of soda produces a blueish black.

1. Resists on padded Aniline Black.

White Resist I.

500 parts tragacanth (60 : 1000)
150 parts sodium acetate
135 parts sodium bisulphite 67° Tw.
215 parts water
1000 parts.

White Resist II.

200 parts British gum powder
500 parts potassium sulphite 91° Tw.
200 parts water
100 parts soda lye 91° Tw.
1000 parts.

Is profitably employed for Aniline Black padding liquids containing tannin.

White Resist III.

500 parts tragacanth (60 : 1000)
150 parts sodium acetate cryst.
25 parts Hydrosulphite NF conc.
325 parts water
1000 parts.

This white is very useful in case the goods impregnated with the Aniline padding black have already turned slightly greenish with lying.

White Resist IV.

100 parts zinc white
100 parts water
400 parts tragacanth (60 : 1000)
150 parts sodium acetate cryst.
150 parts water
100 parts albumen solution 1 : 1
1000 parts.

Coloured Resist I.

5— 30 parts basic dyestuff
305—280 parts water
50 parts acetic acid 9° Tw.
500 parts acid starch thickening
140 parts acetate of zinc cryst.
1000 parts.

For a better fixation some albumen may be added to the acetate of zinc resist:

Coloured Resist II.

20 parts dyestuff
180 parts water
500 parts tragacanth (60 : 1000)
200 parts acetate of zinc cyst.
100 parts albumen 1 : 1.
1000 parts.

Coloured Resist III.

20 parts dyestuff
30 parts glycerine
150 parts water
800 parts Thickening A
1000 parts.

For the coloured resists II and III basic and direct dyeing dyestuffs are used.

Thickening A.

100 parts	oxide of zinc
150 parts	magnesium acetate 40° Tw.
350 parts	tragacanth (60 : 1000)
100 parts	starch thickening
100 parts	albumen 1:1
800 parts	ground together.

Coloured Resist IV with Pigment Colours.

500 parts	Pigment Colours (f. i. Pigment Red G)
220 parts	tragacanth (60 : 1000)
150 parts	albumen 1 : 1
130 parts	sodium acetate cryst.
1000 parts.	

Coloured resists of very satisfactory fastness to washing and soaping can be obtained by printing colours containing tannin, with the addition of Hydrosulphite NF conc.

Coloured Resist V.

20 parts	basic dyestuff
25 parts	glycerine
10 parts	acetine
185 parts	water
350 parts	wheat starch-tragacanth thickening
50 parts	carbolic acid
80 parts	tannin 1 : 1,
75 parts	Hydrosulphite NF conc.
50 parts	water
5 parts	formaldehyde 40 %
150 parts	sodium acetate cryst.
1000 parts.	

White Resist I

White Resist I.
Coloured Resists III

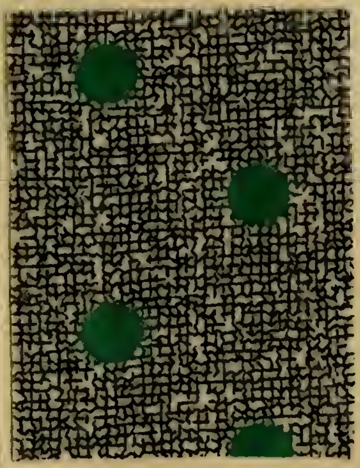
Yellow Printing Colour:
3 % Auramine conc.
Violet Printing Colour:
2 % Methyl Violet BB.
Green Printing Colour:
1,5 % Auramine conc.
1,5 % Brilliant Green cryst. extra.

White Resist I
Coloured Resists III

Dark Blue Printing Colour:
2% **Thionine Blue GO.**
Light Blue Printing Colour:
0,4% **Thionine Blue GO.**
Green Printing Colour:
1,5% **Auramine conc.,**
1,5% **Brilliant Green cryst. extra.**

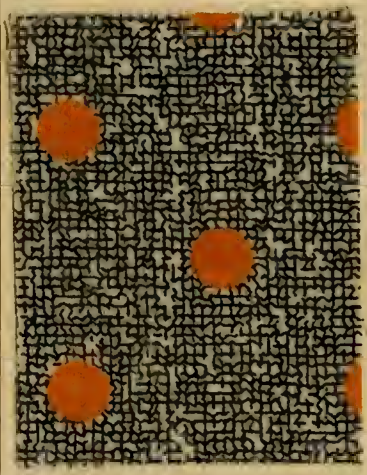
White Resist I
Coloured Resists III

Red Printing Colour:
0,55% **Auramine conc.,** 1,6% **Safranine AN extra,** 0,65% **Rosazeine 4G extra.**
Pink Printing Colour:
0,5% **Rosazeine 4G extra.**
Green Printing Colour:
1,8% **Auramine conc.,** 1,2% **Brilliant Green cryst. extra.**



Steam Aniline Black
Coloured Resist V

Green Printing Colour:
1,2% **Methylene Yellow H,**
0,8% **Thionine Blue GO.**



Steam Aniline Black
Coloured Resist V

Orange Printing Colour:
2% **Flavophosphine R conc. new.**

2. Resists under Aniline Black.

White Resist IV.

70 parts oxide of zinc
294 parts water
75 parts British gum powder
165 parts tragacanth (60 : 1000)
66 parts soda lye 36° Tw.
35 parts sulphocyanide of ammonia 32° Tw.
295 parts sodium acetate cryst.
1000 parts.

White Resist V.

265 parts British gum powder
225 parts Senegal gum thickening 1:1
150 parts oxide of zinc
100 parts sodium acetate cryst.
50 parts magnesium carbonate
50 parts glycerine
156 parts water
4 parts Ultramarine
1000 parts.

White Resist VI.

500 parts starch thickening
300 parts chalk
60 parts soda calc.
135 parts water
5 parts Ultramarine
1000 parts.

White Resist VII.

600 parts tragacanth (60 : 1000)
25 parts soda calc.
175 parts sodium acetate cryst.
200 parts potassium sulphite 91° Tw.
1000 parts.

Coloured Resist VI.

20 parts dyestuff
100 parts water
760 parts zinc paste
40 parts sodium acetate cryst.
80 parts blood albumen
1000 parts.

Zinc Paste.

105 parts wheat starch
715 parts water
25 parts British gum powder
155 parts oxide of zinc
1000 parts.

Applicable to all basic dyestuffs.

Coloured Resist VII.

30 parts dyestuff
140 parts water
80 parts glycerine
200 parts Standard colour I
400 parts Standard colour II
20 parts rapeseed oil
130 parts albumen 1 : 1
1000 parts.

Standard Colour I.

820 parts tragacanth (60 : 1000)
180 parts acetate of zinc
1000 parts.

Standard Colour II.

400 parts oxide of zinc
200 parts glycerine
200 parts tragacanth (60 : 1000)
200 parts water
1000 parts.

Applicable to all basic dyestuffs.

Coloured Resist VIII.

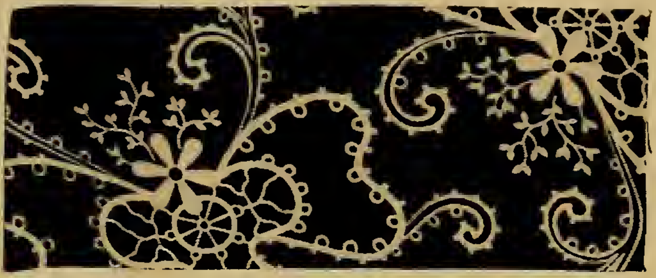
20 parts	dyestuff
580 parts	water
20 parts	sodium phosphate
200 parts	British gum powder
30 parts	glycerine
150 parts	sodium acetate cryst.
1000 parts.	

Coloured Resist IX.

20 parts	dyestuff
480 parts	water
200 parts	British gum powder
30 parts	glycerine
150 parts	sodium acetate
120 parts	albumen 1 : 1
1000 parts.	

The coloured resists VIII and IX are used for fixing Dianil Colours.

The goods printed with the resists can be kept for several days in a dry place without spoiling. They are then padded in the back on the padding machine, dried on the drying machine, steamed for 1—$1\frac{1}{2}$ minutes in the Mather-Platt, chromed in the usual manner, soaped and dried.



White Resist V

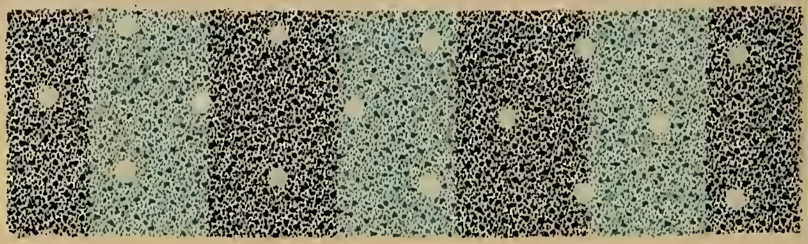
White Resist VI
Coloured Resist VII

Yellow Printing Colour:
3 % Auramine conc.

White Resist VI
Coloured Resist VII

Green Printing Colour:
2,4 % Auramine conc.,
0,6 % Thionine Blue GO.

Very beautiful effects (so-called Pluszansky styles) can be obtained by printing with Aniline Black which contains a basic dyestuff, and then over-printing with an Aniline Black resist. The goods are afterwards steamed for 3 minutes, fixed, washed and soaped.



Tartar emetic resist I (see page 106) Blue M. White Resist VII

Blue M.

80 parts	starch
20 parts	British gum powder
10 parts	**Thionine Blue GO**
518 parts	water, boiled, cooled, then added
50 parts	acetic acid tannin sol. 1 : 1
60 parts	yellow prussiate
150 parts	water
28 parts	chlorate of soda, and before use
84 parts	Aniline salt
1000 parts.	

The employment of the Sulphur Colours for coloured resists under Aniline Black has been described in detail in the chapter on „Thiogene Colours“.

B. DIPHENYL BLACK.

The Diphenyl Black produced on the fibre from p-Amidodiphenylamine by a process of oxidation analogous to that of Aniline Black presents, — along with other prominent properties of fastness which it has in common with Aniline Black, — also the property, hitherto unattained, of not turning green. Moreover, it possesses the great advantage of not impairing the fibre.

The property of Diphenyl Black of not turning green is founded on the fact that the intermediate formation of Emeraldine, which causes Aniline Black to turn green, does not take place during the process of oxidation of p-Amidodiphenylamine, and that the black once produced cannot be converted into Emeraldine, neither by atmospheric influences nor by the reaction of sulphurous acid.

The protection of the fibre, however, is achieved by not using any mineral acid, but only acetic acid, for dissolving the p-Amidodiphenylamine. By this means the generation of free mineral acid during the oxidising process and, consequently, the corrosion of the fibre is almost entirely precluded with proper manipulation.

Whilst the production of Aniline Black is always accompanied by the intermediate formation of Emeraldine, which necessitates an aftertreatment with chromate, p-Amidodiphenylamine can be directly converted into a black which does not turn green, and no subsequent oxidising treatment — the chroming bath — is necessary.

It is, however, to be observed that Diphenyl Black, like Aniline Black, deteriorates by excessive oxidation, by which brown quinone-like decomposition products are formed.

This is the case when these blacks are subjected to the action of strong solutions of chloride of lime, (e. g. in clearing the white), wherein Diphenyl Black proves to be less fast to chlorine than ordinary steam Aniline Black; Oxidation Aniline Black withstands chemicking still better than Steam Aniline Black.

Comparing equal depths of black obtained from Aniline and from p-Amidodiphenylamine the latter is about $2^1/_2$—3 times stronger than Aniline.

For the production of Diphenyl Black, **Diphenyl Black Base I** (p-Amidodiphenylamine) or **Diphenyl Black Oil** (p-Amidodiphenylamine dissolved in Aniline oil) are used, the latter for cheaper blueish blacks which are not expected not to turn green.

p-Amidodiphenylamine, spec. gravity 184, forms, in its chemically pure state, small colourless glittering leaves which melt at 151° F. and turn grey when exposed to air. It does not dissolve easily in water, but is easily soluble in alcohol or ether, also in acetic acid. With acids it forms salts which do not easily dissolve, such as the sulphate. Both ferro- and ferricyanide salts are likewise little soluble, but the latter is sometimes employed in printing colours.

The oxidising agents and carriers of oxygen which are used in the Diphenyl Black process are: chlorates (chlorate of soda) aluminium chloride, also sulphide of copper, copper chloride, cerium chloride, chromium chloride, vanadate of ammonia, and red prussiate.

The prussiates usually used for Steam Aniline Black yield little soluble salts in combination with p-Amidodiphenylamine; for this reason they cannot be employed in solutions as carriers of oxygen. This also precludes the possibility of producing stable padding solutions which are so preeminently useful for the production of Steam Aniline Black resist styles (Prud'homme Black).

1. DIRECT PRINTING WITH DIPHENYL BLACK.

The printing colours are prepared by dissolving Diphenyl Black Base I in acetic and lactic acid and Diphenyl Black Oil DO in acetic, lactic and some muriatic acid, mixing these solutions with the thickening, and adding aluminium chloride 52° Tw., besides sulphide of copper, vanadate of ammonia or cerium chloride and chlorate of soda.

It is advisable to prepare two standard colours, which are to be mixed immediately before use; the one of these standard colours contains the ingredients which serve as carriers of oxygen: or else the latter are added to it just before use. The printing colours can be kept for a few days, if they are well stored.

The black is best developed by short steaming at 212° F. for 1—2 minutes in the Mather-Platt ager.

As the fibre is not impaired, if the process is properly executed, Diphenyl Black may be steamed longer. It can, therefore, also be used in combination with steam colours which have to be steamed for 1—1½ hours, as e. g. Alizarine Red, Basic Colours etc. In employing Diphenyl Blacks which contain Aniline, it may be observed that under certain circumstances the black bleeds into the white parts with a reddish colour. This fault is attributable to drying the pieces too much after printing, or to employing steam which is too dry. This causes the formation of a violet pigment. It is, therefore, essential to avoid any excess of chlorate in the printing colour, to dry the pieces slightly after printing, and not to steam them at too high a temperature. In order to obtain a faultless white, and to avoid an aftertreatment with chemic, it is advisable to previously impregnate the pieces to be printed with a very weak solution of potassium sulphite (1 oz per 10 gallon).

The Diphenyl Black printing colours give very sharp outlines and, contrary to Logwood Black, do not produce doctor streaks. Owing to its most excellent properties Diphenyl Black is extensively used in printing, and we recommend:

Diphenyl Black Base I,

for printing heavy blotch designs even upon very thin materials, such as batistes and muslins, for which Aniline Black cannot be used. It can be employed either by itself or in combination with steam colours which require long steaming for their fixation; but most particularly in all those cases where it is indispensable that the black should not turn green.

Diphenyl Black Oil DO,

by means of which a more blueish and cheaper black than with Diphenyl Black Base I is obtained, is especially applicable to blotches, and to large designs on raised cloths, flanelettes, velvets, half silks etc. For heavy designs on thin materials it must only be used with caution, seeing that for dissolving the oil some muriatic acid is employed besides acetic acid and lactic acid, so that there is some danger of corrosion of the fibre; moreover the tendency of the black to turn green is not wholly excluded.

Black Printing Colour with Diphenil Black Base I.

1100 parts	wheat starch
4500 parts	water
1080 parts	acetic acid 9° Tw.
200 parts	olive oil, boiled for $^1/_2$ hour, then added warm
300 parts	sodium chlorate, then added cold the solution of
350 parts	**Diphenyl Black Base I** in
1300 parts	acetic acid 9° Tw.
450 parts	lactic acid 50 %
	Before use are added
180 parts	aluminium chloride 52° Tw.
100 parts	copper sulphide paste 30 %
300 parts	water
140 parts	cerium chloride 85° Tw.
10000 parts	

Black Printing Colour with Diphenyl Black Oil DO.

1100 parts	wheat starch
5315 parts	water
1125 parts	acetic acid 9° Tw.
200 parts	olive oil, boiled for $^1/_2$ hour, then added warm
300 parts	sodium chlorate, then added cold the solution of
500 parts	**Diphenyl Black Oil DO** in
225 parts	lactic acid 50 %
123 parts	muriatic acid 29° Tw.
67 parts	water
	Before use are added
200 parts	copper sulphide paste 30 %
630 parts	water
215 parts	aluminium chloride 52° Tw.
10000 parts	

Diphenyl Black can also be used along with the insoluble Azo Colours on a naphthol prepare, and surpasses by its excellent properties (fastness to light, washing, soap and rubbing) the Logwood Blacks used in the form of Noir reduit, etc.

Diphenyl Black upon Naphtol Prepare.

45 parts **Diphenyl Black Oil DO**
50 parts acetic acid 9° Tw.
50 parts lactic acid 50 %
14 parts muriatic acid 35° Tw.
612 parts acid starch thickening
45 parts Aniline salt
35 parts sodium chlorate
90 parts water
15 parts copper sulphide paste 30 %
15 parts water
19 parts aluminium chloride 53° Tw.
Before use added
10 parts solution of vanadium (1:1000)
1000 parts

Diphenyl Black upon Iron Mordant.

55 parts **Diphenyl Black Oil DO**
70 parts acetic acid 9° Tw.
50 parts lactic acid 50 %
25 parts muriatic acid 28° Tw.
650 parts acid starch thickening
30 parts sodium chlorate
60 parts water
19 parts aluminium chlorate 53° Tw.
41 parts water
1000 parts.

See pattern on page 163.

5% Diphenyl Black Oil DO

Dark grey Medium grey
Light grey Black

Dark grey Printing Colour:
3,3 % **Alizarine Yellow GG paste**
2,2 % **Chromoglaucine VM paste**

Medium grey Printing Colour:
Dark grey Printing Colour, reduced 1:3

Light grey Printing Colour:
Dark grey Printing Colour, reduced 1:5

Black Printing Colour:
$3\frac{1}{2}$ % **Diphenyl Black Base I**

Red Pink
Olive Black

Dark Blue Light Blue
Green Black

Red Printing Colour:
10 % **Alizarine Red 5F paste 20 %**
Pink Printing Colour:
0,8 % **Alizarine Red No. 1 paste 20 %**
Olive Printing Colour:
4,5 % **Alizarine Yellow GG paste**
4 % **Philochromine G paste**
Black Printing Colour:
3½ % **Diphenyl Black Base I**

Dark Blue Printing Colour:
1,6 % **Methylene Blue DBB extra conc.**
0,4 % **Marine Blue BI**
Light Blue Printing Colour:
Dark Blue Printing Colour, reduced 1:4
Green Printing Colour:
0,7 % **Brilliant Green cryst. extra**
1,3 % **Auramine conc.**
Black Printing Colour:
3½ % **Diphenyl Black Base I**

Diphenyl Black and Azophor Red PN upon Naphthol Prepare

2. PADDING WITH DIPHENYL BLACK.

The goods are padded on the padding machine, and then either dried on hot cylinders, which develop the black, or still better passed through the hotflue and steamed in the Mather-Platt. The latter is preferable, inasmuch as it gives a purer black. For thin materials Diphenyl Black Base I only must be used, as it does not impair the fibre at all; for heavy materials, however, Diphenyl Black Oil is more suitable, as it gives a fuller and bluer black. After the goods are dried and steamed, they are washed and soaped hot.

Diphenyl Black Base I Padding Colour:

Standard Colour A.	600 parts	tragacanth solution 1:10 are diluted with
	750 parts	water
	400 parts	Diphenyl Black Base I are dissolved warm in
	500 parts	lactic acid 50 % and
	1300 parts	acetic acid 40 %, mixed with the above tragacanth solution and made up with
	1450 parts	water to
	5000 parts.	
Standard Colour B.	250 parts	aluminium chloride 53° Tw.
	250 parts	chromium chloride 53° Tw.
	40 parts	copper chloride 77° Tw.
	3460 parts	water, are mixed with
	300 parts	sodium chlorate, dissolved in
	600 parts	hot water, and
	100 parts	oil of turpentine
	5000 parts.	
	10000 parts.	

Diphenyl Black Oil Padding Colour.

Standard Colour A.	600 parts	tragacanth solution 1:10 are diluted with
	750 parts	water
	600 parts	Diphenyl Black Oil DO are dissolved cold in
	1500 parts	acetic acid 40 %, stirred into the tragacanth solution and made up with
	1550 parts	water to
	5000 parts.	
Standard Colour B.	3070 parts	water
	380 parts	muriatic acid 31° Tw.
	160 parts	aluminium chloride 53° Tw.
	250 parts	chromium chloride 53° Tw.
	40 parts	copper chloride 77° Tw.
	100 parts	oil of turpentine
	4000 parts.	
Standard Colour C.	300 parts	sodium chlorate
	700 parts	water
	1000 parts.	
	10000 parts.	

Before use B and C are stirred into A.

Diphenyl Black Base I

Diphenyl Black Oil DO

3. RESIST STYLES, PRODUCED WITH DIPHENYL BLACK.

Diphenyl Black can be resisted, like Aniline Black, by means of alkaline and reducing ingredients. These are: caustic alkalies, carbonates, acetates and sulphites of alkalies and alkaline earths, zinc oxide, zinc acetate etc. An addition of Hydrosulphite NF conc. also produces a favourable effect. As it is not possible as yet to prepare padding baths for black with p-Amidodiphenylamine, which, like those used for the so-called Prud'homme styles, remain stable on the cloth for a sufficiently long time, it is necessary to produce these styles by printing the resists first.

White Resist KS. 5% Diphenyl Black Oil DO

White Resist KS.

250 parts British gum powder
750 parts potassium sulphite 91° Tw.
1000 parts.

VII.

COLOURS PRODUCED ON THE FIBRE BY A PROCESS OF CONDENSATION.

NITROSO BLUE.

(Resorcine Blue MR).

Nitroso Blue which was introduced in 1898 by the Farbwerke Hoechst, also belongs to the colours produced on the fibre.

It is obtained by condensation of Nitroso bases of tertiary aromatic Amines (e. g. p-Nitrosodimethylaniline) with Phenols (Naphthol, Resorcine, 2,7 Dioxynaphthaline etc.) into so-called Quinonimide dyestuffs (Oxazines).

The fixation of these dyestuffs is effected by means of tannin, and material advantages are derived from the fact that the dyestuff ingredients and the fixing agent, — tannin, — can be united into a single printing or padding colour, and that the condensation and the formation of the tannin lake are produced by a short exposure to steam.

The most important and most employed dyestuff of this group of Nitroso Blues is Resorcine Blue MR, i. e., the combination of p-Nitrosodimethylaniline with Resorcine. Its tannin lake is dark blue violet, and it is universally employed in printing, on account of its satisfactory fastness properties, its cheap production and other advantages (it is easily resisted).

p-Nitrosodimethylaniline forms small leaves of a bright green colour which melt at 185° F. It volatilizes slightly with steam. Nitrosodimethylaniline and its salts are poisonous and irritate the skin.

p-Nitrosodimethylanilinechlorhydrate forms sulphur-yellow needles which are easily soluble in water, and melt at 170° F.

Resorcine forms colourless, hygroscopic, rhombic prisms or leaves, which melt at 244° F. Boiling point 530° F. It is easily soluble in water, alcohol and ether, but dissolves with difficulty in cold benzene. It has a sweet, afterwards grating taste, and reduces Fehling's solution and silver solution.

p-Nitrosodimethylaniline is put upon the market in a very stable form as a 50 % base — **Nitroso Base M 50**, — Resorcine, on the other hand is sold, either as such or, already mixed with the tannin necessary for the lake formation, as **Tannoxyphenol R.**

The printing pastes and padding baths are prepared in the following manner:

The Nitroso Base is dissolved, with the addition of water, in the quantity of muriatic acid requisite for the formation of the hydrochloric acid salt. This solution is thickened, and then Resorcine and tannin or Tannoxyphenol and finally oxalic acid added. The amount of tannin materially affects the blue shade, inasmuch as with the diminution of tannin the shade turns considerably redder and fuller than with larger quantities of tannin. In order to avoid corrosion of the fibre, some phosphate of soda, dissolved in water, is added before use.

These printing pastes and padding baths, contrary to those prepared, e. g., with 2,7 Dioxynaphthaline, are very stable without the addition of acetic acid, whereby especially the working of the padding baths is considerably facilitated.

Nitroso Blue can be used for white and coloured resist styles. The resists are prepared with stannous salts and sulphites, and owing to the beauty and fastness of the effects produced, these styles are largely used upon raised winter goods for which Nitroso Blue is particularly suitable. But Resorcine Blue MR is also used for a cheap imitation of Indigo resist styles, in which case the resists are first printed upon the white ground.

In direct printing it may be profitably employed for the production of blue blotches. But it has this drawback that it injures the rollers to some extent.

It is of advantage to add a sufficient quantity of soda lye to the sulphite resist prepared with potassium sulphite, in order to destroy the tannin of the Nitroso colour completely in the subsequent steaming operation, so that the staining of the white places by detached particles of dyestuff may be obviated.

The printed or padded goods are slightly dried, — if no shading dyestuffs are added the pieces must show a pure yellowish colour, — then steamed for 2—3 minutes in the Mather-Platt at 210—212° F. and quickly soaped.

For the embellishment of padded Resorcine Blue Shading Blue B, which also can be resisted with potassium sulphite is used; for coloured resists, however, such dyestuffs are employed as are stable to sulphite or tin salt: Methylene Yellow H, Auramine conc., Flavophosphine, Safranine, Rosazeine, Rosazeine Scarlet G extra, Methylene Blue, Malachite Green, Methylene Grey, Methylene Violet, Victoria Blue, Methyl Violet, Ethyl Blue, Methylene Heliotrope and others.

The following are the most important and typical recipes for Resorcine Blue MR:

Nitroso Blue Printing Paste.

600	parts acid starch thickening
20	parts glycerine
26	parts Nitroso Base M paste 50 % mixed with
20,7	parts water
8,7	parts muriatic acid 36° Tw. then added
20	parts Resorcine dissolved in
147	parts water, and stirred into the acid starch thickening. Then are added
6	parts oxalic acid dissolved in
50	parts water,
60	parts acetic acid tannin sol. 1:1,
40	parts sodium phosphate 1:5 added before use
1000	parts.

Nitroso Blue Padding liquids.

a) with Resorcine.

24 g	**Nitroso Base M paste 50 %**
50 cc	lukewarm water
8 cc	muriatic acid 36° Tw. are well stirred, then is added the solution of
16 g	Resorcine
16 cc	water, then
20—60 g	tannin solution 1:1
60 cc	oxalic acid 1:10, the mixture stirred into
100 cc	tragacanth (60:1000), diluted with water to
800 cc,	and stirred into it before use
8 g	sodium phosphate dissolved in
200 cc	water
1 Litre	

b) with Tannoxyphenol.

24 g	**Nitroso Base M paste 50 %**	
500 cc	water	
8 cc	muriatic acid 36° Tw. are well stirred, then is added the hot solution of	
30 g	Tannoxyphenol R	dissolved in the water bath, then
100 cc	boiling water	
60 cc	oxalic acid 1:10 diluted with cold water to	
900 cc.	Before use slowly stirred into the mixture	
8 g	sodium phosphate dissolved in	
100 cc	cold water	
1 Litre.		

White Resists.

White Resist I.

300 parts	British gum powder
700 parts	potassium sulphite 91° Tw. heated on the water bath
1000 parts.	

White Resist II.

240 parts	British gum powder
560 parts	potassium sulphite 91° Tw
120 parts	soda lye 91° Tw.
80 parts	water
1000 parts.	

White I for printing on white cloth.

220 parts	British gum powder
400 parts	water
60 parts	sodium tartar emetic
170 parts	glue solution 1:2
110 parts	tin cryst. when cooled
40 parts	sodium acetate cryst.
1000 parts.	

White II for printing on white cloth.

280 parts	potassium sulphite 91° Tw.
720 parts	thickening WC
1000 parts.	

Thickening WC.

I	110 parts	china clay
	110 parts	water
II	150 parts	wheat-starch
	200 parts	water
III	300 parts	commercial gum 1:3
		I, II and III are mixed, boiled, then slowly added
IV	20 parts	Japanese wax
	110 parts	petroleum
	1000 parts.	

Glue Solution 1:2.

333 parts	glue are soaked in
500 parts	water, then are added
167 parts	acetic acid 50%, and heated till completely dissolved. Finally made up with diluted acetic acid to
1000 parts.	

White I and II are printed upon white goods, these then padded with the Nitroso padding liquid, dried in the hotflue, steamed for 3 minutes in the Mather-Platt, passed through tartar emetic, washed and soaped.

Coloured Resists.

Sulphite Resists.

	Yellow NS	Orange NS	Red NS	Blue NS	Green NS
Auramine O . . .	30 parts	—	5,6 parts	—	15 parts
Flavophosphine R conc. new . . .	—	30 parts	—	—	—
Safranine O	—	—	16 parts	—	—
Rosazeine 4G . . .	—	—	32 parts	—	—
Methylene Blue DR	—	—	—	30 parts	—
Malachite Green cryst. extra	—	—	—	—	15 parts
Water	320 parts	320 parts	296,4 parts	320 parts	320 parts
Glycerine	30 parts	30 parts	30 parts	30 parts	30 parts
Antimony thickening	500 parts	500 parts	500 parts	500 parts	500 parts
Potassium sulphite 91° Tw.	120 parts	120 parts	120 parts	120 parts	120 parts
	1000 parts	1000 parts	1000 parts	1000 parts	1000 parts.

Antimony Thickening.

40 parts	wheat starch
300 parts	British gum powder
335 parts	water
250 parts	tragacanth (60:1000)
75 parts	antimonine
1000 parts.	

Tin Crystal Resists.

	Yellow NZ	Orange NZ	Red NZ	Blue NZ	Green NZ
Auramine O	25 parts	—	6 parts	—	20 parts
Flavophosphine R conc. new	—	25 parts	—	—	—
Safranine AN extra .	—	—	16 parts	—	—
Rosazeine 4G . . .	—	—	32 parts	—	—
Methylene Blue DR .	—	—	—	30 parts	—
Brilliant Green cryst. extra	—	—	—	—	10 parts
Acetic acid 9° Tw. .	125 parts	125 parts	125 parts	125 parts	125 parts
Water	500 parts	500 parts	471 parts	495 parts	495 parts
Tragacanth (60:1000)	200 parts	200 parts	200 parts	200 parts	200 parts
Tin cryst.	50 parts	50 parts	50 parts	50 parts	50 parts
Sodium acetate cryst.	50 parts	50 parts	50 parts	50 parts	50 parts
Acetine	50 parts	50 parts	50 parts	50 parts	50 parts
	1000 parts	1000 parts	1000 parts	1000 parts	1000 parts.

White II for printing on white cloth

White Resist I
Red NS
Yellow NS
Green NS

Pattern produced on a large scale.

VIII.

INSOLUBLE AZO COLOURS PRODUCED ON THE FIBRE.

GENERAL REMARKS.

The employment of the insoluble Azo Colours has considerably increased both in quantity and importance since their successful introduction into the printing and dyeing industries by the Farbwerke Hoechst. This applies particularly to the so-called **Paranitraniline Red** which, owing to its great beauty, fastness, cheapness and easy application has acquired a predominating position in printing (partly also in cotton dyeing) to the prejudice of Alizarine. Like Paranitraniline Red **Alpha-Naphtylamine Claret Red**, equally distinguished for its full and beautiful shade and for the cheapness of its production, has become a chief article in printing.

Moreover, the use of both products has received a great impetus by the superior resist and discharge styles which have come into vogue in recent years, and they now form an essential part of the production in calico printing of all countries.

Besides red and claret there are other shades produced on the fibre by the coupling process to-day, e. g. pink, yellow orange, orange, blue, black, brown, but it is not possible up to the present date to obtain a pure greenish yellow and green in the same manner.

The Diazo- and Tetrazo-compounds, put upon the market as „Azophor dyestuffs“, have materially contributed to the introduction and ready adoption of the insoluble Azo Colours; since ice, which is often difficult to procure, can be dispensed with, their application is considerably facilitated, and the goods come up much more evenly in consequence of their great stability. Up to the present the following Azophor Colours have been put upon the market: **Azophor Red PN, Azophor Orange MN, Azophor Blue D, Azophor Pink A, Azophor Black S and DP.**

Azophor Red PN is used for dyeing naphtholed goods, and especially for printing. It is also very suitable for the production of discharge red upon Indigo according to the chromate discharge method, and can likewise be used for red resists in Indigo styles.

The employment of **Azophor Blue D**, the stable Tetrazo compound of Dianisidine, is limited, like that of Dianisidine Blue, as it has never yet been possible to unite copper with the Tetrazo dyestuff of β-Naphthol perfectly fast to acid; the Dianisidine Blue, in itself a beautiful colour, which is fast to soap and light, is only used in small quantities.

The most important use now made of Dianisidine in calico printing is the production of a combination black with benzidine, and, furthermore, the production of blue upon red, according to the persulphate resist method. This method has been adopted in several countries, with excellent results.

The **Azophor Blacks** have found an extensive use as substitutes for Logwood Black, still much employed in printing next to ice colours, for they are faster, can be combined more easily, and also white resist effects can be obtained upon them with potassium sulphite and tin resists.

As a prepare for all Azo Colours produced on the fibre β-Naphthol still occupies the first place. **β-Naphthol R** containing a small quantity of naphtholsulphonic acid produces particularly blueish shades, for which reason it is also used to a very large extent. Of equally great importance is the oil mordant, **Para Soap PN**, introduced into the Para Red process by the Farbwerke Hoechst.

Although the large daily output of calico print works has scarcely ever to reckon with the fact that the goods impregnated with β-Naphthol might turn yellow or darker, it has become customary in many places to render the naphthol prepare more stable by the addition of antimony compounds (tartar emetic or antimonate of soda and glycerine). Instead of antimony compounds sulphites have a similar, though weaker, protective effect.

The endeavour to impart to Paranitraniline the finest blue shade, has led to such great improvements in the manufacture of this dyestuff, that it may now be pronounced almost chemically pure. Likewise the β-Naphthol which is now put on the market, is a pure product and contains α-Naphthol only in almost imperceptible traces.

Similarly α-Naphthylamine, which is most extensively used either as base or as hydrochloride, is a very pure product. **α-Naphthylamine salt S powder** put upon the market by Farbwerke Hoechst is also used to a large extent in printing, as it yields diazo solutions of considerably greater stability.

It may here be mentioned that the developing baths prepared with α-Naphthylamine yield less beautiful and rather more bronzing shades if used immediately after their preparation than after having been left to stand for some time.

The demand for fiery scarlet and pink shades has recently grown at several places. The former are produced on a naphthol prepare by means of **Chloranisidine**, the latter by means of **Azo Pink BB**.

In concentrated solutions Azo Pink BB yields both in dyeing and printing scarlet shades which excel by their beautiful hue.

For the production of brown shades upon naphthol prepare **Benzidine** and **Tolidine** are still sometimes used, particularly in printing.

Benzidine is further used in combination with Dianisidine for the production of black, as has been stated before.

Furthermore must be mentioned: **Para Brown R and G.** These browns are obtained by coupling Brown Salt R and Brown Salt G with Paranitrodiazobenzene. In order to produce deep shades, the colours must be allowed to develop sufficiently before the dyed goods are washed and soaped.

The chief value of Para Brown R and G lies in the fact that both can be discharged perfectly by Hydrosulphite NF conc., which is not the case with Benzidine Brown and Tolidine Brown.

By aftertreating Para Browns with hot copper solutions the depth of the shade is materially increased. This copper treatment (about $^3/_4$ oz copper sulphate per gallon, 2—5 minutes at the boil) can also be applied without detriment after the discharge.

An excellent method for the production of a dischargeble brown, the shade of which can be varied by altering the proportion of the ingredients used, is the topping of Paranitraniline Red with Steam Aniline Black (Superpositionspuce of Henry Schmid). The brown produced in this manner can be discharged white by means of Hydrosulphite NF conc. before the Aniline Black is developed and red resist effects can be obtained by the employment of alkaline substances.

The general mode of using the insoluble Azo Colours has undergone no change since their introduction, inasmuch as their development with Diazo compounds is always preceded by the preparing of the material with a naphthol sodium solution. Nor has any new method of finishing the dyed or printed goods been adopted. New however, is the proposal to utilize the reducing action of a weak impregnation with Hydrosulphite NF conc., with subsequent Mather-Platt passage, for obtaining a pure white.

On the other hand important progress has been made in resist and discharge printing, which has contributed in a decisive manner to the enormous developement of the use of the insoluble Azo Colours. The strong reducing action of stannous salts was formerly almost exclusively utilized for resist effects on Azo Colour styles (as a matter of fact the tin resist method is still to-day the only safe one upon Alpha-Naphtylamine Claret). But since on Para-nitraniline Red a pure white cannot be obtained with certainty by means of tin resists, moreover since the latter, unless very carefully manipulated, are apt to tender the goods, the Farbwerke Hoechst have endeavoured to find other more efficacious resists, and they have succeeded in introducing into the printing trade their so-called potassium sulphite resists.

However, these resists, although still used to a very large extent, are being gradually replaced, in their turn, by Hydrosulphite discharges which yield a still better white. Both the tin and the sulphite resists may be coloured by the addition of suitable dyestuffs.

One of the best and most successful methods of producing resist effects under Azo colours is the **Tannin-Resist Method**; this is exclusively used for coloured resists, and has contributed immensely to the development of Azo colour styles. By means of this method it became possible to produce a series of very beautiful and fast effects, especially on winter goods. The tannin resist styles surpass the tin and sulphite resist styles by far in fastness and beauty; it is possible to produce with tannin resists the favourite blue red styles, also multicoloured covered discharges upon Para Red and α-Naphthylamine Claret, in fastness and beauty hitherto unattained.

White and coloured discharges are obtained upon an Azo Colour ground by means of:

1. Tin Discharges,
2. Alkali Glucose Discharges, and
3. Discharges with stable Hydrosulphite Compounds.

Tin discharges.

The Azo Colours produced on the fibre are very stable to stannous discharges on account of their insolubility in water and acid. But since in 1896 Henry Schmid found, that acetine acted as an excellent solvent for these dyestuffs, when added to very concentrated stannous discharges, the Farbwerke Hoechst have been able, by means of their Discharge White PN, Discharge Yellow PN, Discharge Blue PN, PPN and Discharge Green PN, to produce both white and coloured discharge effects upon the β-Naphtholazo compounds of the Nitranilines, the Nitrotoluidines, β-Naphthylamine and several Amidoazo bases. They are obtained by steaming at 212—216° F. in the Mather-Platt. The Azo dyestuffs, however, produced from α-Naphthylamine, Benzidine, Tolidine and Dianisidine cannot be discharged in this manner.

This method yields very good results; but in cases where both white and coloured discharges were printed side by side, it was difficult to obtain perfectly clean effects owing, in the first place, to some particles of tin oxide obstinately adhering to the fibre, and in the second place to some brownish decomposition products being formed.

Alkali-Glucose Discharges.

The Alkali-glucose discharge method, patented by Schläpfer, Wenner & Co. of Salerno, is a successful application of the alkaline Turkey red discharge process to Azo Colour styles; very beautiful results are obtained by it.

The above two methods of discharging the insoluble Azo Colours have been far surpassed by the hydrosulphite discharge method, but they will always remain extremely interesting, both chemically and historically.

Discharges with stable Hydrosulphite Compounds.

By means of hydrosulphite the problem of discharging seems to have found its most successful solution. This process was taken up by print works immediately on becoming known, and led to the production of many articles which excel by the beauty and regularity of the discharges obtained. The idea of using hydrosulphites for discharging the insoluble Azo colours was not far to seek, as the attempts to utilize the zinc-dust-bisulphite colour for this purpose reach far back. But the tendency of the printing pastes to decompose was a great obstacle to obtaining good results. A progress in this direction was the substitution of potassium sulphite for the bisulphite in the zinc dust discharge, which gave more stable colours. Both methods, however, struggled in vain against the difficulties which made themselves felt in printing: these discharge pastes always clogged the engraving.

The attempts to use concentrated hydrosulphites as discharges proved, likewise, a total failure, on account of the instability of these preparations. Only when the firm of Emil Zündel of Moscow succeeded in discovering and producing in a pure state, a stable hydrosulphite compound, the **Formaldehyd Hydrosulphite**, a complete success was assured. Like the bisulphites, the hydrosulphites possess a great chemical affinity to aldehydes and ketones with which they are capable of forming characteristic stable compounds. For discharge purposes the formaldehyde compound of hydrosulphite, compared to the other possible compounds, e. g. the acetonhydrosulphite, is by far the most important. This stable hydrosulphite compound was put upon the market in 1903 by the Farbwerke Hoechst under the name of **Hydrosulphite NF Hoechst**, and since September 1905 another product of double the discharging strength, under the name of **Hydrosulphite NF conc.** has been manufactured by them.

The formaldehyde-hydrosulphite compound yields excellent and stable printing colours, and Para Reds and Para Browns are very easily discharged by short steaming in the Mather-Platt. α-Naphthylamine Claret, however, withstands the Hydrosulphite NF conc. unless the process of steaming is carried out at a very high temperature and for a prolonged time. The discharge can also be effected by the addition of certain salts — alkaline iron solution, citrate of iron and nitrite — to the Hydrosulphite NF conc. pastes.

A surprisingly favourable influence is exercised by Rodogene MLB. If the goods are either prepared with Rodogen or the latter is added to the discharges, good discharge effects are obtained on α-Naphtylamine Claret.

The additions of some dyestuffs, e. g. Alizarine Orange, Setopaline, Patent Blue V, Induline Scarlet, and of certain aromatic ammonia bases, or of derivatives of Anthraquinone have an equally favourable effect upon the discharges.

As only minute quantities are required in certain cases for this process, the results must be explained as a certain katalytic action of these substances. Particularly interesting is also the fact that Induline Scarlet, added to the diazo-naphthaline bath in very small quantities, makes the resulting Naphthylamine Claret easily dischargeable by the ordinary formaldehyd-hydrosulphite discharge.

The employment of Hydrosulphite NF conc. offers special advantages for coloured discharges prepared with basic dyestuffs, as no precipitation will take place.

The following chapters contain particulars regarding the ice colours and the operations carried on in their production generally, and also discuss the use of the Azo colours in printing.

The insoluble Azo Colours produced on the fibre are mostly Naphthol Azo Colours obtained by the reaction of diazotised aromatic amines or diamines upon naphthol. The most valuable dyestuffs of this class are those produced by means of β-naphthol.

Besides Naphthol Azo Colours several other Azo Colours of more complicated composition have been produced on the fibre since 1902. These are combinations of Diazo compounds with certain Azo dyestuffs of the Vesuvine and Chrysoïdine series dyed or padded upon the cotton, amongst which, especially, the so-called Para Browns have found more extensive employment.

The insoluble Azo Colours produced on the fibre are distinguished for great fulness and brilliancy, great fastness to washing and light, and simple mode of preparation. Owing to these advantages they are used for a variety of purposes in cotton dyeing and printing. The process of formation of the dyestuff takes place within and upon the cotton fibre, and consists in the union, i. e. the coupling of the diazo compound produced from the amine with the naphthol. As the success of the dyeing depends essentially on the smooth course of the coupling, strict attention to certain conditions in the interaction of the two components is indispensable.

Foremost of those conditions are the following:

The β-naphthol must be present on the fibre in a soluble form as naphtolate of sodium, and any excess of mineral acid (muriatic acid, sulphuric acid) in the diazo solution must be neutralized by alkali (soda, caustic soda, acetate of soda, sodium phosphate, chalk etc.), or replaced by the acetic acid, phosphoric acid etc., which do not prevent the coupling.

By the action of metal salts, especially of copper salts the properties of most of the insoluble β-Naphthol-Azo dyestuffs undergo an essential change. This change consists in the transformation into pigments of different and often valuable shades and enhanced fastness properties. As the most important example may be mentioned Dianisidine Naphthol Blue. Whilst the dyestuff produced on the fibre from Tetrazodianisol and β-Naphthol shows a dull violet which is not fast to light, the pigment obtained by the action of copper salts forms a blue of preeminent beauty and great fastness to soap, and its fastness to light surpasses even that of Indigo.

The Nitraniline Red produced by the Diazo compound of Paranitraniline with β-naphthol is transformed by the action of copper salts into a beautiful tobacco brown of great fastness to soap and light.

The transformation into the copper-compound can be brought about in the following manner:

1. by treating the Azo colour, when properly developed upon the fibre, with hot copper solutions,
2. by adding a suitable copper salt to the Diazo compound,
3. by mixing into the naphthol prepare an alkaline copper solution: e. g. sodium copper tartrate.

Unfortunately the union between copper and the Azo dyestuff is not very firm, so that small quantities of acids (perspiration), or hot soda solutions effect a separation of the copper lake.

The fastness to light of the insoluble Azo Colours surpasses by far that of most direct and basic colours and is only exceeded by the Alizarine colours.

The fastness to soap is very satisfactory. When boiled together with white the latter is not tinted or only very slightly soiled in soaping. This is a characteristic feature of the Azo colours as compared with the direct colours. Also the fastness to acids is excellent (except the coppered shades); moreover, the Azo Colours withstand the action of chloride of lime, but they are strongly affected by sodium-hypochlorite solutions.

All the dyestuffs produced on the fibre are more or less liable to rub or to sublimate. The first named evil can, however, be reduced to a minimum, and well dyed Paranitraniline Red does not rub off more than ordinary Alizarine Red. — At a higher temperature these dyestuffs sublimate (except the coppered shades), and naphthol also has this drawback. Care must therefore be taken that the goods etc. impregnated with naphtolate of soda are not subjected to too great a heat nor left on hot metal drums for any length of time. Also the action of moist and dry steam is generally harmful. (The coppered Azo Colours, e. g. Dianisidine Blue, however, are improved by steaming.)

1. PREPARING IN NAPHTHOL.

Preparing in naphthol is the first operation in the production of insoluble Azo Colours upon the fibre; it is carried out by impregnating the cotton fibre by means of padding with a solution of naphthol in soda lye to which, in most cases, Turkey red oil, tragacanth thickening etc. are added. The padding of the cotton cloth is best done on a padding machine whose box is fitted with several guide rollers. After squeezing between well wrapped squeezing rollers or India rubber rollers as evenly as possible, the goods are dried in the hotflue.

For preparing in naphthol the following products are chiefly to be considered:

1. β-Naphthol,
2. β-Naphthol R Hoechst,
3. α-Naphthol,
4. Naphthol D.

β-Naphthol $C_{10}H_7(OH)$, mol. weight 144, in its pure state forms small brilliant leaves, and is put upon the market in lumps or ground as a white powder. It melts at 252° F. and boils at 545° F. The ground product is more easily and surely soluble than the lumps; it dissolves quickly in little hot water on pouring the necessary quantity of soda lye upon it. β-Naphthol is not easily soluble in cold nor hot water, but dissolves easily in alkalies, ether and benzol. With alkalies it forms phenolates, e. g. a naphthol sodium compound with caustic soda. Carbonic acid precipitates naphthol from these solutions. For this reason it is injurious to allow the solution to stand for any length of time, on account of the CO_2 contained in the air. By a prolonged exposure to air and light β-naphthol is apt to turn brownish. It must therefore be kept in closed vessels.

α-Naphthol has very similar properties to β-naphthol, and is also put upon the market in lumps or ground. It melts at 201° F. and boils at 533° F.

Besides the above two kinds of naphthol certain other naphthol compounds are used, viz **β-Naphthol R Hoechst** (a mixture of β-naphthol with the sodium salt of β-naphthol-monosulphonic acid F., sold as **Mixing Salt**), which serves for producing the most blueish shade of Paranitraniline Red, and **Naphthol D** which is employed for the production of a Dianisidine Blue fairly fast to perspiration.

The Farbwerke Hoechst put the naphthols upon the market in great purity, free from organic or inorganic admixtures. As the purity of the naphthols — above all of β-naphthol — influences the beauty and fastness of the shade, it is advisable to make a test by heating a sample. A residue indicates mineral impurities; common salt, Glauber's salt, dextrine etc. can also be detected by dissolving it in alcohol or ether in which the impurities remain undissolved.

In order to test β-naphthol for α-naphthol:

1 gr β-naphthol is dissolved in 100 cc boiling water, the cooled solution is filtered and a slight excess of chloride of lime added. A violet shade indicates α-naphthol, whereas pure β-naphthol shows a yellow at first, which, disappears again by adding a slight excess of chloride of lime.

From the intensity of the violet shade the degree of impurity with α-naphthol can be inferred.

In order to prepare the naphthol solution, the required quantity of naphthol is first made into a paste with some hot water, then the necessary quantity of soda lye added, and the whole heated until all the naphthol is dissolved. Care must be taken that the soda lye is pure, as impure lye containing sulphates yields less beautiful shades which are liable to rub considerably. The quantity of soda lye in the naphthol solution is in many cases, especially in dark Azo Colours, much larger than would be necessary for forming naphthol sodium. An excess of soda lye in the naphthol prepare produces deeper shades which, however, are apt to bronze. To the naphthol sodium solution are added in certain cases oil mordants (Turkey red oil, Para soap PN, castor oil ammonia or soda soap), thickenings (tragacanth, gelatine etc.), or certain salts (sodium acetate, alkaline copper solution, sodium antimony solution etc.), sometimes also glycerine. These additions effect in most cases a favourable change of the shade and fastness of the Azo Colours.

Naphthol sodium solutions or goods impregnated with them gradually turn brown when exposed to air and light, whereby duller shades are produced. This browning effect of air and light is mitigated by limiting as much as possible the quantity of caustic soda used for dissolving the naphthol, and by the addition to the prepare of an alkaline antimony solution containing glycerine.

In padding thick materials it is advisable to use the naphthol solution lukewarm, and to pass the goods twice or three times through, in order that they may be thoroughly impregnated. The goods must be squeezed well, so that the quantity of naphthol solution which might dry on the surface of the material is reduced to a minimum. This will also reduce the rubbing. The temperature of the hotflue may be 158°—176° F.; on leaving the hotflue the goods must be perfectly dry but not too hot. Where a hotflue is not available, or where the production is a very large one, the naphtholed goods can also be dried on the drying cylinders. In this case the first 2—4 drums must be covered with cloth, and care must be taken that the naphtholed goods be dried equally on both sides, and that they leave the drying machine without being overheated. For this purpose it is advisable to reduce the tension of the steam and, consequently, the temperature of the last drying cylinders. A great disadvantage of this drying method is that, if for unforseen reasons the naphtholed goods remain on the drying cylinders, the naphthol is liable to sublimate, which will have a very unfavourable effect upon the final results. Therefore when the goods are dried on the cylinders, the use of naphthol solutions containing antimony is to be especially recommended.

2. DIAZOTISING.

The Diazo- or Tetrazo-compounds of amines and diamines are obtained by the reaction of free nitrous acid upon the hydrochloric or sulphuric acid salts of these aromatic amido bases.

Paranitraniline and α-Naphthylamine are the principal bases, employed in dyeing.

Paranitraniline, mol. weight 138, is a yellow coloured crystalline substance, melting at 297° F., which, although little soluble in water, as a base forms salts with mineral acids which dissolve in water.

Paranitraniline is sold in a very pure state in the form of small needles or as a greenish yellow, finely ground powder, under the name of Paranitraniline extra.

As impurities Paranitraniline may contain Metanitraniline and especially Orthonitraniline. The latter is volatile in steaming. By boiling Paranitraniline with water in a glass vessel covered with filter paper, the paper is coloured yellow if Orthonitraniline is present.

Paranitraniline is dissolved by heating it with muriatic acid or sulphuric acid. When adding an excess of acid the salt precipitates again on cooling. If the solution containing an excess of acid is well stirred whilst ice is being added, the precipitation takes place in the form of fine crystals, as are necessary for diazotising. The Diazo solution obtained by the reaction of sodium nitrite upon these fine crystals keeps for a long time without decomposing when kept cold, if an excess of mineral acid is present.

α-Naphthylamine, mol. weight 143, is in its pure state a colourless base of peculiar smell which melts at 122° F., and boils at 572° F.

α-Naphthylamine is put upon the market as a pure base, as an hydrochloride, as a powder and as a 36% paste, and also as a sulphate in the form of a finely ground, easily diazotisable powder, under the name of α-Naphthylamine Salt S Powder, which yields more stable Diazo solutions than the hydrochloride.

Exposed to air and light, the base and its salts are coloured violet to black. In hot diluted muriatic acid it is easily soluble. An excess of acid and cooling effects precipitation of the hydrochloride. Especially in concentrated hot solutions to which ice is added whilst being stirred the precipitation is brought about in the requisite finely divided, easily diazotisable form. The sulphate of α-Naphthylamine is not easily soluble in water or acid. Nitrous acid converts the salts of α-Naphthylamine into Diazo Naphthaline which is moderately stable in very concentrated solutions, when a large excess of mineral acids is present and at a low temperature.

Metanitraniline, mol. weight 138, forms long yellow needles, melts at 230° F. and boils at 545° F. It has a sweet taste, and is not easily soluble in water. In diazotising it behaves like Paranitraniline and can also be used in the same manner for dyeing and printing.

Orthonitrotoluidine, mol. weight 151,7 forms large yellow monoclinic needles, and melts at 171,5° F. With β-naphthol it gives a bright orange, and with regard to its properties is very similar to Paranitraniline.

Chloranisidine, mol. weight 157,5, forms fine needles, melts at 125,6° F. and boils at 468° F. It dissolves easily in alcohol, ether and benzol. With β-naphthol it gives bright scarlet shades.

Benzidine, mol. weight 184, forms large brilliant leaves melting at 251,6° F. It does not easily dissolve in water, but is easily soluble in alcohol and ether. It forms a sulphate which does not dissolve easily. Coupled with β-naphthol it gives brown shades, fairly fast to soap.

Tolidine, mol. weight 211,6, forms in its pure state small iridescent leaves melting at 264,2° F. Not easily soluble in water, it dissolves easily in alcohol and ether. In its properties and use it greatly resembles Benzidine, and, like it, it forms a sulphate of little solubility. The brown shades obtained with β-naphthol have a more violet hue than Benzidine Brown.

Dianisidine, mol. weight 244, forms a grey powder melting at 278,6° F. Coupled with β-naphthol it gives a dull reddish violet of limited fastness. By the entry of copper into the dyestuff compound, however, a blue of Indigo-like hue, very fast to soap and light is produced.

The Diazo- or Tetrazo substances, as a rule, decompose easily; their preparation and preservation requires, therefore, the strict adherence to certain conditions. These are:

1. Excess of Acid. The diazotising of most of the aromatic amines is best effected in the presence of an excess of acid. At the same time, the presence of free mineral acid retards or prevents the formation of decomposition products of the Diazo solution (Diazo Amido compounds, Phenols etc.).

The excess of acid used in practice is about 20—50 %, in rarer cases 70—100 % of the quantity of acid necessary for the formation of the Amine salts and the decomposition of the nitrite.

2. Excess of Nitrite. Like an excess of free acid, that of free nitrous acid has a favourable effect, as the diazotising takes place more smoothly; any loss of nitrous acid caused by continuous stirring is thus replaced. Too great an excess of nitrite (above 10 %) must, however, be avoided, because the liberated nitrous acid vapours are injurious to health, and they also damage the copper of the printing rollers, dyeing cisterns and colour tubs. An excess of nitrous acid favours also the decomposition of the Diazo compounds.

3. Temperature. The temperature most favourable for the formation and preservation of the Diazo compounds is that of melting ice. The diazotising of the majority of the Amines takes place at a temperature of about 32° to at most 41° F. A corresponding excess of ice, which should be constantly present, counterbalances the injurious effect of the heat generated in the diazotising process. The more concentrated the diazotising solution, the lower must be its initial temperature and the larger the relative quantity of ice necessary for neutralizing the generated heat. In greatly diluted solutions, however, the diazotising succeeds also without the employment of ice. Not all the Amines however are diazotized at a low temperature; there are, on the contrary, aromatic Amines which yield the best results when treated at the ordinary or a lukewarm temperature.

Diazotised cold are: Aniline, the Toluidines, Nitranilines, Nitrotoluidines, Naphthylamines, Benzidine, Tolidine, Dianisidine, Diphenetidine etc., whilst Amidoazobenzol, Amidoazotoluol and Nitrophenetidine (Blue Red) are best diazotised at 68 - 86° F.

4. Fine subdivison of the Amido Base or it's salts. Since the hydrochlorides or sulphates of the Amines are mostly very little soluble, especially in the presence of an excess of acid, the free nitrous acid is made to react in most cases upon the salts precipitated in the form of fine crystals. A perfect diazo solution is only effected when these salts are present in the finest possible (micro-crystalline) form. Larger crystal aggregates are not affected by the nitrous acid. Consequently, it is of the greatest importance for the result of the diazotising that the Amines (either as salts or as a free base), are in a state of finest subdivision. With this object the Amido base is first made into the hydrochloric or sulphuric acid salt and then the nitrite solution allowed to react upon it. Or else a so-called Nitrite paste is made of the Amido base and the nitrite solution and this mixed into the diluted hydrochloric or sulphuric acid. After diazotising the Diazo solution is filtered through a cloth, diluted with water as required for the developing bath, and the free mineral acid neutralized immediately before use by the addition of sodium acetate, soda, soda lye, sodium phosphate or carbonate of lime (chalk). In some cases a certain amount of thickening (tragacanth or flour thickening) is added to the developing bath.

It is advisable to keep a stock of nitrite in solution for diazotising. Before preparing the solution the percentage of nitrite of soda in the commercial sodium nitrite is determined by means of titration with permanganate of potash. In general it is advisable to prepare from the commercial article of high percentage (95 %) nitrite solutions of 145 parts (twice normal) or 290 parts (four times normal) per 1000 parts of liquid.

Metal salts exercise a considerable effect upon the stability of the Diazo compounds as well as upon the shades of the resulting Azo dyestuffs. Metal salts which increase the acidity of the Diazo baths, in some cases enhance their stability, e. g. chloride of zinc in Diazo-naphtaline solutions; whereas copper solutions mostly effect a rapid decomposition of many Diazo compounds. An important exception are the Tetrazo compounds of Dianisidine and Diphenetidine which withstand the addition of copper salts well.

Chromic acid and bichromates added to the above-named dyestuffs, actually improve their stability.

As already mentioned, certain Amines can be diazotised without ice, i. e., in very diluted solutions and by employing cold spring water. Quite recently some methods have been devised by which also more concentrated Diazo solutions intended for Diazo printing colours can be prepared without ice. We shall refer to these in discussing the Diazo printing colours.

The fact that the Diazo compounds require considerable and often not easily procurable quantities of ice for their preparation and preservation, and that the developing baths made therefrom are still very liable to decompose, has brought about endeavours to find products which contain the Diazo compounds in a stable form. Amongst the discovered stable Diazo compounds the Azophor dyestuffs prepared and put upon the market by the Farbwerke Hoechst are the only colours of that description which can dispense with artificial cooling and yield developing baths of great stability. The simplicity of their manipulation, also the certainty of their results, has procured for these **Azophor Colours** a rapid introduction into the print works.

Azophor Red PN is a finely grained, reddish yellow powder which is easily soluble in cold water, leaving a small flaky residue ($^1/_2$—1 %). Not neutralized, the solution of Azophor Red is stable for a long time; and the printing pastes and dye baths prepared from it, are considerably less subject to decomposition than are those prepared with Paranitraniline. Azophor Red PN must be kept in a cool and dry place.

Azophor Orange MN has a somewhat lighter appearance. In respect of solubility and stability it resembles Azophor Red PN.

Azophor Blue D is a greyish brown powder, which darkens on exposure to light and air without detriment to its dyeing properties. Its solubility equals that of Azophor Red PN.

Azophor Pink A is a finely grained, light reddish yellow powder equally soluble to Azophor Red PN. When left to stand, it turns redder but is very stable.

Azophor Black S is a granular light brown powder which gradually darkens when exposed to air and light. In order to dissolve it completely, it is advisable to pour acetic acid over it and let it stand for some time. Its stability is very satisfactory.

Azophor Black DP is a fine dark brown powder easily soluble in cold water. It is very stable, although it soon darkens on being exposed to light and air. The printing colours of both brands of Azophor Black are still more stable than those of Azophor Red.

3. DYEING WITH DIAZO SOLUTIONS.

The formation of the insoluble Azo dyestuff (coupling) from the β-naphthol present on the fibre as sodium salt with the Diazo compound of the dye bath takes place within the cotton fibre immediately these two components come into contact with each other. Although this reaction takes place rapidly, there are still certain variations .to be noted with the various Diazo compounds. E. g. the Tetrazo compounds of the Diamines (Dianisidine) couple much more slowly and, consequently, sometimes more unevenly than the Diazo solutions of the Monamines (Paranitraniline). On the other hand, the coupling depends also upon the composition of the Diazo solutions: Paranitrodiazobenzene couples more quickly than the Azophor Red produced therewith. In dyeing with Diazo solutions both the rapidity of the coupling and the difference of the material to be dyed have to be considered, e. g. when passing thick naphtholed goods through the Diazo solution, they must be thoroughly impregnated by the developing bath, and sufficient time must be allowed for the coupling of the Diazo compounds.

After the development of the Azo colours the goods are well washed and soaped, whereby on the one hand the shades are often materially improved, and on the other hand, the superfluous dyestuff which mostly causes the colour to rub off, is removed. After repeated thorough washing the goods are hydro-extracted and finally dried.

When using developing baths which contain two kinds of Diazo compounds, for the purpose of producing mixed shades, it is advisable to use the smallest possible boxes, to replenish the liquid constantly, and to pass the naphtholed material through quickly, in order to prevent the colours from being exhausted unevenly.

The following are the **Methods for the Production of Azo Colour Styles** in printing:

A. Printing with thickened Naphthol solutions and subsequent dyeing in Diazo solutions.

B. Printing with thickened Diazo solutions on material prepared with Naphthol solutions.
C. Padding with Naphthol solutions and subsequent dyeing in Diazo solutions.
D. Production of Azo Colours by coupling dyestuffs of the Vesuvine or Chrysoidine series with Diazo Compounds.
E. Resist Effects on Insoluble Azo Colours.
F. Discharge Effects on Insoluble Azo Colours.

A. PRINTING WITH THICKENED NAPHTHOL SOLUTIONS AND SUBSEQUENT DYEING IN DIAZO SOLUTIONS.

This method of producing insoluble Azo Colours which yields very good results, is now rarely used, and is only employed for simple styles. The Naphthol printing colour described below is printed and the pieces then dried carefully and at not too high a temperature, so as to prevent the Naphthol from sublimating.

1. Naphthol Printing Colour A (for Paranitraniline and Azophor Red).

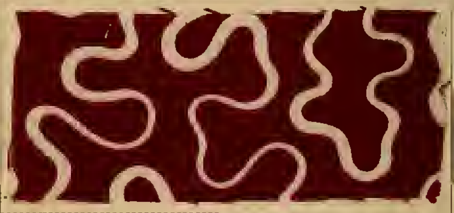
30 parts	β-Naphthol R
370 parts	hot water
70 parts	soda lye 36° Tw.
500 parts	tragacanth (60:1000)
30 parts	Para soap PN
1000 parts.	

2. Naphthol Printing Colour B (for α-Naphthylamine Claret).

30 parts	β-Naphthol
400 parts	hot water
70 parts	soda lye 36° Tw.
500 parts	tragacanth (60:1000)
1000 parts.	

The Naphthol prints are then developed on the padding machine in the Diazo solutions of p-Nitraniline, α-Naphthylamine etc., described on page 342, washed and soaped.

Naphthol Printing Colour A
Paranitraniline Red



Naphthol Printing Colour B
α-Naphthylamine Claret

B. PRINTING WITH THICKENED DIAZO SOLUTIONS ON MATERIAL PREPARED WITH NAPHTHOL SOLUTIONS.

The goods are padded with the various prepares (described below), dried in the hotflue or on the drying cylinders, printed with the Diazo printing colours, dried, washed and soaped.

A padding machine for preparing the goods in naphthol combined with a hotflue is illustrated by the sketch on page 347.

Naphthol Prepare.

For preparing in Naphthol the following are used: β-Naphthol, β-Naphthol R and RL (both for Para Red blue shade), Naphthol D (for Dianisidine Blue fast to perspiration), and α-Naphthol (which is added in rare cases to the β-Naphthol prepare). Furthermore, oil mordants: Para soap PN or Turkey red oil; also sometimes antimony compounds and more seldom aluminate of soda and cupric-sodium tartrate.

If the goods are dried over drying cylinders, the employment of a naphthol prepare containing antimony is advisable. — According to Dr. Lauber and Dr. Caberti the addition of alkaline antimony oxide solution to naphthol prepares prevents the browning of the materials impregnated with such solutions, when being dried on hot metal surfaces (drying on cylinders), or when left to lie for some time in the open air before developing. Additions of sulphites or pyrosulphites likewise to a certain degree, have a simular effect.

The following are the most important naphthol prepares:

1. Naphthol Prepare for Para Red and m-Nitraniline Orange.

	1.	2.
β-Naphthol	25 parts	—
β-Naphthol R	—	25 parts
hot water	200 parts	200 parts
soda lye 36° Tw.	47 parts	59 parts
Para soap PN	25 parts	25 parts
made up to	1000 parts	1000 parts

Prepare 2 is used especially for blueish shades of red.

2. Naphthol Prepare for Azo Pink BB and Blue Red O.

	3.
β-Naphthol	16 parts
hot water	200 parts
soda lye 36° Tw.	38 parts
Para soap PN	20 parts
made up to	1000 parts

3. Naphthol Prepare for α-Naphthylamine Claret Benzidine and Tolidine Chocolate.

The addition of fatty mordants produces bronzy and duller shades; their use is therefore to be limited or omitted altogether. The addition of tragacanth retards the coupling, but yields more even and clearer shades.

	4.		5.
β-Naphthol	25 parts	β-Naphthol	22 parts
water	200 parts	α-Naphthol	3 parts
soda lye 36° Tw.	47 parts	soda lye 36° Tw.	47 parts
tragacanth (60:1000)	75 parts	hot water	200 parts
water	500 parts	tragacanth (60:1000)	40 parts
made up to	1000 parts	made up to	1000 parts

For dark claret shades, obtained from α-Naphthylamine Claret an addition of some α-Naphthol for preparing is of advantage. The shades obtained, however, are not so fast to light.

The undermentioned Naphthol prepares are to be specially recommended for drying on the cylinder, viz No. 6 for p-Nitraniline, No. 7 for α-Naphthylamine. It is advisable, in drying on the cylinder drying machine, to wrap at least the first 2 or 3 cylinders with a light cotton cloth and to work in such a manner as to avoid the overheating of the material.

	6.	7.
β-Naphthol	25 parts	25 parts
soda lye 36° Tw.	47 parts	47 parts
hot water	100 parts	100 parts
hydrate of alumina 50%	20 parts	—
soda lye 36° Tw.	18 parts	—
neutral Para soap PN	25 parts	—
hot water	200 parts	200 parts
tragacanth (60:1000)	80 parts	80 parts
powdered tartar emetic	3 parts	3 parts
glycerine	30 parts	30 parts
hot water	100 parts	100 parts
made to up	1000 parts	1000 parts.

4. Naphthol Prepare for Dianisidine Naphthol Blue and Azophor Blue.

	8.	9.
β-Naphthol	25 parts	—
Naphthol D	—	25 parts
water	200 parts	200 parts
soda lye 36° Tw.	59 parts	59 parts
Para soap PN	50 parts	50 parts
sodium acetate cryst.	15 parts	15 parts
water	500 parts	500 parts
made up to	1000 parts	1000 parts.

5. Naphthol Prepare for Azophor Black.

In printing large blotch designs with Azophor Black it is advisable to use a naphthol prepare containing tragacanth. It is also possible to obtain a very blueish Para Red upon this prepare, by using the acid Para Red Printing Colour III described on page 330.

	10.
β-Naphthol	25 parts
soda lye 36° Tw.	59 parts
tragacanth (60:1000)	100 parts
made up to	1000 parts.

6. Naphthol Prepare for Mixed Diazo Compounds.

	11.
β-Naphthol	30 parts
soda lye 36° Tw.	71 parts
Para soap PN	25 parts
tragacanth (60:1000)	35 parts
sodium acetate cryst.	30 parts
made up to	1000 parts.

Diazo Printing Colours.

In order to reduce to a minimum the liability of the Diazo solutions to decompose in printing, it is advisable:

1. to prepare the Diazo printing colours in small portions, and only to add the sodium acetate required for neutralizing the free mineral acid immediately before printing,
2. to use small copper furnishing boxes, which can be cooled with cold water or, still better, with ice,

3. to print on the doctor instead of using a colour box when working with colours which froth, so that only a small portion of the colour is exposed at a time to decomposition and is continually replenished by fresh colour.

4. to keep the naphthol prepare strongly alkaline, or to add to it sodium acetate, in which case the addition of this salt to the printing colour becomes unnecessary,

5. to use brush furnishers in order to prevent sticky decomposition products from clogging the engraving.

As a rule the Diazo printing colours are prepared by thickening the Diazo solutions with suitable thickenings, and by neutralizing the free mineral acid, which prevents the coupling, by means of sodium acetate or soda lye. Experience has shown that sodium phosphate is very suitable for neutralizing, and yields much more stable printing colours than those prepared with sodium acetate.

As the best thickening for Diazo printing pastes, as regards ultimate stability and shade, may be considered the flour-tragacanth and the wheat starch-tragacanth thickenings which are to be recommended; they are cheaper than tragacanth and yield equally good results, whilst gum, dextrine, leiogomme and also British gum are not to be recommended, as they are liable to decompose the Diazo compounds.

Recently a thickening prepared with Iceland moss has been much used in the production of ice colours, owing to its low cost. This thickening is prepared similarly to that of tragacanth, by first soaking the moss in water and then boiling it for several hours. A useful thickening is obtained with 60 parts of Iceland moss per litre.

The methods to be employed in the preparation of Diazo compounds have already been described in outline on page 319. Below we give the full particulars for the preparation of Diazo Colours now in use. We have still to mention a mode of preparing Diazo colours without ice.

The preparation of Diazo Printing pastes without ice can be carried out by two methods, viz:

1. in such a manner that two thickened standard colours are made: the one contains the nitrite solution, and the other the base to be diazotised, together with the requisite amount of acid; both colours are mixed before use. The thickening present moderates and regulates the diazotizing reaction and counteracts the decomposition of the Diazo compounds,

2. in such a manner that the diazotizing of Paranitraniline is effected with an addition of sodium phosphate. This latter method is successfully carried out according to the undermentioned directions and yields

a very bright blueish Para Red. It may also be remarked that the substitution of oxalic acid for the mineral acid required for diazotising produces a good result without the use of ice.

The Azophor Colours which are always employed without ice have found a large application in printing, notwithstanding their higher cost, on account of the certainty and simplicity of their use.

Treatment of the printed goods.

After printing the goods are dried sharply (they must not be left too long on the steam plates of the hotflue or on the drying cylinders) and then washed. In order to prevent the white from becoming stained by loose particles of the Diazo compounds, it is advisable to take care that some excess of naphthol is always present on the material, and that the printing colours are not used in too concentrated form. The excess of Diazo solution can, however, be counteracted by hanging the printed goods overnight in a warm chamber, or also by a very short passage through the Mather-Platt (prolonged steaming impairs the shade). The same object is attained in the simplest and surest manner, however, by passing the printed and well dried goods for a short time through a hot, slightly acidified bath, and then washing them on the washing machine. Instead of the acid bath, boiling soap or a hot diluted naphthol solution may also be used. — After washing, the goods are usually soaped for a short time, then washed and dried.

Paranitraniline Red.

For the production of Para Red printing colours are used: Paranitraniline extra powder and Azophor Red PN on prepares: 1, 2 and 6 (see page 325 and 326).

Paranitraniline Red Printing Colour I.

(Diazotised after dissolving with acid.)

	22	parts **Paranitraniline** dissolved in
	120	parts hot water and
	41,3	parts muriatic acid 36° Tw., then cooled and added
	200	parts ice and water, at 32° F. added
	42	parts nitrite solution (290 parts per 1000)
made up to	470	parts, filtered and mixed into
	500	parts tragacanth (60:1000), and before use added
	30—40	parts sodium acetate cryst.
	1000	parts.

Paranitraniline Red Printing Colour II.
(Diazotised with Nitrite Paste.)

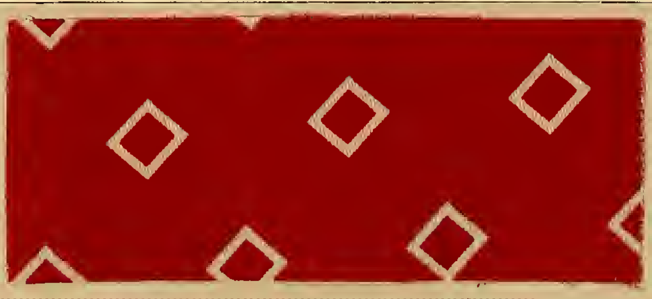
22 parts **Paranitraniline** are made into a paste with
42 parts nitrite solution (290 parts per 1000) and
80 parts cold water, and whilst being stirred, slowly entered into a mixture of
250 parts ice and water and
41,3 parts muriatic acid 36° Tw., allowed to stand for $^1/_4$ hour then filtered,
made up to 470 parts mixed into
500 parts tragacanth (60:1000), and before use added
30—40 parts sodium acetate cryst.
1000 parts.

Paranitraniline Red Printing Colour III.
(Diazotised without Ice.)

22,5 parts **Paranitraniline extra** are made into a smooth paste with the solution of
37 parts sodium phosphate cryst. in
75 parts water, then added the mixture of
20 parts sulphuric acid 169° Tw. and
132 parts cold water. After being well mixed the solution of
13,5 parts sodium nitrite cryst. and
50 parts cold water is poured gradually into the mixture. When properly diazotised, the liquid is filtered and thickened with
650 parts tragacanth thickening
1000 parts.

Printing Colour with Azophor Red PN.

90 parts **Azophor Red PN** are dissolved in
350 parts cold water, left to stand for $^1/_2$ hour, filtered, and the filtrate slowly diluted and neutralized with
47 parts soda lye 36° Tw. in
100 parts water. This solution is stirred into
500 parts flour- or starch-tragacanth thickening, then added
5—10 parts sodium acetate cryst., and
made up to 1000 parts.



Naphthol Prepare 2. Azophor Red PN.

m-Nitraniline Orange.

For the same are used: m-Nitraniline and Azophor Orange MN on the prepares 1, 2 and 6 (see page 325 and 326).

m-Nitraniline Printing Colour.

28 parts **m-Nitraniline** are dissolved in
200 parts hot water and
51,9 parts muriatic acid 36° Tw., cooled whilst being well stirred; then about
100 parts ice, and at 32—41° F.
52 parts nitrite solution (290 parts in 1000) are slowly added. After $^{1}/_{4}$ hour the liquid is diluted to
500 parts and filtered.
400 parts of this diazo solution are thickened with
500 parts tragacanth (60:1000), and before printing
30—40 parts acetate of soda cryst. and
60 parts water are added.
1000 parts.

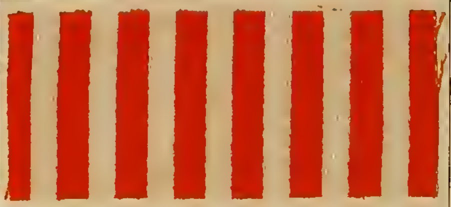
Azophor Orange MN Printing Colour.

90 parts **Azophor Orange MN** are dissolved in
250 parts water, left to stand for $^{1}/_{2}$ hour, filtered, and the filtrate slowly neutralized with
47 parts caustic soda 36° Tw. in
93 parts water. This solution is stirred into
500 parts flour tragacanth thickening or starch tragacanth thickening, then
5—10 parts acetate of soda cryst. are added, and the whole
made up to 1000 parts.

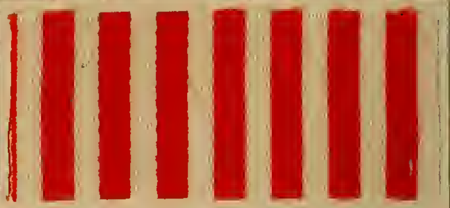
Nitrotoluidines may also be used for the production of Orange shades.

Orthonitrotoluidine Printing Colour.

30 parts **Nitrotoluidine** are dissolved in
200 parts hot water, and
59 parts muriatic acid 36° Tw., and cooled whilst being well stirred
100 parts ice are then added, and at 32—41° F.
52 parts nitrite solution (290 parts in 1000) slowly poured into it. After $^{1}/_{4}$ hour diluted to
500 parts and filtered.
Into 400 parts of this diazo solution
500 parts tragacanth (60:1000) are stirred and before printing
40 parts acetate of soda cryst. and
60 parts water are added.
1000 parts.



Naphthol Prepare I.
Azophor Orange MN.



Naphthol Prepare I.
Nitrotoluidine.

For the production of fiery Scarlet shades Chloranisidine is used. Its diazo-compound is printed in the usual manner upon the Naphthol prepare which is generally used for Para Red.

Diazo Solution.

20 parts **Chloranisidine salt M** are dissolved in
200 parts water, then
200 parts ice and
23,6 parts muriatic acid 36° Tw., are added. Whilst being stirred
26 parts nitrite solution (290:1000) are poured slowly into it, and the solution filtered and made up to
500 parts.

Printing Colour.

470 parts tragacanth (60:1000)
500 parts diazo-solution
30 parts sodium acetate cryst.
1000 parts.

Naphthol Prepare I. Chloranisidine salt M.

α) **Naphthylamine Claret.**

α-Naphthylamine Base, α-Naphthylamine hydrochloride paste 36 % and α-Naphthylamine salt S powder, are used for the production of α-Naphthylamine claret. α-Naphthylamine salt S powder may be diazotised without ice, and the printing colours made with it are fairly stable. For Naphthol prepares 4, 5 and 7 see page 326.

α-Naphthylamine Printing Colour made from the Base.

20 parts **α-Naphthylamine Base** are dissolved in
200 parts hot water and
14,4 parts muriatic acid 36° Tw., then cooled and
150 parts ice added. After that
28,1 parts muriatic acid 36° Tw. and at 32° F.
37,5 parts nitrite solution (290 : 1000) are slowly stirred into the liquid, left to stand for 10 minutes, filtered, made up to
500 parts, and then stirred into
460 parts tragacanth (60 : 1000). Before use
40 parts sodium acetate cryst. are added
1000 parts.

α-Naphthylamine Printing Colour made from α-Naphthylamine Paste 36 %.

70 parts **α-Naphthylamine Hydrochloride paste 36 %** are mixed with
100 parts water
200 parts ice and
34,2 parts muriatic acid 36° Tw. at 32° F.
37,5 parts nitrite solution (290 : 1000) are slowly stirred into the liquid, then left to stand for 10 minutes, made up to
460 parts, filtered and stirred into
500 parts tragacanth (60 : 1000). Before use
40 parts sodium acetate cryst. are added
1000 parts.

α-Naphthylamine Printing Colour made from α-Naphthylamine salt S powder.

28 parts **α-Naphthylamine salt S powder** are made into a paste with
100 parts water,
150 parts ice
14,4 parts sulphuric acid 169° Tw. and
100 parts ice are added. After that
37,5 parts nitrite solution (290 : 1000) are slowly stirred into the liquid at about 32° F., then left to stand for 10 minutes and made up to
460 parts, then stirred into
500 parts tragacanth (60 : 1000). Before use
40 parts sodium acetate cryst. are added
1000 parts.

α-Naphthylamine Printing Colour without Ice.

I.
28 parts **α-Naphthylamine salt S powder** are made into a paste with
100 parts water and thickened with
250 parts wheat starch tragacanth thickening, then
100 parts water and
20 parts sulphuric acid 169° Tw. are added

II.
250 parts wheat starch tragacanth thickening
37,5 parts nitrite solution (290 : 1000)
150 parts water

Standard paste II is slowly stirred into I. Before use
40—50 parts sodium acetate cryst., are added and the whole made up to

1000 parts.

Naphthol Prepare 4. α-Naphthylamine salt S powder

Dianisidine Naphthol Blue.

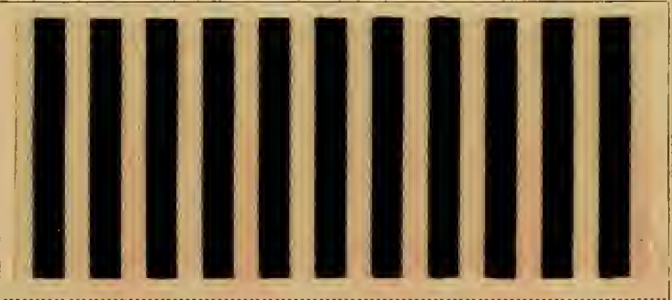
The characteristic feature of Dianisidine-Naphthol-Blue, which is distinguished for its fastness to light and soap, is the additional employment of copper salts in its preparation.

The following Dianisidine compounds are put upon the market:

Dianisidine Salt dry,
Dianisidine Salt moist 80 %,
Dianisidine Sulphate,
Dianisidine Base,
Azophor Blue D,
for Naphthol prepare 8 and 9 (see page 327).

Printing Colour made from Dianisidine Salt.

16,5 parts **Dianisidine Salt dry** are made into a paste with
11,8 parts muriatic acid 36° Tw. and
45 parts hot water, then cooled with
300 parts ice water, and at 32—41° F.
28 parts nitrite solution (290 : 1000) added
500 parts of this diazo solution
350 parts are stirred into
500 parts flour tragacanth thickening, to which are added
50 parts copper chloride 77° Tw. and
100 parts water
1000 parts.



Naphthol Prepare 9. Dianisidine Salt.

In the foregoing recipe 16,5 parts **Dianisidine Salt dry** may be replaced by 20,5 parts **Dianisidine Salt moist**, or 12,5 parts **Dianisidine Base**; in the latter case instead of 10 parts muriatic acid 36° Tw. 15 parts are used.

Printing Colour made from Azophor Blue D.

36 parts **Azophor Blue D** are dissolved in
300 parts cold water, filtered and made up to
350 parts, then stirred into
576 parts flour tragacanth thickening, and finally
70 parts copper chloride 77° Tw. and
4 parts chromic acid cryst. added
1000 parts.

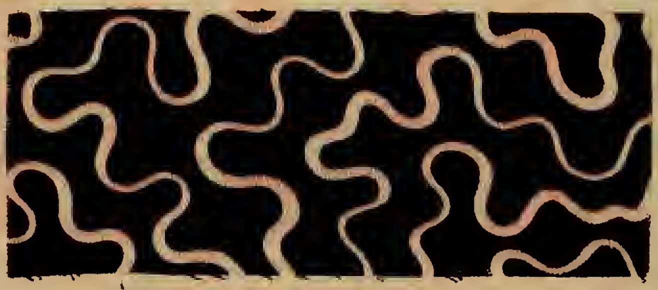
Naphthol Prepare 9. Azophor Blue D

Benzidine Brown.

Benzidine Base and Benzidine Sulphate are used upon Naphthol prepare 4 (see page 326).

Printing Colour made from Benzidine Base.

14,4 parts	**Benzidine Base** are dissolved at the boil in
150 parts	water and
18,8 parts	muriatic acid 36° Tw., after cooling
200 parts	ice and
31,3 parts	muriatic acid 36° Tw. are added and then at 32° F.,
41,6 parts	nitrite solution (290 : 1000) slowly stirred into the liquid. The whole is left to stand from 5—10 minutes, then made up to
500 parts	and stirred into
458 parts	tragacanth (60 : 1000). Before use
42 parts	sodium acetate cryst. are added
1000 parts.	

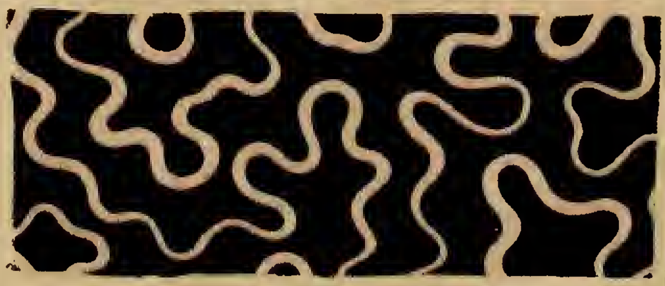


Naphthol Prepare 4. Benzidine Base

Tolidine Brown.

This Brown which is rather faster to light than Benzidine Brown is prepared from Tolidine Base. For Naphthol prepare 4 see page 326.

The mode of preparation of the printing colour is the same as indicated for Benzidine Brown, only instead of 14,4 parts Benzidine Base 17 parts Tolidine Base are used.



Naphthol Prepare 4. Tolidine Base.

For the production of pink upon a naphthol prepare the following are used: Blue Red O, Azo Pink BB, Azophor Pink A.

Blue Red O (Nitrophenetidine 25 %).

The diazotising is effected without ice at a temperature of 68—77° F. For light shades which are to be printed upon material prepared with concentrated naphthol solutions, it is necessary, to keep the printing colour correspondingly acid, so that the excess of alkali in the prepare is sufficiently counteracted.

Diazo Solution.

146 parts **Blue Red O** (Nitrophenetidine 25 %) are carefully mixed with
66 parts nitrite solution (290:1000) and
40 parts water, and are then slowly added into a mixture of
94,4 parts muriatic acid 36° Tw., at 77° F., and
250 parts water. When completely dissolved, the liquid is diluted to
1000 parts and filtered.

The diazo solution is distinguished for great stability.

	Light Pink	Dark Pink
Diazo solution	150 parts	500 parts
Tragacanth (60:1000)	600 parts	450 parts
Water	80 parts	—
Acetic Acid 9° Tw.	150 parts	—
Sodium acetate cryst.	20 parts	50 parts
	1000 parts.	1000 parts.

Naphthol Prepare 3, see page 326.
Dark Pink and Light Pink: Blue Red O.

Azo Pink BB.

By means of Azo Pink BB, blueish pink shades are obtained, but in dark shades a scarlet is produced which is distinguished for its blueish hue. The diazotising of the Azo Pink BB, which is put upon the market as a hydrochloride, is best carried out at a low temperature, according to the recipe below. It is to be noted that the diazo-compound is liable to crystallize if the solutions are very concentrated or too cold.

Diazo Solution.

26 parts **Azo Pink BB** are well mixed with
72 parts cold water and
30,7 parts muriatic acid 36° Tw., then
100 parts ice and
200 parts water, and whilst being slowly stirred
26 parts nitrite solution (290:1000) are added. After being left to stand for some time, the solution is filtered and diluted with cold water to
500 parts.

Red Printing Colour.

460 parts	tragacanth (60:1000)
500 parts	diazo solution
40 parts	sodium acetate cryst.
1000 parts.	

Pink Printing Colour.

500 parts	tragacanth (60:1000)
60 parts	diazo solution
75 parts	acetic acid 9° Tw.
355 parts	water
10 parts	sodium acetate cryst.
1000 parts.	

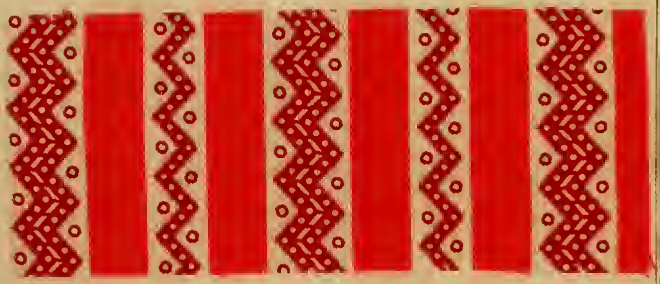
Naphthol Prepare 3, see page 326.
Red and Pink Printing Colours: Azo Pink BB.

Azophor Pink A.

With Azophor Pink A a brilliant yellowish pink is obtained upon a naphthol ground. For light shades the printing colours contain acetic acid, in order to counteract the alkali of the strong naphthol prepare, and to produce even results.

Pink Printing Colour.

20 parts **Azophor Pink A** are dissolved in
400 parts cold water, left to stand for $^1/_2$ hour, filtered, and
45 parts acetic acid 9° Tw. added. The whole is then diluted to
500 parts thickened with
485 parts tragacanth (60:1000), and before use
15 parts sodium acetate cryst. added
1000 parts.



Naphthol Prepare I.
Red Printing Colour. Pink Printing Colour.

Red Printing Colour: **Azophor Red PN.**
Pink Printing Colour: **Azophor Pink A.**

For the production of insoluble **Black** Azo Colours upon the fibre:
Azophor Black S and
Azophor Black DP are used.

In order to obtain a perfect solution, the use of acetic acid as a solvent for Azophor Black S is to be recommended. The excess of acid is neutralized in this case by means of caustic soda. A deeper black is produced on a prepare containing tragacanth than on one containing Para soap. Where deeply engraved printing rollers are used, the Azophor Black S printing colour must be correspondingly reduced, as otherwise brownish blacks may easily result; it is advisable to use rather thick printing colours. Azophor Black DP, however, yields better results the more concentrated the printing colours are. Most essential for both brands of Azophor Black is the employment of flour tragacanth thickening, as much fuller and especially more stable printing colours are obtained therewith.

Printing Colour made from Azophor Black S.

80 parts **Azophor Black S** are dissolved cold in
100 parts acetic acid 9° Tw. and
145 parts water, then
95 parts soda lye 36° Tw. and
80 parts cold water, slowly added, and the whole thickened with
500 parts flour tragacanth thickening. Strained before printing.
1000 parts.

Printing Colour made from Azophor Black DP.

80 parts **Azophor Black DP**
380 parts water
500 parts flour tragacanth thickening
40 parts sodium acetate cryst.
1000 parts.

Naphthol Prepare 2
Black Red

Black Printing Colour: **Azophor Black S.**
Red Printing Colour: **Azophor Red PN.**

Naphthol Prepare 4
Black Claret

Black Printing Colour: **Azophor Black DP.**
Claret Printing Colour: **α-Naphthylamine Salt S powder.**

Naphthol Prepare 2. Black Printing Colour.
Claret Printing Colour. Dyed in: Paranitraniline Red.

Black Printing Colour: **Azophor Black DP.**
Claret Printing Colour: **α-Naphthylamine Salt S powder.**

The insoluble Azo Colours are very often printed in conjunction with other colours which are easily fixed by short steaming. In that case the oil mordant and perhaps also the naphthol prepare appears to exercise a fixing influence.

If small amounts of antimony are added to the prepare, the fastness of these colours is increased. Very useful are the basic dyestuffs named below, which are printed in the ordinary way with tannin, but with an addition of larger quantities of tartaric acid or citric acid (instead of 2 parts up to 40 parts in 1000 parts printing colour). They are then fixed by a short passage through the Mather-Platt. Likewise certain bisulphite dyestuffs, e. g. Alizarine Blue, Ceruleine or Philochromine and Chromoglaucine etc. are used in the same manner.

The following are dyestuffs which, when used in conjunction with insoluble Azo Colours, can be fixed by short steaming:

Auramine, Methylene Yellow H, Flavophosphine, Rosazeine 4G, 6G and 6GD, Safranine, Methyl Violet, Marine Blue, Victoria Blue, Methylene Blue, Thionine Blue, Ethyl Blue, Malachite Green, Brilliant Green, Alizarine Blue S, Ceruleine S, Chromoglaucine VM, BMI, Philochromine B, G, etc.

Naphthol Prepare 6. Yellow P.
Green P.
Azophor Red PN.

Naphthol Prepare 7. Yellow P.
Blue P.
α-Naphthylamine Salt S powder

	Yellow P	Green P	Blue P
Auramine conc.	30 parts	14 parts	—
Brilliant Green cryst. extra	—	8 parts	—
Violet crystals O	—	—	6 parts
Methylene Blue DBB extra conc.	—	—	24 parts
Acetic acid 9° Tw.	200 parts	200 parts	200 parts
Citric acid	25 parts	25 parts	25 parts
Acid starch thickening	350 parts	350 parts	350 parts
Tragacanth (60 : 1000)	200 parts	200 parts	200 parts
Water	45 parts	103 parts	45 parts
Acetic acid tannin sol. (1 : 1)	150 parts	100 parts	150 parts
	1000 parts	1000 parts	1000 parts.

C. PADDING WITH NAPHTHOL SOLUTIONS AND SUBSEQUENT DYEING WITH DIAZO SOLUTIONS.

The recipes for preparing the naphthol solutions are given on page 325 and following pages, also the operation of diazotising and the particulars in connection therewith are fully described on page 319 and following pages. — The developing baths are prepared from the various amido bases in the following manner:

Paranitraniline Red.

For Naphthol Prepare 1, 2, 6 see page 325 and 326.

Diazotising after dissolving with acid.

14 parts **p-Nitraniline extra** are dissolved in
60 parts boiling water and
26 parts hydrochloric acid 36° Tw., cooled whilst being well stirred, so that the p-Nitraniline may be separated in the finest possible form. Then
100 parts ice, and, at 32—35° F.,
26 parts nitrite solution (290 in 1000) are added. After frequent stirring the solution is filtered; before use
30 parts sodium acetate cryst. are added and the whole diluted to
1000 parts.

Diazotising of Nitrite Paste.

14 parts **p.-Nitraniline extra** are made into a paste with
10 parts water, cooled, and then
26 parts nitrite solution (290 : 1000) are added; this paste whilst being stirred, is added in several portions into the mixture of
26 parts hydrochloric acid 36° Tw. and
200 parts ice water and ice. After frequent stirring the solution is filtered; before use
30 parts sodium acetate cryst. are added and the whole diluted to
1000 parts.

Azophor Red PN.

For Naphthol Prepare 1, 2, 6 see page 325 and 326.

56 parts **Azophor Red PN** are made into a paste with
400 parts cold water, left to stand for $^1/_2$ hour, filtered when completely dissolved, then slowly neutralized with
29,5 parts soda lye 36° Tw. and
100 parts water, after which
5 parts sodium acetate cryst. are added and diluted to
1000 parts.

m-Nitraniline, which is only rarely used for plain shades or for resist styles is diazotised in the same manner as p-Nitraniline. Azophor Orange MN can also be used in like manner to Azophor Red PN.

Chloranisidine is employed for producing fiery scarlet shades.

Chloranisidine.

For Naphthol Prepares 1, 2, 6 see page 325 and 326.

20 parts **Chloranisidine Salt M** are dissolved in
200 parts water, then are added
23,6 parts hydrochloric acid 36° Tw.,
200 parts ice, after which are slowly added
26 parts nitrite solution (290 : 1000) filtered after being diazotised, before use
30 parts sodium acetate are added and diluted with water to
1000 parts.

α-Naphthylamine Claret.

For Naphthol Prepares 4, 5, 7 see page 326.

α-Naphthylamine Base.

14,3 parts **α-Naphthylamine Base** are dissolved in
300 parts hot water and
11,8 parts hydrochloric acid 36° Tw., cooled, then
23,6 parts hydrochloric acid 36° Tw. and
200 parts ice are added. When cooled to about 32° F.,
26 parts nitrite solution (290 : 1000) are poured into the liquid whilst being stirred, then filtered, and before use
30 parts sodium acetate cryst. are added. The whole is diluted with cold water to
1000 parts.

α-Naphthylamine Hydrochloride Paste 36%

50 parts **α-Naphthylamine Hydrochloride Paste** 36 % are well mixed with
50 parts cold water, then
200 parts ice, and at 32° F.
23,6 parts hydrochloric acid 36 Tw. are added. After that
26 parts nitrite solution (290 : 1000) are added, and the solution filtered after 10—15 minutes. Before use
30 parts sodium acetate cryst. are added to the liquid, and the whole diluted to
1000 parts.

α-Naphthylamine Salt S Powder.

19,2 parts α-**Naphthylamine Salt S Powder** are made into a paste with
200 parts cold water and
10 parts sulphuric acid 169° Tw. to which are added
200 parts ice. Then are slowly added whilst being stirred, at about 32° F.
26 parts nitrite solution (290 : 1000). After standing for $^{1}/_{4}$ hour, the liquid is filtered and thickened with
100 parts tragacanth (60:1000). Before use
30 parts sodium acetate cryst. are added and the whole diluted to
1000 parts.

For the production of deep Grenade shades (which are easily dischargeable with Hydrosulphite NF conc. Hoechst) Fast Azo Grenade is used.

Fast Azo Grenade.

22,5 parts **Fast Azo Grenade Base M** and
10 parts tragacanth (60 : 1000) are finely ground with
40 parts water, then
100 parts ice
40 parts water
35,4 parts hydrochloric acid 36° Tw. are added. Then whilst being stirred
26 parts nitrite solution (290 : 1000) are slowly added. After being left for some time, the liquid is diluted to 1000 parts, and before use
40 parts sodium acetate cryst. are added
1000 parts.

It is advisable to dilute this bath with an equal quantity of water before dyeing, in order to prevent the colours from bronzing and sublimating.

Benzidine Puce and Tolidine Puce.

For Naphthol Prepare see page 326.

18 parts **Benzidine Base** or 21 parts **Tolidine Base** are dissolved with
23,6 parts hydrochloric acid 36° Tw. and
100 parts boiling water, slowly cooled, then
200 parts ice and
40,1 parts hydrochloric acid 36° Tw. are added, after which at 32—41° F.
52 parts nitrite solution (290 : 1000), are slowly added, filtered after $^{1}/_{4}$ hour. Before use
40 parts sodium acetate cryst., thickened with
100 parts tragacanth (60 :1000), are added and diluted to
1000 parts.

Dianisidine Naphthol Blue prepared from Dianisidine Salt.

For Naphthol Prepare 8 and 9 (see page 327).

Medium Blue.

8,3	parts	**Dianisidine Salt dry** are made into a paste with
5,9	parts	hydrochloric acid 36° Tw. and
20	parts	hot water, then cooled with
100	parts	ice water, after which
14	parts	nitrite solution (290:1000) are added at 32°—41° F., filtered after 10 minutes and the liquid slowly stirred into
75	parts	flour tragacanth thickening. Then
41,5	parts	chloride of copper solution 77° Tw., and before use
2	parts	chromic acid dissolved in water are added, and diluted to
1000	parts.	

Azophor Blue D.

For Naphthol Prepare 8 and 9 (see page 327).

Medium Blue.

25	parts	**Azophor Blue D** are dissolved in
800	parts	water, filtered and thickened with
75	parts	flour tragacanth thickening. Then
41,5	parts	chloride of copper solution 77° Tw. and
1	parts	chromic acid dissolved in water are added, and diluted to
1000	parts.	

In the foregoing recipes the chloride of copper solution 77° Tw. can be replaced with advantage by Copper Solution N. 40 parts chloride of copper 77° Tw. are eqivalent to 100 parts Copper Solution N.

Copper Solution N.

160	parts	chloride of copper solid,
42,6	parts	acetate of copper cryst. are dissolved in 600 parts water, then
80	parts	sodium nitrite cryst. and
75	parts	acetic acid 12° Tw. are added, and diluted with water to
1000	parts.	

Mixed Diazo Compounds.

In order to obtain mixed shades by means of insoluble Azo Colours, the Azophor Dyestuffs are used with advantage. These, in virtue of their greater stability, are better suited for that purpose than the corresponding freshly prepared diazo solutions.

Developing Bath for Brown.

20	parts	**Azophor Red PN**
20	parts	**Azophor Black S** are made into a paste with water and diluted to
500	parts	then thickened with
50	parts	tragacanth (60:1000), after which
30	parts	sodium acetate cryst.
300	parts	water
17,7	parts	soda lye 36° Tw. are slowly added, and before dyeing
35	parts	Copper Solution N (see above), and
70	parts	water are added
1000	parts.	

Developing Bath for Blue.

10	parts	**Azophor Blue D**
15	parts	**Azophor Black S** are made into a paste with water, and diluted to
500	parts	then thickened with
50	parts	tragacanth (60:1000), after which
40	parts	sodium acetate cryst.
300	parts	water are slowly added, and before dyeing
35	parts	Copper Solution N and
70	parts	water are added
1000	parts.	

Dyeing with Diazo Solutions.

The apparatus for dyeing plain shades on naphtholated goods, is represented by the sketch on page 347 which also shows a installation for preparing in naphthol. In works where naphtholated materials printed with resists or very thick cloths are to be dyed in diazo solutions, the proper construction of such an apparatus is of special importance. It consists of the following parts:

1. The developing box with guide rollers is constructed either of wood or of metal. It is advisable not to make it too large so that the developing bath may be oftener renewed. In dyeing goods printed with resists it is advisable not to pass them through the bath, but direct through the squeezing rollers with the printed side uppermost, in order to prevent the colour from running into the resists. In that case a wooden roller (up to 20 inches in diameter, and covered with flannell), rotates in the bath; the upper small squeezing roller is pressed against the lower one with but slight pressure.

In order to wet and dye thick materials evenly the developing liquid can be squirted upon the cloth through a perforated pipe which is fixed above the material and near the squeezing apparatus.

Instead of the flannell covering and in order to carry larger quantities of developing liquid on to the cloth the former may be replaced by an endless felt apron which runs over two guide rollers in the box and over the lower squeezing roller. In those cases where the bath is damaged by some of the printed resists being washed off and soiling the liquid, the precaution can be used (as will be described in discussing the tannin discharge styles) to collect the squeezed-out liquid separately.

2. An airing installation is attached to the apparatus by means of which the coupling of the Azo Colour is completed.

3. An open washing machine consisting of becks with squirting pipes, squeezing rollers and water cisterns.

In dyeing resist styles these becks can be filled according to requirements with tartar emetic, diluted acid, hot water, soap solution etc.

The goods, after being passed through the open washing machine, are again washed either in rope form, or, heavy resist designs which rub off easily are manipulated on another open washing and soaping machine; they are finally squeezed and dried.

D. PRODUCTION OF AZO COLOURS BY COUPLING DYESTUFFS OF THE VESUVINE OR CHRYSOIDINE SERIES WITH DIAZO COMPOUNDS.

The dyestuffs of the Vesuvine and Chrysoidine series containing free Amido groups can be coupled on the fibre with Diazo compounds, whereby brown shades of great brilliancy and fastness can be obtained. The best and most important results are produced by the employment of Brownsalt G (Vesuvine), Brownsalt R (Chrysoidine) or of the Dark Brownsalt G and R

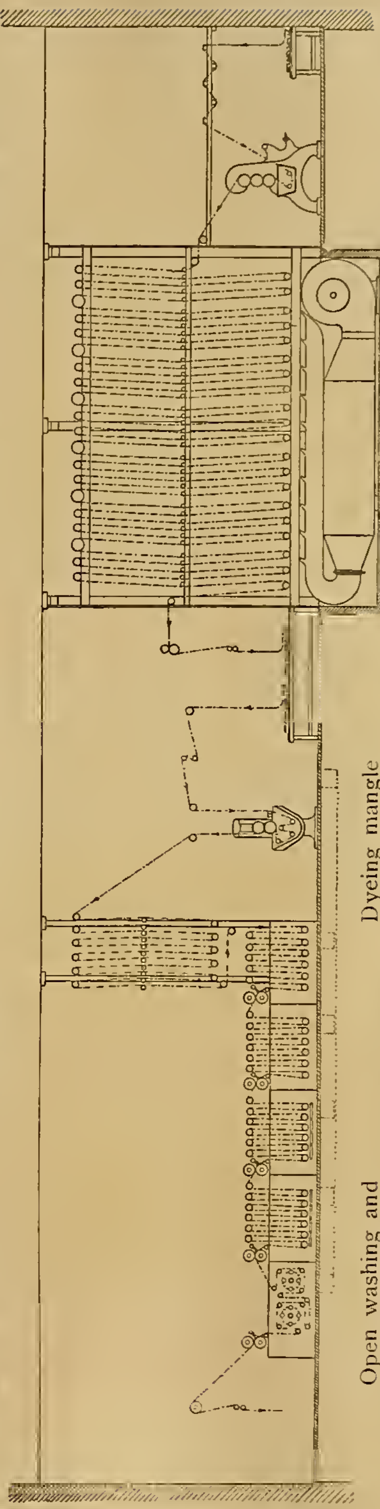


Fig. 23

in conjunction with Paranitrodiazobenzene. These brown shades are faster to light than the β-Naphthol compounds of Benzidine and Tolidine, do not sublimate on keeping, are sufficiently fast to ironing, and yield very good discharge effects with hydrosulphite discharges.

The method of employment is as follows:

The bleached cotton cloth is padded with the solutions of Brownsalt G (Vesuvine) or of Brownsalt R (Chrysoidine) to which some acetic acid and tragacanth thickening are added in order to prevent them from bronzing. The Dark Brownsalts are more soluble than the ordinary Brownsalts and are dissolved without the addition of acetic acid. They are slightly acid and require, therefore, a small addition of acetate of soda to the padding bath in order neutralise the free acid. The goods are then dried in the hot-flue or on the cylinder drying machine, and afterwards passed through the solution of Paranitrodiazobenzene neutralized with sodium acetate. This passage must not be too short, and the goods must lie for $^1/_4$ hour before being washed. Brownsalt G and Dark Brownsalt G give more yellowish shades than Brownsalt R and Dark Brownsalt R. — The goods are then washed, soaped and dried. By printing with thickened Brownsalt solutions upon white or naphtolated material and subsequent dyeing with Paranitraniline various excellent effects can also be produced.

Prepare for Para Brown.

15 parts	**Brownsalt R or G** are dissolved in
200 parts	boiling water and
50 parts	acetic acid 9° Tw., mixed with
50 parts	tragacanth (60:1000) and
600 parts	water, and made up with water to
1000 parts.	

Prepare for Para Dark Brown.

15 parts	**Dark Brownsalt R or G** are dissolved in
200 parts	boiling water mixed with
75 parts	tragacanth (60:1000) after cooling
3 parts	acetate of soda are added and the whole made with water up to
1000 parts.	

Developing Bath (see page 342).

14 parts	Paranitraniline extra diazotised, mixed with
30 parts	sodium acetate, and diluted to
1000 parts.	

Brownsalt Printing Colour.

20 parts	**Brownsalt R or G**
310 parts	water
70 parts	acetic acid 9° Tw.
600 parts	acid starch thickening
1000 parts.	

Para Brown R

Para Brown R:
Brownsalt R,
Paranitraniline extra.

Para Brown G

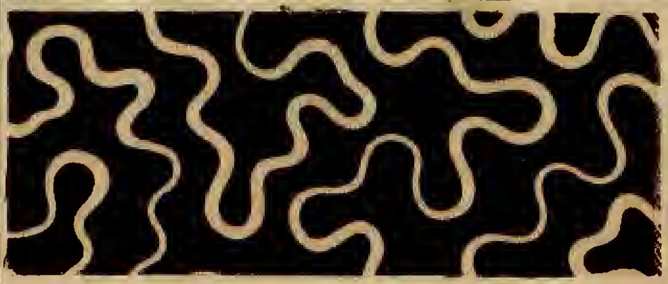
Para Brown G:
Brownsalt G,
Paranitraniline extra.

Para Dark Brown R

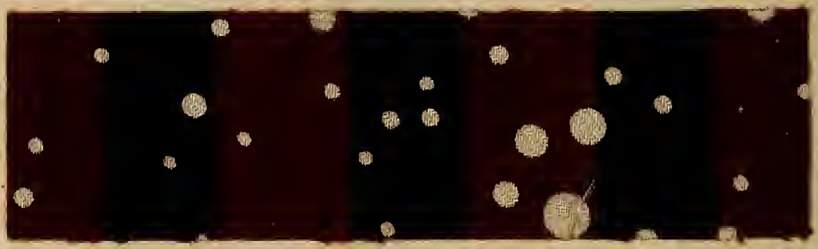
Para Dark Brown R:
Dark Brownsalt R,
Paranitraniline extra.

Para Dark Brown G

Para Dark Brown G:
Dark Brownsalt G,
Paranitraniline extra.



Brownsalt Printing Colour: Brownsalt R
Dyed with: 14 parts Paranitraniline per 1000



Para Brown R, discharged with Hydrosulphite NF conc.

Prepare for Para Brown R diluted 1:2. Brownsalt Printing Colour.
Dyed with: 14 parts Paranitraniline per 1000.
Discharge White NFC (see page 365).

E. RESIST STYLES ON INSOLUBLE AZO COLOURS.

In order to obtain white and coloured resist effects on Azo Colours, such colours as contain substances which have either a decomposing effect upon the diazo compounds, or reduce to a large extent or counteract altogether the coupling power of the naphthol are printed on the naphthol prepares. Such substances are e. g. stannous salts, sulphites, tannin, phenol alkali, strong organic acids, as e. g. citric acid, tartaric acid, persulphates etc.

Besides the above certain other media are used which when added to the resists essentially enhance the resist effect by mechanically covering the ground, as e. g. china clay, wax, paraffin and fats.

The following resists are to be distinguished:

1. Tin resists,
2. Sulphite resists,
3. Tannin resists,
4. Persulphate resists.

The naphthol solutions to be considered in the production of resist and discharge styles were already discussed on page 325 and the following pages, the developing baths and the method of dyeing therewith on page 342 and the following pages.

1. Tin Resists.

Stannous salts, more especially the easily procurable tin crystals, have a strongly resisting effect upon diazo compounds which they quickly decompose. Considering that fixed organic acids, such as tartaric acid, citric acid or oxalic acid have also a strong resisting action, and exercise a favourable effect upon the white, they are mostly added to the tin resists. It is to be noted that the tin crystals must be of good quality, i. e. they must have no yellowish tinge and be perfectly soluble. In order to increase the resisting power of the tin resists, mechanically resisting additions, as e. g. china clay, glue, paraffin, wax, are made.

The white resists prepared with stannous salts are liable to produce a yellowish white. In order to purify it, and to remove the last traces of small amounts of tin compounds still adhering, the goods must be well soured. This operation is best carried out in the open; a short passage through an acid mixture, similar to the Indigo discharge bath, prepared from sulphuric and oxalic acid, has proved very advantageous.

The tin coloured resists are generally prepared with basic dyestuffs, which withstand the reduction, or with pigment colours, e. g. Auramine, Methylene Yellow H, Flavophosphine, Phosphine, Rosazeine 4G, 6G, 6GD, Methyl Violet, Marine Blue, Victoria Blue, Methylene Blue, Thionine Blue, Ethyl Blue, Malachite Green, Brilliant Green, also Chrome Yellow, Chrome Orange, Guignet Green.

The coloured resists with basic dyestuffs are mostly printed with an addition of tannin, and subsequently passed through tartar emetic. The addition of tannin can be omitted if the fastness of these tannin discharges is not of great importance.

White Resists.

White Resist I.

450 parts	tin crystals
450 parts	gum solution 1 : 1
50 parts	tartaric acid
50 parts	glycerine
1000 parts.	

If antimony compounds are added to the white resists, covers with basic colours can be resisted.

White Resist III.

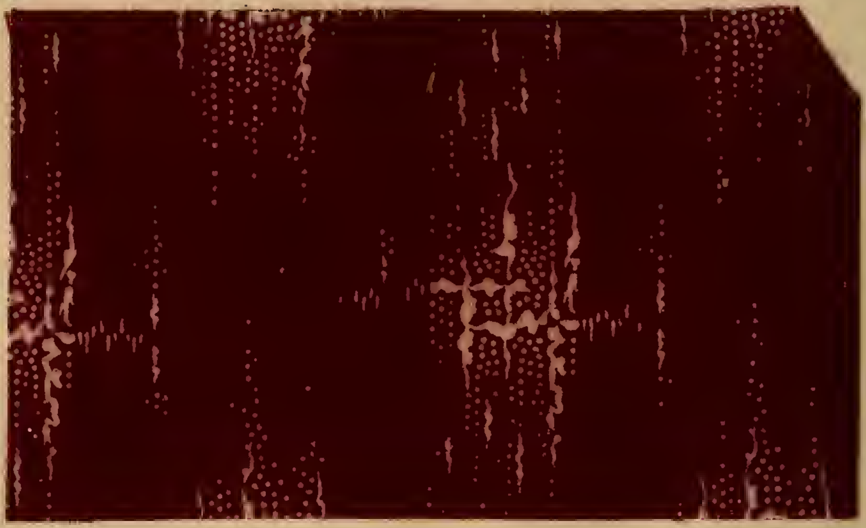
225 parts	British gum powder
225 parts	water
150 parts	tin crystals
50 parts	tartaric acid
350 parts	sodium tartar emetic
1000 parts.	

250 parts	acid starch thickening
250 parts	tin crystals
50 parts	tartaric acid
350 parts	glue solution 1 : 2
100 parts	china clay
1000 parts.	

Glue Solution 1 : 2.

335 parts	glue are soaked in
415 parts	water and heated till completely dissolved with the addition of
250 parts	acetic acid 9° Tw. The loss in weight caused by boiling is made up with diluted acetic acid.
1000 parts.	

Pattern produced on a large scale.



White Resist I.

Pattern produced on a large scale.

White Resist I.

Coloured Resists.

a) with basic dyestuffs.

	Yellow Z	Pink Z	Blue Z	Green Z
Auramine conc.	30 parts	—	—	—
Rosazeine 4G	—	40 parts	—	—
Victoria Blue B	—	—	25 parts	—
Brilliant Green cryst. extra	—	—	—	20 parts
Methylene Yellow H	—	—	—	10 parts
Water	—	30 parts	25 parts	—
Acetic acid 9° Tw.	100 parts	100 parts	100 parts	100 parts
Acid Starch thickening	500 parts	500 parts	500 parts	500 parts
Tartaric acid	50 parts	50 parts	50 parts	50 parts
Glycerine	50 parts	50 parts	50 parts	50 parts
Acetic Acid-tannin sol. 1 : 1	120 parts	80 parts	100 parts	120 parts
Tin crystals	150 parts	150 parts	150 parts	150 parts
	1000 parts	1000 parts	1000 parts	1000 parts

b) with Pigment Colours.

Chrome Yellow Z.

300 parts	Chrome Yellow paste
100 parts	glycerine
60 parts	water
200 parts	tragacanth (60 : 1000)
40 parts	tartaric acid
300 parts	tin crystals
1000 parts.	

Pattern produced on a large scale.

Benzidine Brown. Chrome Yellow Z. Blue Z. Green Z.

2. Sulphite Resists.

Concentrated solutions of potassium sulphite or sodium bisulphite neutralized with ammonia, thickened with British gum, dextrine or gum are used for the production of sulphite resists. Potassium sulphite is generally preferable to the other sulphites, on account of its solubility.

The sulphite resists produce under Paranitraniline Red or Azophor Red a purer, less yellowish white than the tin resists, and there is no danger of corroding the cotton fibre. — On the other hand, the white obtained with tin resists is considerably better than that produced with sulphite resists under α-Naphthylamine Claret.

The following are the most important sulphite resists:

White Resist I.

250 parts British gum powder } are dissolved hot.
750 parts potassium sulphite 91° Tw. } are dissolved hot.
1000 parts.

White Resist II.

200 parts oxide of zinc powder
300 parts thickening SG
500 parts potassium sulphite 91° Tw.
1000 parts.

A very good resist for Para Red, resists also Azophor Black covers.

White Resist III.

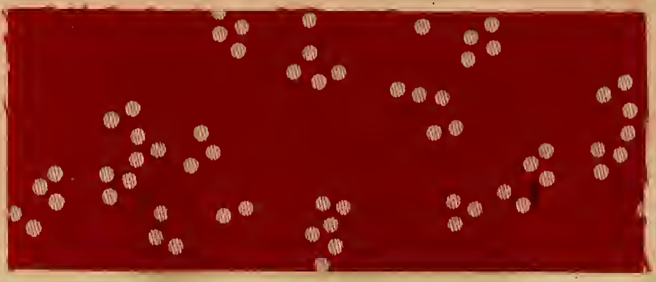
120 parts stannous hydrate paste are slowly stirred into
60 parts gum solution
460 parts soda lye 91° Tw. then
265 parts gum solution
55 parts bisulphite $71^{1}/_{2}$° Tw.
40 parts glycerine are slowly added
1000 parts.

This Resist is used for fine patterns under heavy covers.

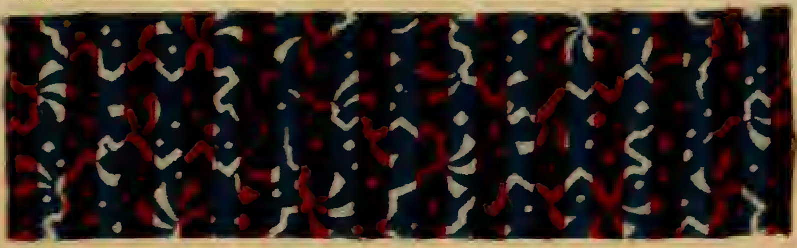
For the production of Coloured Resists pigment colours are employed, e. g.

Blue Resist U.

300 parts ultramarine powder are very finely ground with
20 parts glycerine and
180 parts water, then
100 parts tragacanth (60:1000)
150 parts albumen (1:1)
250 parts potassium sulphite 91° Tw. are added
1000 parts.



Naphthol Prepare 2. White Resist II. Paranitraniline extra.



Light Indigo. Naphthol Prepare 2. White resist II. Developing bath: Azophor Red PN. Cover: Chlorate discharge II (see page 113) reduced 1:1.

3. Tannin Resists.

Tannin has a strong resisting effect upon diazo compounds. By means of this reaction it is possible to produce coloured resists with tannin dyestuffs. which possess great fastness to washing and soap, and surpass the tin crystal resists, which are always liable to form lakes — in beauty and fastness.

White resist effects cannot be satisfactorily produced with tannin: the importance of tannin resists lies rather in the possibility to produce brilliant coloured resist effects (large designs) with tannin dyestuffs on an Azo colour ground.

The resisting action of tannin is increased by the addition of certain fixed organic acids.

The composition of some tannin resists may be gathered from the following recipes:

	Yellow	Green T	Blue T
Auramine conc.	20 parts	—	—
Methylene Yellow H	—	10 parts	—
Brilliant Green cryst. extra	—	6 parts	—
Methylene Blue DBB extra conc.	—	4 parts	—
New Ethyl Blue RS	—	—	12 parts
Marine Blue RI	—	—	12 parts
Violet crystals O	—	—	6 parts
Acetic acid 9° Tw.	260 parts	260 parts	205 parts
Acetine	50 parts	50 parts	50 parts
Acid starch thickening	550 parts	550 parts	535 parts
Tartaric acid	20 parts	20 parts	—
Oxalic acid	—	—	60 parts
Acetic acid tannin sol (1:1)	100 parts	100 parts	120 parts
	1000 parts	1000 parts	1000 parts.

Instead of acid starch the thickening SG which possesses partly mechanically resisting properties, can be used with advantage.

In order to ensure a good fixation of these tannin resists it is advisable to dry the goods thoroughly after printing, then to hang them in a warm place, or to run them over the drying cylinder. A short passage through the Mather-Platt is also often serviceable.

Since the depth of the Azo colours is unfavourably influenced by a previous steaming of the naphtholated and printed goods, but more especially by the contact of the material with the hot copper rollers of the Mather-Platt, it is advisable to cover the copper guide rollers with wooden laths or to engrave upon them dented longitudinal stripes, whereby the surface of contact between material and rollers is reduced to a minimum. Before steaming these goods it is advisable to saturate the steam in the Mather-Platt with naphthol vapour.

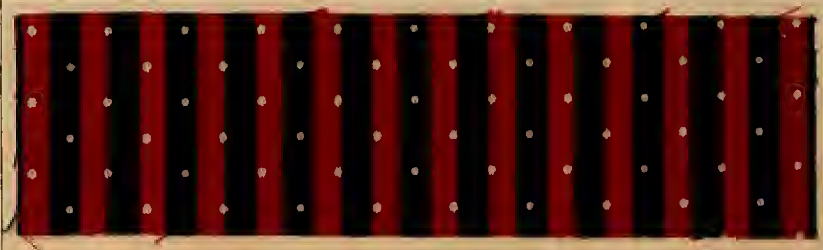
After steaming the colours are developed in the diazo bath, which is done on the apparatus described on page 346.

In order to prevent the developing bath from being soiled by the sqeezed-out padding liquid, the apparatus is constructed in such a manner that the superfluous developing liquid is drained off separately. Thin materials can be passed direct through the squeezing rollers of the padding machine, the lower thickly covered roller of which rotates in the developing bath. Thick materials receive a short passage through the bath. The printed side runs face upwards; the upper squeezing roller is better not wrapped. After developing, the goods are well squirted with water, washed, then passed through tartar emetic, and finally soaped in the open.

Instead of printing with tannin colours upon naphthol ground the following method can be adopted:

The acid tannin colours are printed upon the material, steamed for $^1/_2$—1 hour, then padded with naphthol solution without being washed, and finally developed in the diazo bath.

In this case the naphthol solution is padded on the printing machine; thin material is best padded on the back.



Naphthol Prepare 2. Resist PZ. Blue T.
Paranitraniline Red Developing bath.

Resist PZ.

175 parts	British gum powder
275 parts	water
350 parts	sodium tartar emetic
50 parts	tartaric acid
150 parts	tin crystals.
1000 parts.	

Patterns produced on a large scale.

Blue T Green T

Blue T Green T α-Naphthylamine Claret Azophor Black S

Blue T Green T α-Naphthylamine Claret Azophor Black S

4. Persulphate Resists.

The persulphate resist process is used for the production of coloured discharges on naphthol ground, and chiefly for the production of Blue Red styles by means of Dianisidine Naphthol Blue and Para Red.

Persulphates have an oxidising influence upon naphthol, without, however, impairing the tetrazo compound of Dianisidine. Nor do they effect injuriously the Naphthol Azo dyestuff of Dianisidine.

If, then, a Dianisidine Naphthol Blue printing colour containing copper and mixed with persulphate is printed upon naphtholated goods, the Dianisidine Naphthol Blue is formed at once, and the superfluous naphthol still remaining on the printed places is made ineffective by the persulphate, so that in subsequently dyeing with Paranitrodiazobenzene pure blue patterns on a red ground are obtained. In order to obviate the injurious browning effect of the copper salt of the Dianisidine printing colour upon the Paranitraniline Red, a certain quantity of oxalate of ammonia is added to the red developing bath and the subsequent soap bath. This prevents the red from forming the brown copper lake. For persulphates ammonium persulphate and the more stable potassium persulphate can be used.

The goods prepared with naphtol prepare are printed with the blue printing colour which contains besides tetrazo Dianisidine also copper chloride and the persulphate, then quickly dried, dyed in the developing bath, (the goods must not be passed through the bath but run direct through the squeezing rollers of the padding machine), and immediately washed.

After a thorough washing the goods are soaped in the open with soap and oxalate of ammonia, and again, if required, in rope form in the same manner.

Naphthol prepare D.

20 parts	β-Naphthol
32 parts	soda lye 36° Tw.
500 parts	hot water
30 parts	Para soap PN
30 parts	sodium acetate cryst. made up with water to
1000 parts.	

Blue Printing Colour D.

500 parts	flour thickening
400 parts	Dianisidine solution
50 parts	potassium persulphate cryst.
40 parts	copper chloride 77° Tw.
10 parts	water
1000 parts.	

Dianisidine Solution.

16,5	parts	Dianisidine Salt dry
100	parts	water
10	parts	hydrochloric acid 36° Tw. When dissolved,
250	parts	ice and
28	parts	nitrite solution (290 : 100) are slowly added. When completely diazotized, made up with water to
1000	parts.	

Developing Bath.

14	parts	Paranitraniline extra diazotised mixed with
30	parts	sodium acetate cryst. and
20	parts	oxalate of ammonia cryst. and made up with water to
1000	parts.	

Soap Bath.

4 parts olive oil soap }
2 parts oxalate of ammonia } per 1000 parts at 140° F. for 15 minutes.

Naphthol Prepare D. Blue Printing Colour D.
Paranitraniline Developing Bath.

F. DISCHARGE EFFECTS ON INSOLUBLE AZO COLOURS.

In our general discussion of Azo Colours it was mentioned on page 313 that the tin discharge and the alkali-glucose discharge yield good results, but that both these methods had been superseded by the hydrosulphite discharge, and had now only an historical interest. We may, therefore, here dispense with a detailed description of these two discharge methods.

Hydrosulphite Discharges.

On page 314 it was already stated that only since the discovery of stable compounds of hydrosulphite the solution of the hydrosulphite discharge problem became possible. Up to the present the formaldehyde compound of hydrosulphite alone is of importance for discharge purposes, and this has already found a most extensive application.

The Formaldehyde Compound of Hydrosulphite, which was first obtained by the chemists of the firm of Emil Zündel in Moscow in 1902, is put upon the market as

Hydrosulphite NF Hoechst,
Hydrosulphite NF conc. Hoechst, or as
Hydrosulphite NF conc. special, Hoechst,

in the form of white or brownish solid substances of fine crystalline structure. Protected from dampness and from heat, the substance keeps unimpaired for many weeks in closed vessels. It is deliquescent in a damp atmosphere and melts in the water bath at about 122° F, without losing its reducing power.

Cold Indigo sulphonic acid solution is not reduced by it, but must be heated to about 122° F. The hydrosulphurous acid is, therefore, present in Hydrosulphite NF in a masked form. Strong alkalies favour the decomposition when heated; bisulphite destroys the compound at a cold temperature, as do also strong acids. The formaldehyde compound of sodium hydrosulphite was first obtained by the reaction of formaldehyde upon hydrosulphite in solution or in solid form. In accordance with the constitution of sodium hydrosulphite, which was only elucidated by this reaction, a mixture of bisulphite-formaldehyde and hydrosulphite-formaldehyde in approximately equal molecular quantities is thereby produced.

This mixture is identical with Hydrosulphite NF Hoechst. The chemists of Emil Zündel in Moscow succeeded later on in obtaining from the above mixture by crystallisation a well crystallised product which showed more than double the discharging strength of the mixture, and which is now called Sodium-Sulphoxylate.

The Farbwerke Hoechst produce this substance by a special process, and put it upon the market as Hydrosulphite NF conc. Hoechst. In addition to its very high concentration and excellent stability, this substance is extremely suitable for very concentrated white and coloured discharges.

In preparing the discharges the Hydrosulphite NF conc. is dissolved in a little water whilst slightly heated and, some thickening being added, discharges are obtained which are stable for months and are capable of producing pure white on Para Red, Para Brown R and G, Metanitraniline Orange, Amido Azo Benzene Red, Amido Azo Toluene Crimson, also on the Superposition Puce of Henri Schmid, and other Azo Colours.

It has already been mentioned on page 314 that α-Naphthylamine Claret could not be discharged directly with the formaldehyde compound of hydrosulphite, and that this was only possible by a patented process with an addition of iron salts.

The Farbwerke Hoechst, in studying the problem of the hydrosulphite discharge of a-Naphthylamine Claret, made the interesting observation that certain compounds, obtained by the reaction of formaldehyde upon xylidine and similar amido bases very materially improve the dischargeability of α-Naphtylamine Claret and a series of other insoluble Azo Colours, as e. g. β-Naphthylamine, Chloranisidine, Azo Pink BB, Benzidine, Tolidine etc., as well as of certain direct dyeing colours.

Such a product has been put upon the market under the name of Rodogene MLB which is a very energetic addition to hydrosulphite discharges, and permits of a good utilization of Hydrosulphite NF conc.

There is also a number of other substances which enhance the discharging power of formaldehyde-hydrosulphite for α-Naphthylamine Claret, as e. g. fatty mordants, such as Turkey red oil, also glycerine and acetine.

The method of employing hydrosulphite discharges with Rodogene was however soon superseded by that based on the use of Induline Scarlet, described already on page 315, which is especially of great importance for discharging α-Naphthylamine Claret and the other not easily dischargeable Azo Colours. It is most remarkable that not only is the discharge effected with absolute certainty, but also that very small quantities of this catalytically acting dyestuff already produce excellent discharge effects with Hydrosulphite NF conc. Induline Scarlet can be employed in two ways, either as an addition to the hydrosulphite discharge, or to the diazo bath, for the purpose of producing an α-Naphthylamine Claret which can be well discharged with the hydrosulphite discharge used for Para Red.

For the first method an addition of about 0,2 % Induline Scarlet of the weight of the Hydrosulphite NF conc. used is sufficient to produce the desired discharge effect; a small addition of Methylene Blue besides, has proved very effective. In order, however, to produce an α-Naphthylamine Claret, which can be discharged direct by Hydrosulphite NF conc., about $^1/_2$—$1^1/_2$ grs Induline Scarlet are added to 1 litre of the diazo bath.

Under the name of Hydrosulphite NF conc. special the Farbwerke Hoechst have put on the market a hydrosulphite which contains the additions necessary for discharging α-Naphthylamine Claret etc.

In addition to Induline Scarlet other dyestuffs and certain aromatic compounds have also a most favourable effect upon the discharges prepared with Hydrosulphite NF conc. Above all others Patent Blue V deserves to be here mentioned.

It is necessary, however, to add to the hydrosulphite discharge much larger quantities of this dyestuff than of Induline Scarlet, and it has been found that, in order to preserve the effect of the discharges so prepared, an addition of formaldehyde is required. Formaldehyde, either alone or, still better, in conjunction with phenol, counteracts the premature reduction of Patent Blue in the discharge whereby the stability of the discharge is assured.

The Patent Blue hydrosulphite discharge, as compared with the Induline Scarlet discharge, presents this great advantage that the discharge is effected within a shorter time and, under certain conditions, a purer white is also obtained than by the Induline Scarlet discharge. For it has been found that the white in very large discharge designs attains a slightly pink hue from some obstinately adhering Induline Scarlet, in which case the goods must be soaped and, if necessary, slightly chemicked after steaming, so as to clear perfectly the white. These operations, however, can be dispensed with in using the Patent Blue discharge.

It may be mentioned that the kind of thickening used for the discharges materially influences the purity of the white; for instance, flour and starch tragacanth thickenings give a better result than gum or dextrine thickenings.

Latterly a still better method has been discovered for discharging α-Naphthylamine claret, based on the use of Anthraquinone in conjunction with Hydrosulphite. The discharging colours containing Anthraquinone do not only give better discharge effects, but owing to their energetic action considerably less Hydrosulphite need be employed.

The best white discharge effects are now obtained by combining the Anthraquinone with the Patent Blue discharge.

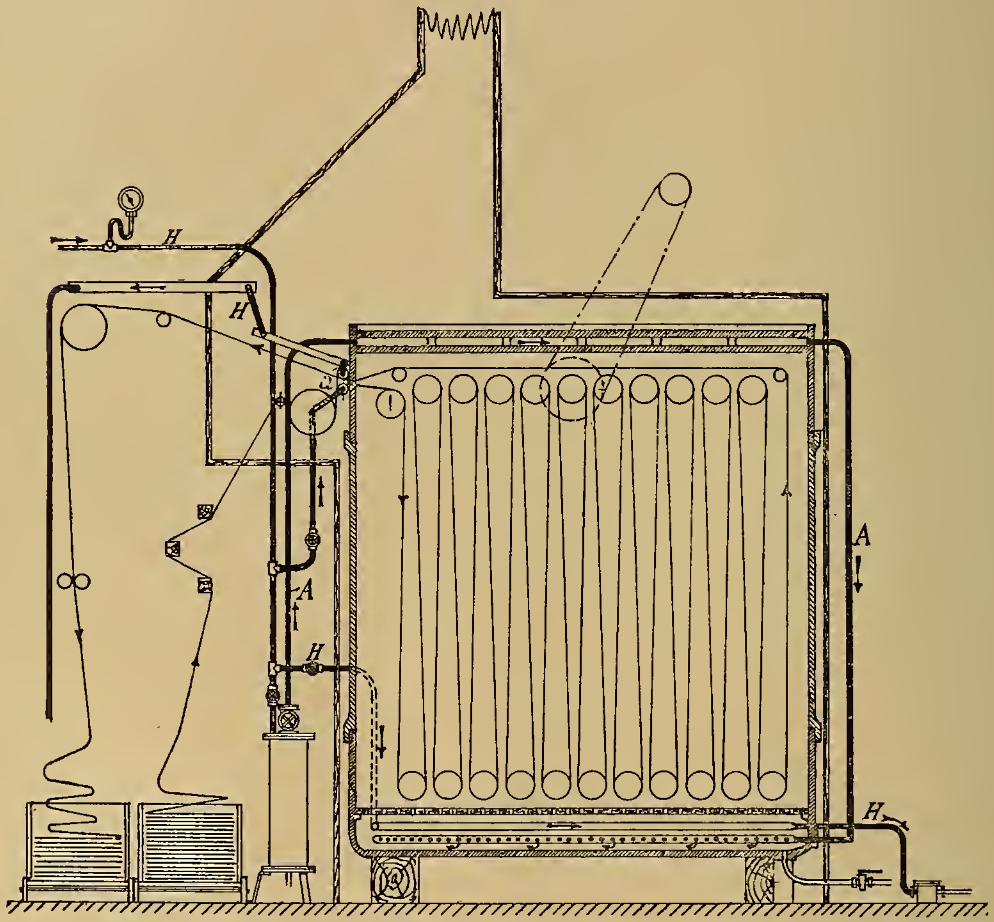


Fig. 24.

The discharge of Azo Colours is best carried out by a passage of 2—3 minutes' duration at 212—216^0 F. through the Mather-Platt; the steam must be as free from air as possible. The goods are steamed with live steam, and the ordinary Mather-Platt quick agers which are used in most print works, can be easily and suitably altered for this purpose.

The accompanying sketch illustrates the arrangement of a Mather-Platt altered for the purposes of hydrosulphite discharging.

In order to obtain an atmosphere of steam as free from air as possible the slit of the apparatus, which is best at the bottom, must be as narrow as possible, and every other opening that may be in it (e. g. manhole etc.) should be well closed; so that the steam has no other exit but through the slit intended for the entrance and egress of the goods.

Other precautions to be recommended are: thorough isolation of the apparatus with isolating material and wood lining, water separator and, if required, a small drying drum fitted in front of the slit through which the goods enter.

A steaming apparatus specially constructed for hydrosulphite discharge and hydrosulphite Indigo printing is represented by the following sketch of the Elsässische Maschinenbaugesellschaft, Mülhausen i/A. Similar apparatus are also constructed by other firms, e. g. by Emil Welter, Mülhausen i/A.

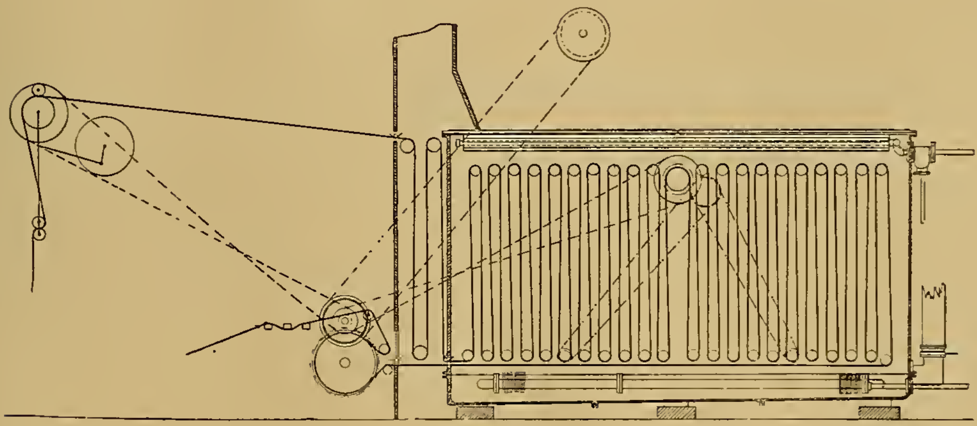


Fig. 25

The goods enter and leave the apparatus through a long slit, whilst the steam, entering from above, effects a good displacement of air.

The entrance of the steam is effected by means of two perforated steam pipes, fitted lengthways at the top of the apparatus, to which protecting boards are affixed in order to prevent water drops. Before the goods are passed through the apparatus and when all the air is displaced, the manhole is shut so that the steam is forced to escape only through the entrance slit.

Certain Azo Colours, especially Para Brown G and R are more efficiently destroyed by an acid hydrosulphite discharge than by a neutral or an alkaline discharge. According to our observations, Hydrosulphite NF conc. can be mixed with hydrochloric or acetic acid until a strong acid reaction takes place without losing in efficiency, if an excess of formaldehyde is present. This is of great advantage in the preparation of coloured discharges.

For the production of coloured discharges, dyestuffs, which withstand reduction, together with the mordants requisite for fixing (tannin, chrome acetate etc.) are added to the white discharge.

For coloured discharges the following can be used: Methylene Yellow H, Auramine, Flavophosphine, Leather Yellow O, Thionine Blue GO, Methylene Blue, Discharge Marine Blue, Rosazeine and Eosine dyestuffs, Alizarine dyestuffs, except the Alizarine Yellow brands, Chromoglaucine VM, BMI, Philochromine, Indigo and Thiogene dyestuffs. In coloured discharges prepared with basic dyestuffs an addition of about 50 parts phenol per 1000 parts prevents premature lake formation. Under these circumstances it is possible to produce coloured discharges which yield very full and even discharge effects, without the employment of acids as solvents. Very fine half discharges can be obtained with somewhat reduced alkaline discharges upon Para Brown R and G.

If sodium acetate is added to the discharge white, a pure white is obtained on the Superposition Puce, composed of Para Red and Steam Aniline Black. Sodium acetate by itself, however, serves for producing red resists upon this brown.

Treatment of Goods printed with Discharges.

The white and coloured discharges are dried well after printing, then steamed in the Mather-Platt for 2—3 minutes, as described above, afterwards washed and, if necessary, soaped. For coloured discharges containing tannin dyestuffs the usual antimony passage is given after steaming. It is well to let the goods lie in the open air before washing or passing them through the antimony bath, in order to allow the re-oxidation of the leuco-compounds of the dyestuffs to take place in the air. In certain circumstances a chrome bath also gives good results. The passage through tartar emetic, chroming bath, soap bath and the washing is advantageously carried out in a continuous open-washing machine, from which the pieces, after being well squeezed, pass direct upon the drying cylinder for final drying.

Directions for the Preparation of Discharges.

The following are the most important recipes for discharge styles with Hydrosulphite NF conc. Hoechst.

A. White and Coloured Discharges on Para Red, Para Brown and Fast Azo Grenade.

Discharge White NFC.

225 parts	Hydrosulphite NF conc. dissolved at 122° F. in
225 parts	gum solution 1:1
50 parts	glycerine
50 parts	water
450 parts	wheat starch tragacanth thickening
1000 parts.	

Discharge White NFS.

225 parts	Hydrosulphite NF conc. dissolved at 122° F. in
225 parts	gum solution 1:1, cooled, and then added
$7^1/_2$ parts	formaldehyde 40 % and slowly added
10 parts	hydrochloric acid 36° Tw.
$82^1/_2$ parts	water, then stirred into
450 parts	wheat starch tragacanth thickening
1000 parts.	

Discharge White NFS is advantageously used for Para Brown and Fast Azo Grenade.

For very fine designs, on raised cloths Hydrosuphite NFW Hoechst and Hydrosulphite NFX Hoechst are used. The former contains zinc white, the latter lithophone as filling. These additions prevent the absorption and disappearance of the discharge in the material, and clear the discharged white very efficiently.

Discharge White NFW.

600 parts	Hydrosulphite NFW
400 parts	flour thickening
1000 parts.	

Discharge White NFX.

600 parts	Hydrosulphite NFX
400 parts	flour thickening
1000 parts.	

The discharge effected with Hydrosulphite NFX is more stable to acid than that with NFW. In addition to the above the Discharge White S prepared with Hydrosulphite NF conc. special, as described on page 368, can also be used for discharging Paranitraniline and Para Brown.

Specially to be recommended as the best thickenings for coloured discharges are those containing starch-tragacanth, which yield colours faster to soap than the discharges thickened with gum solution.

1. Neutral Coloured Discharges containing Basic Dyestuffs with the addition of Phenol.

	Discharge Yellow P	Discharge Blue P	Discharge Blue PA	Discharge Green P
Methylene Yellow H	20 parts	—	—	20 parts
Thionine Blue GO	—	20 parts	—	10 parts
Discharge Marine Blue S extra conc.	—	—	30 parts	—
Glycerine	30 parts	30 parts	30 parts	30 parts
Acetine	10 parts	10 parts	10 parts	10 parts
Water	180 parts	230 parts	220 parts	220 parts
Wheat Starch Tragacanth Thickening	250 parts	250 parts	250 parts	250 parts
Phenol	60 parts	60 parts	60 parts	60 parts
Aqueous Tannin solution 1:1	100 parts	100 parts	100 parts	100 parts
Hydrosulphite Thickening NFC	350 parts	300 parts	300 parts	300 parts
	1000 parts	1000 parts	1000 parts	1000 parts.

Discharge Yellow PA = Yellow P, only with **Auramine conc.** instead of Methylene Yellow H.

Discharge Orange P = Yellow P, only with **Flavophosphine R conc. new** instead of Methylene Yellow H.

Hydrosulphite Thickening NFC.

500 parts	Hydrosulphite NF conc. are dissolved at 122°—140° F in
500 parts	gum solution 1:1
1000 parts.	

Thickening for reductions.

300 parts	Hydrosulphite Thickening NFC
400 parts	wheat starch tragacanth thickening
250 parts	water
25 parts	aqueous tannin solution 1:1
25 parts	glycerine
1000 parts.	

Preparation of Coloured Discharges.

The dyestuff is dissolved with glycerine, acetine and water, stirred slowly into the thickening, then the mixture is heated again, in order to facilitate the solution, the phenol slowly added, lastly the tannin solution and the hydrosulphite thickening added cold.

2. Coloured Discharges with Mordant Dyestuffs.

The most important mordant dyestuffs for coloured discharges are the dyestuffs of the Gallocyanine series, whose leuco compounds withstand reduction.

Discharge Blue VM.

50 parts	Chromoglaucine VM paste 40 %
200 parts	water, stirred into
350 parts	wheat starch tragacanth thickening
100 parts	green acetate of chrome 32½° Tw.
300 parts	Hydrosulphite Thickening NFC
1000 parts.	

Indigo Blues are obtained in the same manner by means of Chromoglaucine BMI paste.

200 parts Chromoglaucine BMI paste = 50 parts Chromoglaucine VM paste.

For pink discharges phthalic acid dyestuffs, fixed with chrome mordants, are to be recommended.

Discharge Pink.

	1.	2.	3.
Erythrosine A	40 parts	—	—
Eosine extra AG	—	40 parts	—
Phloxine B extra conc.	—	—	40 parts
Water	290 parts	290 parts	290 parts
Glycerine	30 parts	30 parts	30 parts
British gum powder, are dissolved, cooled, then slowly added	200 parts	200 parts	200 parts
Acetate of chrome $32\frac{1}{2}^{\circ}$ Tw.	100 parts	100 parts	100 parts
Hydrosulphite Thickening NFC, see page 366	340 parts	340 parts	340 parts
	1000 parts	1000 parts	1000 parts.

3. Neutral Coloured Discharges as Tannin Lakes with Albumen Solution.

	Yellow	Green	Blue
Auramine Tannin Lake	400 parts	250 parts	—
Thionine Blue Lake	—	150 parts	400 parts
Albumen solution 1:1	150 parts	150 parts	150 parts
Burnt starch solution 1:1	100 parts	150 parts	150 parts
Hydrosulphite Thickening NFC (see page 366)	350 parts	300 parts	300 parts
	1000 parts	1000 parts	1000 parts.

The tannin lakes used contain:

50 Auramine conc. } in 1000 parts upon
50 Thionine Blue GO } heavy spar substratum.

B. White and Coloured Discharges for Superposition Puce according to Henri Schmid.

The material dyed with Para Red is padded on the padding machine with Steam Aniline Black padding liquid, carefully dried in the hotflue, and then printed with the discharges before the Aniline Black is developed.

Steam Aniline Black Padding Liquid for Puce HS.

Standard Solution I.

28 parts Aniline salt
2 parts Aniline oil
200 parts water
50 parts tragacanth (60:1000)

Standard Solution II.

10 parts sodium chlorate
200 parts water

Standard Solution III.

18 parts yellow prussiate cryst.
200 parts water

I, II, III are mixed, and diluted before use with water to 1000 parts.

Discharge White HS.

225 parts	Hydrosulphite NF conc.,
175 parts	water
450 parts	tragacanth (60:1000)
150 parts	sodium acetate cryst,
1000 parts.	

Red Resist HS.

450 parts	tragacanth (60:1000)
400 parts	water
150 parts	sodium acetate cryst.
1000 parts.	

The Coloured discharges for Puce HS (Yellow Resist HS, Green Resist HS) are prepared in the same manner as those with the addition of phenol on Para Red (see page 365), only 130 parts Sodium acetate cryst. per 1000 parts printing colour are added for resisting the Aniline Black.

C. White and Coloured Discharges upon α-Naphthylamine Claret and Benzidine Brown etc.

Discharge White NFI.

250 parts	Hydrosulphite NF conc.
50 parts	glycerine
170 parts	water
500 parts	wheat starch tragacanth thickening
30 parts	Induline Scarlet solution (1:100)
1000 parts.	

The mixture is heated till the Hydrosulphite NF conc. is dissolved and the Induline Scarlet is completely reduced.

Discharge White S.

250 parts	Hydrosulphite NF conc. special are dissolved by heating at 122° F. in
150 parts	water and
50 parts	glycerine and stirred into
550 parts	wheat starch tragacanth thickening
1000 parts.	

Discharge White NFA.

200 parts	Hydrosulphite NF conc. dissolved by heating at 122° F. in
300 parts	gum solution 1:1 then
435 parts	starch tragacanth thickening
50 parts	Anthraquinone in paste
15 parts	caustic soda 76½° Tw. are added
1000 parts.	

Discharge White NFP.

20 parts	Patent Blue V
100 parts	glycerine
50 parts	water
270 parts	wheat starch tragacanth thickening are dissolved, then added cold
40 parts	phenol
20 parts	formaldehyde 40 % after which is added the solution of
250 parts	Hydrosulphite NF conc.
50 parts	water
200 parts	wheat starch tragacanth thickening
1000 parts.	

1. Coloured Discharges with **Hydrosulphite NF conc. special.**

	Discharge Yellow S	Discharge Blue S	Discharge Green S
Auramine conc.	20 parts	—	24 parts
Thionine Blue GO	—	6 parts	6 parts
Water	40 parts	194 parts	70 parts
Glycerine	50 parts	50 parts	50 parts
Wheat starch tragacanth thickening	350 parts	350 parts	350 parts
Ethyl tartaric acid 22° Tw.	20 parts	20 parts	20 parts
Alcohol	50 parts	—	50 parts
Aqueous tannin solution 1:1	80 parts	30 parts	80 parts
Sodium Turkey red oil 50 %	50 parts	50 parts	50 parts
Hydrosulphite NF conc. special	170 parts	150 parts	150 parts
Gum solution 1:1	170 parts	150 parts	150 parts
	1000 parts	1000 parts	1000 parts.

2. Coloured Discharges with **Induline Scarlet** in the Printing Colours.

	Discharge Yellow AI	Discharge Orange AI	Discharge Blue AI	Discharge Green AI
Auramine conc.	20 parts	—	—	20 parts
Flavophosphine R conc. new	—	20 parts	—	—
Thionine Blue GO	—	—	20 parts	10 parts
Water	40 parts	90 parts	130 parts	100 parts
Glycerine	50 parts	50 parts	50 parts	50 parts
Wheat starch tragacanth thickening	350 parts	350 parts	350 parts	350 parts
Ethyl tartaric acid 22° Tw.	20 parts	20 parts	20 parts	20 parts
Alcohol	50 parts	—	—	—
Aqueous tannin solution 1:1	80 parts	80 parts	80 parts	100 parts
Sodium Turkey red oil 50 %	50 parts	50 parts	50 parts	50 parts
Hydrosulphite Thickening NFI	340 parts	340 parts	300 parts	300 parts
	1000 parts	1000 parts	1000 parts	1000 parts.

Hydrosulphite Thickening NFI.

500 parts Hydrosulphite NF conc. are heated at 122° F. with
450 parts gum solution 1:2
1 parts Induline Scarlet and
49 parts water, until the Hydrosulphite NF conc. is dissolved and the Induline Scarlet is completely reduced.
1000 parts

Preparation of the Coloured Discharges.

The dyestuff is mixed with water, glycerine, wheat starch tragacanth thickening and alcohol, and heated until dissolved. After being well cooled, ethyl tartaric acid, tannin solution, Turkey red oil and finally the Hydrosulphite previously dissolved in gum solution and then cooled, or Hydrosulphite Thickening NFI, is added.

Discharge Blue CI.

50 parts	**Chromoglaucine VM paste**
250 parts	water
400 parts	wheat starch tragacanth thickening
50 parts	acetate of chrome $32^1/_2{}^0$ Tw.
250 parts	Hydrosulphite Thickening NFI
1000 parts.	

Discharge Grey CI = { 3 parts Discharge Blue CI
7 parts Discharge Orange AI

3. Coloured discharges with Anthraquinone in the Printing Colours.

	Discharge Yellow NFA	Discharge Blue NFA	Discharge Green NFA
Auramin conc.	20 parts	—	24 parts
Thionine Blue GO	—	30 parts	6 parts
Glycerine	30 parts	30 parts	30 parts
Water	140 parts	170 parts	170 parts
Starch tragacanth thickening	250 parts	250 parts	250 parts
Phenol	80 parts	80 parts	80 parts
Acetin	10 parts	10 parts	10 parts
Aqueous tannin sol. 1 : 1	80 parts	80 parts	80 parts
Hydrosulphite NF conc.	170 parts	150 parts	150 parts
Gum solution 1 : 1	170 parts	150 parts	150 parts
Anthraquinone in paste	50 parts	50 parts	50 parts
	1000 parts	1000 parts	1000 parts

Paranitraniline Red
Discharge White NFC

Paranitraniline Red Discharge
White HS Steam Aniline Black

Paranitraniline Red
Discharge White NFC Discharge Yellow P
Discharge Blue P Discharge Green P

Paranitraniline Red
Discharge White NFC Discharge Yellow PA
Discharge Blue PA Discharge Green PA

Paranitraniline Red
Discharge White NFC Discharge Blue VM Discharge Blue P Discharge Green P

Para Brown G
Discharge White NFS

Para Brown R Discharge White NFS
Discharge Orange P Discharge Blue P
Discharge Green P

Puce HS Discharge White HS
Red Resist HS

Puce HS Discharge White HS
Red Resist HS Yellow Resist HS
Green Resist HS

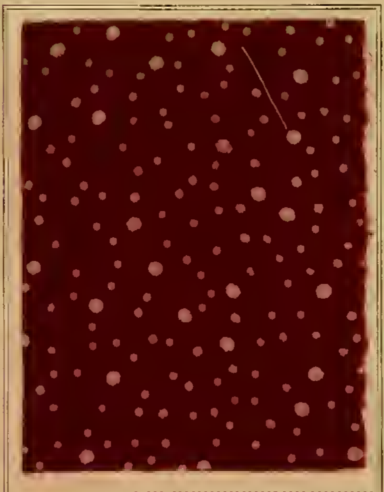
Paranitraniline Red
Discharge White S Discharge Yellow S Discharge Blue S Discharge Green S

α-Naphthylamine Claret
Discharge White S Discharge Yellow S Discharge Blue S Discharge Green S

α-Naphthylamine Claret
Discharge White NFA

α-Naphthylamine Claret
Discharge White NFP

α-Naphthylamine Claret
Discharge White NFI



α-Naphthylamine Claret I
Discharge White NFC

NB. α-Naphthylamine Claret I was prepared with an addition of 0,5 parts Induline Scarlet per 1000 parts of the diazo bath.

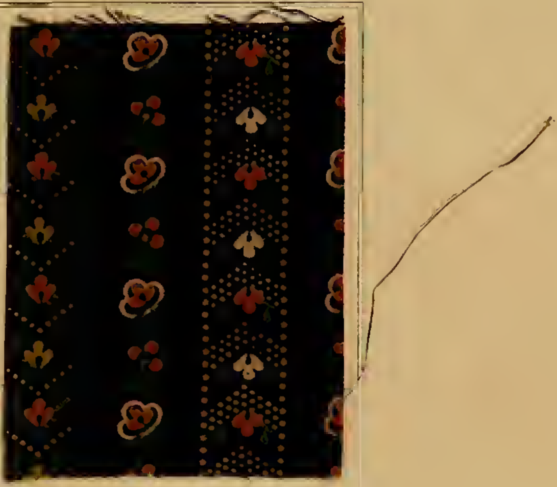
α-Naphthylamine Claret Discharge White NFI Discharge Blue CI Discharge Blue AI Discharge Green AI

α-Naphthylamine Claret Discharge White NFI Discharge Grey CI Discharge Grey CI (1:3) Discharge Green AI

α-Naphthylamine Claret Discharge White NFA Discharge Yellow NFA Discharge Blue NFA Discharge Green NFA

Benzidine Brown
Discharge White NFI

Benzidine Brown
Discharge White NFI Discharge Blue CI Discharge Blue AI Discharge Green AI



Benzidine Brown
Discharge White NFI Discharge Yellow AI Discharge Orange AI Discharge Green AI

Resists under Discharges with Hydrosulphite N F conc.

By printing substances with an acid and oxidising reaction the discharge effect of overprinted Hydrosulphite can be completely paralysed.

If antimony salts are added to these resisting substances, the hydrosulphite coloured discharges prepared with certain basic dyestuffs can also be thrown off. For the production of these resists fixed organic acids are to be considered, e. g. citric or tartaric acid, besides chlorates, persulphates, chromates, peroxide of manganese, and metal salts with oxidising reaction, such as copper salts, ferric salts etc. We recommend principally citric or tartaric acid in combination with chlorate of soda.

The latter is preferable for Para Red, as it influences the red shade favourably.

On Para Brown (R and G) the discharge effect can also be successfully resisted by means of an alkaline copper solution. In this case the brown shade turns deeper in the places printed with the resist containing copper.

Chrome dyestuffs, e. g. Chromoglaucine, Philochromine etc. which are easily destroyed by oxidising agents are likewise easily thrown off by the resist containing citric acid and sodium chlorate.

Contrary to the general rule the best resist effects are obtained if the hydrosulphite discharges are printed before the resists are dry. It is therefore expedient to print the resist under the discharge in one operation.

After printing the goods are well dried, then steamed in the Mather-Platt for 2—3 minutes at 212—214° F., and finally finished in the usual manner.

The following recipes show the composition of the resists:

Resist I under Discharge White.
for Para Red and Para Brown.

840 parts	gum solution 1:1
60 parts	citric acid cryst.
100 parts	sodium chlorate
1000 parts.	

Resist II under Discharge White
for Para Brown.

400 parts	burnt starch thickening 1:1
200 parts	caustic soda 77° Tw. are heated, then cooled, and
400 parts	alkaline copper solution slowly stirred into the mixture
1000 parts.	

Resists III under Discharge Yellow
for Methylene Yellow H and Auramine.

500 parts	gum solution 1:1
100 parts	citric acid cryst.
200 parts	sodium tartar emetic
200 parts	sodium chlorate
1000 parts.	

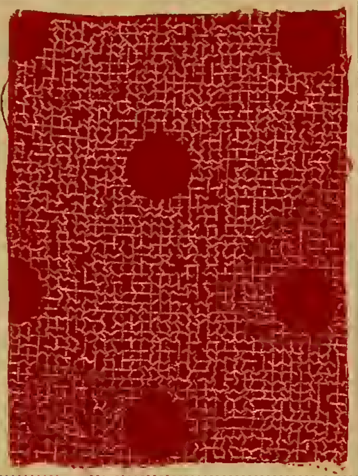
Resist IV under Discharge Blue
for Chromoglaucine.

600 parts	gum solution 1:1
200 parts	citric acid cryst.
200 parts	sodium chlorate
1000 parts.	

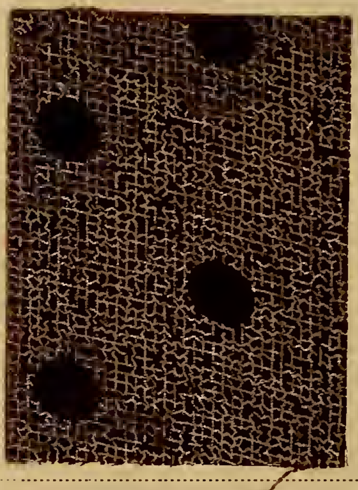
Alkaline Copper Solution.

1000 parts copper chloride 77° Tw. are diluted with
500 parts tartaric acid cryst. and
400 parts glycerine, to the above are added in portions whilst cooling
1200 parts soda lye 77° Tw.

The composition of the discharges can be seen from the descriptions on page 365 and 366.



Paranitraniline Red Resist I
Discharge White NFC, reduced 3:2



Para Brown R Resist I
Discharge White NFC, reduced 3:2

Paranitraniline Red
Resist IV Discharge Blue VM

Para Brown R
Resist III Discharge Yellow P

VARIOUS TABLES.

1. Table of Some Atomic Weights.

O = 16.

(According to the determinations of the German Chemical Society.)

Aluminium	Al	27,1	Magnesium	Mg	24,36
Antimony	Sb	120	Manganese	Mn	55
Arsenic	As	75	Mercury	Hg	203
Barium	Ba	137,4	Molybdenum	Mo	96
Bismuth	Bi	208,5	Nickel	Ni	58,7
Boron	B	11	Nitrogen	N	14,04
Bromine	Br	79,96	Oxygen	O	16
Cadmium	Cd	112,4	Phosphorus	P	31
Calcium	Ca	40	Platinum	Pt	194,8
Carbon	C	12	Potassium	K	39,15
Cerium	Ce	140	Silicium	Si	28,4
Chlorine	Cl	35,5	Silver	Ag	107,93
Chromium	Cr	52,1	Sodium	Na	23,05
Cobalt	Co	59	Strontium	Sr	87,6
Copper	Cu	63,6	Sulphur	S	32,06
Fluorine	F	19	Tin	Sn	118,5
Gold	Au	197,2	Titanium	Ti	48
Hydrogen	H	1,01	Tungsten	W	184
Iodine	J	126,85	Uranium	U	239,5
Iron	Fe	56	Vanadin	V	51,2
Lead	Pb	206,9	Zinc	Zn	65,4

2. Comparison of Thermometric Scales.

Celsius	Réaumur	Fahrenheit	Celsius	Réaumur	Fahrenheit	Celsius	Réaumur	Fahrenheit
+ 100	+ 80	+ 212	+ 53	+ 42,4	+ 127,4	+ 6	+ 4,8	+ 42,8
99	79,2	210,2	52	41,6	125,6	5	4	42
98	78,4	208,4	51	40,8	123,8	4	3,2	39,2
97	77,6	206,6	50	40	122	3	2,4	37,4
96	76,8	204,8	49	39,2	120,2	2	1,6	35,6
95	76	203	48	38,4	118,4	1	0,8	33,8
94	75,2	201,2	47	37,6	116,6	0	0	32
93	74,4	199,4	46	36,8	114,8	— 1	— 0,8	30,2
92	73,6	197,6	45	36	113	2	1,6	28,4
91	72,8	195,8	44	35,2	111,2	3	2,4	26,6
90	72	194	43	34,4	109,4	4	3,2	24,8
89	71,2	192,2	42	33,6	107,6	5	4	23
88	70,4	190,4	41	32,8	105,8	6	4,8	21,2
87	69,6	188,6	40	32	104	7	5,6	19,4
86	68,8	186,8	39	31,2	102,2	8	6,4	17,6
85	68	185	38	30,4	100,4	9	7,2	15,8
84	67,2	183,2	37	29,6	98,6	10	8	14
83	66,4	181,4	36	28,8	96,8	11	8,8	12,2
82	65,6	179,6	35	28	95	12	9,6	10,4
81	64,8	177,8	34	27,2	93,2	13	10,4	8,6
80	64	176	33	26,4	91,4	14	11,2	6,8
79	63,2	174,2	32	25,6	89,6	15	12	5
78	62,4	172,4	31	24,8	87,8	16	12,8	3,2
77	61,6	170,6	30	24	86	17	13,6	1,4
76	60,8	168,8	29	23,2	84,2	18	14,4	— 0,4
75	60	167	28	22,4	82,4	19	15,2	2,2
74	59,2	165,2	27	21,6	80,6	20	16	4
73	58,4	163,4	26	20,8	78,8	21	16,8	5,8
72	57,6	161,6	25	20	77	22	17,6	7,6
71	56,8	159,8	24	19,2	75,2	23	18,4	9,4
70	56	158	23	18,4	73,4	24	19,2	11,2
69	55,2	156,2	22	17,6	71,6	25	20	13
68	54,4	154,4	21	16,8	69,8	26	20,8	14,8
67	53,6	152,6	20	16	68	27	21,6	16,6
66	52,8	150,8	19	15,2	66,2	28	22,4	18,4
65	52	149	18	14,4	64,4	29	23,2	20,2
64	51,2	147,2	17	13,6	62,6	30	24	22
63	50,4	145,4	16	12,8	60,8	31	24,8	23,8
62	49,6	143,6	15	12	59	32	25,6	25,6
61	48,8	141,8	14	11,2	57,2	33	26,4	27,4
60	48	140	13	10,4	55,4	34	27,2	29,2
59	47,2	138,2	12	9,6	53,6	35	28	31
58	46,4	136,4	11	8,8	51,8	36	28,8	32,8
57	45,6	134,6	10	8	50	37	29,6	34,6
56	44,8	132,8	9	7,2	48,2	38	30,4	36,4
55	44	131	8	6,4	46,4	39	31,2	38,2
54	43,2	129,2	7	5,6	44,6	40	32	40

For conversion of:

°C into °R multiply by 4, divide by 5,
°C into °F „ „ 9, „ „ 5, add 32,
°R into °C „ „ 5, „ „ 4,
°R into °F „ „ 9, „ „ 4, add 32,
°F into °R subtract 32, multiply by 4, divide by 9,
°F into °C „ 32, „ „ 5, „ „ 9.

3. Comparison of the Specific Gravities with the Degrees Beaumé and Twaddle.

Spec. Grav. (at 59° F)	Degrees Beaumé	Degrees Twaddle	Spec. Grav. (at 59° F)	Degrees Beaumé	Degrees Twaddle	Spec. Grav. (at 59° F)	Degrees Beaumé	Degrees Twaddle
1,000	0	0	1,290	32,4	58	1,580	53,0	116
1,005	0,7	1	1,295	32,8	59	1,585	53,3	117
1,010	1,4	2	1,300	33,3	60	1,590	53,6	118
1,015	2,1	3	1,305	33,7	61	1,595	53,9	119
1,020	2,7	4	1,310	34,2	62	1,600	54,1	120
1,025	3,4	5	1,315	34,6	63	1,605	54,4	121
1,030	4,1	6	1,320	35,0	64	1,610	54,7	122
1,035	4,7	7	1,325	35,4	65	1,615	55,0	123
1,040	5,4	8	1,330	35,8	66	1,620	55,2	124
1,045	6,0	9	1,335	36,2	67	1,625	55,5	125
1,050	6,7	10	1,340	36,6	68	1,630	55,8	126
1,055	7,4	11	1,345	37,0	69	1,635	56,0	127
1,060	8,0	12	1,350	37,4	70	1,640	56,3	128
1,065	8,7	13	1,355	37,8	71	1,645	56,6	129
1,070	9,4	14	1,360	38,2	72	1,650	56,9	130
1,075	10,0	15	1,365	38,6	73	1,655	57,1	131
1,080	10,6	16	1,370	39,0	74	1,660	57,4	132
1,085	11,2	17	1,375	39,4	75	1,665	57,7	133
1,090	11,9	18	1,380	39,8	76	1,670	57,9	134
1,095	12,4	19	1,385	40,1	77	1,675	58,2	135
1,100	13,0	20	1,390	40,5	78	1,680	58,4	136
1,105	13,6	21	1,395	40,8	79	1,685	58,7	137
1,110	14,2	22	1,400	41,2	80	1,690	58,9	138
1,115	14,9	23	1,405	41,6	81	1,695	59,2	139
1,120	15,4	24	1,410	42,0	82	1,700	59,5	140
1,125	16,0	25	1,415	42,3	83	1,705	59,7	141
1,130	16,5	26	1,420	42,7	84	1,710	60,0	142
1,135	17,1	27	1,425	43,1	85	1,715	60,2	143
1,140	17,7	28	1,430	43,4	86	1,720	60,4	144
1,145	18,3	29	1,435	43,8	87	1,725	60,6	145
1,150	18,8	30	1,440	44,1	88	1,730	60,9	146
1,155	19,3	31	1,445	44,4	89	1,735	61,1	147
1,160	19,8	32	1,450	44,8	90	1,740	61,4	148
1,165	20,3	33	1,455	45,1	91	1,745	61,6	149
1,170	20,9	34	1,460	45,4	92	1,750	61,8	150
1,175	21,4	35	1,465	45,8	93	1,755	62,1	151
1,180	22,0	36	1,470	46,1	94	1,760	62,3	152
1,185	22,5	37	1,475	46,4	95	1,765	62,5	153
1,190	23,0	38	1,480	46,8	96	1,770	62,8	154
1,195	23,5	39	1,485	47,1	97	1,775	63,0	155
1,200	24,0	40	1,490	47,4	98	1,780	63,2	156
1,205	24,5	41	1,495	47,8	99	1,785	63,5	157
1,210	25,0	42	1,500	48,1	100	1,790	63,7	158
1,215	25,5	43	1,505	48,4	101	1,795	64,0	159
1,220	26,0	44	1,510	48,7	102	1,800	64,2	160
1,225	26,4	45	1,515	49,0	103	1,805	64,4	161
1,230	26,9	46	1,520	49,4	104	1,810	64,6	162
1,235	27,4	47	1,525	49,7	105	1,815	64,8	163
1,240	27,9	48	1,530	50,0	106	1,820	65,0	164
1,245	28,4	49	1,535	50,3	107	1,825	65,2	165
1,250	28,8	50	1,540	50,6	108	1,830	65,5	166
1,255	29,3	51	1,545	50,9	109	1,835	65,7	167
1,260	29,7	52	1,550	51,2	110	1,840	65,9	168
1,265	30,2	53	1,555	51,5	111	1,845	66,1	169
1,270	30,6	54	1,560	51,8	112	1,850	66,3	170
1,275	31,1	55	1,565	52,1	113	1,855	66,5	171
1,280	31,5	56	1,570	52,4	114	1,860	66,7	172
1,285	32,0	57	1,575	52,7	115	1,865	67,0	173

4. Comparison of the Degrees Beaumé with the Specific Gravities of liquids that are heavier than water.

Degrees Bé	Spec. Grav. 12,5° C	Degrees Bé	Spec. Grav. 12,5° C	Degrees Bé	Spec. Grav. 12,5° C	Degrees Bé	Spec. Grav. 12,5° C
0	1,0000	19	1,1516	37	1,3447	55	1,6158
1	1,0069	20	1,1608	38	1,3574	56	1,6342
2	1,0140	21	1,1702	39	1,3703	57	1,6529
3	1,0212	22	1,1798	40	1,3834	58	1,6720
4	1,0285	23	1,1896	41	1,3968	59	1,6916
5	1,0358	24	1,1994	42	1,4105	60	1,7116
6	1,0434	25	1,2095	43	1,4244	61	1,7322
7	1,0509	26	1,2198	44	1,4386	62	1,7532
8	1,0587	27	1,2301	45	1,4531	63	1,7748
9	1,0665	28	1,2407	46	1,4678	64	1,7960
10	1,0745	29	1,2515	47	1,4828	65	1,8195
11	1,0825	30	1,2624	48	1,4984	66	1,8428
12	1,0907	31	1,2736	49	1,5141	67	1,839
13	1,0990	32	1,2849	50	1,5301	68	1,864
14	1,1074	33	1,2965	51	1,5466	69	1,885
15	1,1160	34	1,3082	52	1,5633	70	1,909
16	1,1247	35	1,3202	53	1,5804	71	1,935
17	1,1335	36	1,3324	54	1,5978	72	1,960
18	1,1425						

5. Comparison of the Degrees Beaumé with the Specific Gravities of liquids that are lighter than water.

Degrees Bé	Spec. Grav. 12,5° C	Degrees Bé	Spec. Grav. 12,5° C	Degrees Bé	Spec. Grav. 12,5° C	Degrees Bé	Spec. Grav. 12,5° C
10	1,0000	23	0,9183	36	0,8488	49	0,7892
11	0,9932	24	0,9125	37	0,8439	50	0,7849
12	0,9865	25	0,9068	38	0,8391	51	0,7807
13	0,9799	26	0,9012	39	0,8343	52	0,7766
14	0,9733	27	0,8957	40	0,8295	53	0,7725
15	0,9669	28	0,8902	41	0,8249	54	0,7684
16	0,9605	29	0,8848	42	0,8202	55	0,7644
17	0,9542	30	0,8795	43	0,8156	56	0,7604
18	0,9480	31	0,8742	44	0,8111	57	0,7565
19	0,9420	32	0,8690	45	0,8066	58	0,7526
20	0,9359	33	0,8639	46	0,8022	59	0,7487
21	0,9300	34	0,8588	47	0,7978	60	0,7449
22	0,9241	35	0,8538	48	0,7935	61	0,7411

6. Specific Gravity of solutions of Ammonia at 59° F referred to water of 59° F = 1.

(Lunge and Wiernik.)

Spec. Grav.	Per cent NH_3	1 litre contains grs. NH_3 at 59° F	Correction for $\pm 1^4/_5$ °F	Spec. Grav.	Per cent NH_3	1 litre contains grs. NH_3 at 59° F	Correction for $\pm 1^4/_5$ °F	Spec. Grav.	Per cent NH_3	1 litre contains grs. NH_3 at 59° F	Correction for $\pm 1^4/_5$ °F
1,000	0,00	0,0	0,00018	0,960	9,91	95,1	0,00029	0,920	21,75	200,1	0,00047
0,998	0,45	4,5	0,00018	0,958	10,47	100,3	0,00030	0,918	22,39	205,6	0,00048
0,996	0,91	9,1	0,00019	0,956	11,03	105,4	0,00031	0,916	23,03	210,9	0,00049
0,994	1,37	13,6	0,00019	0,954	11,60	110,7	0,00032	0,914	23,68	216,3	0,00050
0,992	1,84	18,2	0,00020	0,952	12,17	115,9	0,00033	0,912	24,33	221,9	0,00051
0,990	2,31	22,9	0,00020	0,950	12,74	121,0	0,00034	0,910	24,99	227,4	0,00052
0,988	2,80	27,7	0,00021	0,948	13,31	126,2	0,00035	0,908	25,65	232,9	0,00053
0,986	3,30	32,5	0,00021	0,946	13,88	131,3	0,00036	0,906	26,31	238,3	0,00054
0,984	3,80	37,4	0,00022	0,944	14,46	136,5	0,00037	0,904	26,98	243,9	0,00055
0,982	4,30	42,2	0,00022	0,942	15,04	141,7	0,00038	0,902	27,65	249,4	0,00056
0,980	4,80	47,0	0,00023	0,940	15,63	146,9	0,00039	0,900	28,33	255,0	0,00057
0,978	5,30	51,8	0,00023	0,938	16,22	152,1	0,00040	0,898	29,01	260,5	0,00058
0,976	5,80	56,6	0,00024	0,936	16,82	157,4	0,00041	0,896	29,69	266,0	0,00059
0,974	6,30	61,4	0,00024	0,934	17,42	162,7	0,00041	0,894	30,37	271,5	0,00060
0,972	6,80	66,1	0,00025	0,932	18,03	168,1	0,00042	0,892	31,05	277,0	0.00060
0,970	7,31	70,9	0,00025	0,930	18,64	173,4	0,00042	0,890	31,75	282,6	0,00061
0,968	7,82	75,7	0,00026	0,928	19,25	178,6	0,00043	0,888	32,50	288,6	0,00062
0,966	8,33	80,5	0,00026	0,926	19,87	184,2	0,00044	0,886	33,25	294,6	0,00063
0,964	8,84	85,2	0,00027	0,924	20,49	189,3	0,00045	0,884	34,10	301,4	0,00064
0,962	9,35	89,9	0,00028	0,922	21,12	194,7	0,00046	0,882	34,95	308,3	0,00065

The figures for correction in column 4 apply to the difference of temperature between 55—63° F, e. g, if, at 55°, the specific gravity is found to be 0,900, it must be put at 59° as 2 × 0,00057 = 0,001 less, which then gives the specific gravity as 0,899, by which the proportion of ammonia becomes $^1/_8$ % higher.

7. Specific Gravity of Caustic Soda at 59° F.

(Lunge.)

Spec. Grav.	Bé	Twaddle	Per cent Na OH	Spec. Grav.	Bé	Twaddle	Per cent Na OH	Spec. Grav.	Bé	Twaddle	Per cent Na OH
1,007	1	1,4	0,61	1,142	18	28,4	12,64	1,320	35	64,0	28,83
1,014	2	2,8	1,20	1,152	19	30,4	13,55	1,332	36	66,4	29,93
1,022	3	4,4	2,00	1,162	20	32,4	14,37	1,345	37	69,0	31,22
1,029	4	5,8	2,71	1,171	21	34,2	15,13	1,357	38	71,4	32,47
1,036	5	7,2	3,35	1,180	22	36,0	15,91	1,370	39	74,0	33,69
1,045	6	9,0	4,00	1,190	23	38,0	16,77	1,383	40	76,6	34,96
1,052	7	10,4	4,64	1,200	24	40,0	17,67	1,397	41	79,4	36,25
1,060	8	12,0	5,29	1,210	25	42,0	18,58	1,410	42	82,0	37,47
1,067	9	13,4	5,87	1,220	26	44,0	19,58	1,424	43	84,8	38,80
1,075	10	15,0	6,55	1,231	27	46,2	20,59	1,438	44	87,6	39,99
1,083	11	16,6	7,31	1,241	28	48,2	21,42	1,453	45	90,6	41,41
1,091	12	18,2	8,00	1,252	29	50,4	22,64	1,468	46	93,6	42,83
1,100	13	20,0	8,68	1,263	30	52,6	23,67	1,483	47	96,6	44,38
1,108	14	21,6	9,42	1,274	31	54,8	24,81	1,498	48	99,6	46,15
1,116	15	23,2	10,06	1,285	32	57,0	25,80	1,514	49	102,8	47,60
1,125	16	25,0	10,97	1,297	33	59,4	26,83	1,530	50	106,0	49,02
1,134	17	26,8	11,84	1,308	34	61,6	27,80				

8. Quantities of Calcium Oxide in Milk of Lime at 59° F.

(Lunge and Blattner.)

Degrees Beaumé	Weight of 1 litre in grs	CaO in 1 litre grs	CaO Weight Per cent	Degrees Beaumé	Weight of 1 litre in grs	CaO in 1 litre grs	CaO Weight Per cent
1	1007	7,5	0,745	16	1125	159	14,13
2	1014	16,5	1,64	17	1134	170	15,00
3	1022	26	2,54	18	1142	181	15,85
4	1029	36	3,54	19	1152	193	16,75
5	1037	46	4,43	20	1162	206	17,72
6	1045	56	5,36	21	1171	218	18,61
7	1052	65	6,18	22	1180	229	19,40
8	1060	75	7,08	23	1190	242	20,34
9	1067	84	7,87	24	1200	255	21,25
10	1075	94	8,74	25	1210	268	22,15
11	1083	104	9,60	26	1220	281	23,03
12	1091	115	10,54	27	1231	295	23,96
13	1100	126	11,45	28	1241	309	24,90
14	1108	137	12,35	29	1252	324	25,87
15	1116	148	13,26	30	1263	339	26,84

9. Specific gravity of Hydrochloric Acid.

(Lunge and Marchlewski.)

Specific Gravity at $\frac{59^\circ F}{39^\circ F}$ (vacuum)	Degrees Beaumé	Degrees Tw.	100 parts by weight contain in chemically pure acid		1 litre contains kos		Specific Gravity at $\frac{59^\circ F}{39^\circ F}$ (vacuum)	Degrees Beaumé	Degrees Tw.	100 parts by weight contain in chemically pure acid		1 litre contains kos	
			Per cent HCl	Acid 20° Bé	HCl	Acid 20° Bé				Per cent HCl	Acid 20° Bé	HCl	Acid 20° Bé
1,000	0,0	0,0	0,16	0,49	0,0016	0,0049	1,115	14,9	23	22,86	71,21	0,255	0,794
1,005	0,7	1	1,15	3,58	0,012	0,036	1,120	15,4	24	23,82	74,20	0,267	0,831
1,010	1,4	2	2,14	6,66	0,022	0,067	1,125	16,0	25	24,78	77,19	0,278	0,868
1,015	2,1	3	3,12	9,71	0,032	0,099	1,130	16,5	26	25,75	80,21	0,291	0,906
1,020	2,7	4	4,13	12,86	0,042	0,131	1,135	17,1	27	26,70	83,18	0,303	0,944
1,025	3,4	5	5,15	16,04	0,053	0,164	1,140	17,7	28	27,66	86,17	0,315	0,982
1,030	4,1	6	6,15	19,16	0,064	0,197	1,1425	18,0		28,14	87,66	0,322	1,002
1,035	4,7	7	7,15	22,27	0,074	0,231	1,145	18,3	29	28,61	89,13	0,328	1,021
1,040	5,4	8	8,16	25,42	0,085	0,264	1,150	18,8	30	29,57	92,11	0,340	1,059
1,045	6,0	9	9,16	28,53	0,096	0,298	1,152	19,0		29,95	93,30	0,345	1,075
1,050	6,7	10	10,17	31,68	0,107	0,333	1,155	19,3	31	30,55	95,17	0,353	1,099
1,055	7,4	11	11,18	34,82	0,118	0,367	1,160	19,8	32	31,52	98,19	0,366	1,139
1,060	8,0	12	12,19	37,97	0,129	0,403	1,163	20,0		32,10	100,00	0,373	1,163
1,065	8,7	13	13,19	41,09	0,141	0,438	1,165	20,3	33	32,49	101,21	0,379	1,179
1,070	9,4	14	14,17	44,14	0,152	0,472	1,170	20,9	34	33,46	104,24	0,392	1,220
1,075	10,0	15	15,16	47,22	0,163	0,508	1,171	21,0		33,65	104,82	0,394	1,227
1,080	10,6	16	16,15	50,31	0,174	0,543	1,175	21,4	35	34,42	107,22	0,404	1,260
1,085	11,2	17	17,13	53,36	0,186	0,579	1,180	22,0	36	35,39	110,24	0,418	1,301
1,090	11,9	18	18,11	56,41	0,197	0,615	1,185	22,5	37	36,31	113,11	0,430	1,340
1,095	12,4	19	19,06	59,37	0,209	0,650	1,190	23,0	38	37,23	115,98	0,443	1,380
1,100	13,0	20	20,01	62,33	0,220	0,686	1,195	23,5	39	38,16	118,87	0,456	1,421
1,105	13,6	21	20,97	65,32	0,232	0,722	1,200	24,0	40	39,11	121,84	0,469	1,462
1,110	14,2	22	21,92	68,28	0,243	0,758							

10. Specific Gravity of Nitric Acid.

(Lunge and Rey.)

Specific Gravity	Degrees Twaddle	100 parts contain at 59° F		Specific Gravity	Degrees Twaddle	100 parts contain at 59° F	
		grs HNO_3	grs N_2O_5			grs HNO_3	grs N_2O_5
1,000	0	0,1	0,1	1,265	53	42,1	36,1
1,005	1	1,0	0,8	1,270	54	42,9	36,7
1,010	2	1,9	1,6	1,275	55	43,6	37,4
1,015	3	2,8	2,4	1,280	56	44,1	38,1
1,020	4	3,7	3,2	1,285	57	45,2	38,7
1,025	5	4,6	3,9	1,290	58	45,9	39,4
1,030	6	5,5	4,7	1,295	59	46,7	40,0
1,035	7	6,4	5,5	1,300	60	47,5	40,7
1,040	8	7,3	6,2	1,305	61	48,3	41,4
1,045	9	8,1	7,0	1,310	62	49,1	42,1
1,050	10	9,0	7,7	1,315	63	49,9	42,8
1,055	11	9,8	8,4	1,320	64	50,7	43,5
1,060	12	10,7	9,1	1,325	65	51,5	44,2
1,065	13	11,5	9,9	1,330	66	52,4	44,9
1,070	14	12,3	10,6	1,335	67	53,2	45,6
1,075	15	13,1	11,3	1,340	68	54,1	46,3
1,080	16	13,9	12,0	1,345	69	54,9	47,1
1,085	17	14,7	12,6	1,350	70	55,8	47,8
1,090	18	15,5	13,3	1,355	71	56,7	48,6
1,095	19	16,3	14,0	1,360	72	57,6	49,3
1,100	20	17,1	14,7	1,365	73	58,5	50,1
1,105	21	17,9	15,3	1,370	74	59,4	50,9
1,110	22	18,7	16,0	1,375	75	60,3	51,7
1,115	23	19,4	16,7	1,380	76	61,3	52,5
1,120	24	20,2	17,3	1,385	77	62,2	53,1
1,125	25	21,0	18,0	1,390	78	63,2	54,2
1,130	26	21,8	18,7	1,395	79	64,2	55,1
1,135	27	22,5	19,3	1,400	80	65,3	56,0
1,140	28	23,3	20,0	1.405	81	66,4	56,9
1,145	29	24,1	20,6	1,410	82	67,5	57,9
1,150	30	24,8	21,3	1,415	83	68,6	58,8
1,155	31	25,6	21,9	1,420	84	69,8	59,8
1,160	32	26,4	22,6	1,425	85	71,0	60,8
1,165	33	27,1	23,2	1,430	86	72,2	61,9
1,170	34	27,9	23,9	1,435	87	73,4	62,9
1,175	35	28,6	24,5	1,440	88	74,7	64,0
1,180	36	29,4	25,2	1,445	89	76,0	65,1
1,185	37	30,1	25,8	1,450	90	77,3	66,2
1,190	38	30,9	26,5	1,455	91	78,6	67,4
1,195	39	31,6	27,1	1,460	92	80,0	68,6
1,200	40	32,4	27,7	1,465	93	81,4	69,8
1,205	41	33,1	28,4	1,470	94	82,9	71,1
1,210	42	33,8	29,0	1,475	95	84,4	72,4
1,215	43	34,5	29,6	1,480	96	86,9	73,8
1,220	44	35,3	30,2	1,485	97	87,7	75,2
1,225	45	36,0	30,9	1,490	98	89,6	76,8
1,230	46	36,8	31,5	1,495	99	91,6	78,5
1,235	47	37,5	32,2	1,500	100	94,1	80,6
1,240	48	38,3	32,8	1,505	101	96,4	82,6
1,245	49	39,0	33,5	1,510	102	98,1	84,1
1,250	50	39,8	34,1	1,515	103	99,1	84,9
1,255	51	40,6	34,8	1,520	104	99,7	85,4
1,260	52	41,3	35,4				

11. Specific Gravity of Sulphuric Acid.

(Lunge und Isler.)

Specific Gravity at $\frac{59^0}{39^0}$ F (vacuum)	Degrees Beaumé	Degrees Twaddle	100 parts by weight contain in chemically pure acid	1 litre contains in chem. pure acid	Specific Gravity at $\frac{59^0}{39^0}$ F (vacuum)	Degrees Beaumé	Degrees Twaddle	100 parts by weight contain in chemically pure acid	1 litre contains in chem. pure acid	Specific Gravity at $\frac{59^0}{39^0}$ F (vacuum)	Degrees Beaumé	Degrees Twaddle	100 parts by weight contain in chemically pure acid	1 litre contains in chem. pure acid
			Per cent H_2SO_4	kos H_2SO_4				Per cent H_2SO_4	kos H_2SO_4				Per cent H_2SO_4	kos H_2SO_4
1,000	0	0	0,09	0,001	1,255	29,3	51	34,00	0,426	1,510	48,7	102	60,65	0,916
1,005	0,7	1	0,83	0,008	1,260	29,7	52	34,57	0,435	1,515	49,0	103	61,12	0,926
1,010	1,4	2	1,57	0,016	1,265	30,2	53	35,14	0,444	1,520	49,4	104	61,59	0,936
1,015	2,1	3	2,30	0,023	1,270	30,6	54	35,71	0,454	1,525	49,7	105	62,06	0,946
1,020	2,7	4	3,03	0,031	1,275	31,1	55	36,29	0,462	1,530	50,0	106	62,53	0,957
1,025	3,4	5	3,76	0,039	1,280	31,5	56	36,87	0,472	1,535	50,3	107	63,00	0,967
1,030	4,1	6	4,49	0,046	1,285	32,0	57	37,45	0,481	1,540	50,6	108	63,43	0,977
1,035	4,7	7	5,23	0,054	1,290	32,4	58	38,03	0,490	1,545	50,9	109	63,85	0,987
1,040	5,4	8	5,96	0,062	1,295	32,8	59	38,61	0,500	1,550	51,2	110	64,26	0,996
1,045	6,0	9	6,67	0,071	1,300	33,3	60	39,19	0,509	1,555	51,5	111	64,67	1,006
1,050	6,7	10	7,37	0,077	1,305	33,7	61	39,77	0,519	1,560	51,8	112	65,08	1,015
1,055	7,4	11	8,07	0,085	1,310	34,2	62	40,35	0,528	1,565	52,1	113	65,49	1,025
1,060	8,0	12	8,77	0,093	1,315	34,6	63	40,93	0,538	1,570	52,4	114	65,90	1,035
1,065	8,7	13	9,47	0,102	1,320	35,0	64	41,50	0,548	1,575	52,7	115	66,30	1,044
1,070	9,4	14	10,19	0,109	1,325	35,4	65	42,08	0,557	1,580	53,0	116	66,71	1,054
1,075	10,0	15	10,90	0,117	1,330	35,8	66	42,66	0,567	1,585	53,3	117	67,13	1,064
1,080	10,6	16	11,60	0,125	1,335	36,2	67	43,20	0,577	1,590	53,6	118	67,59	1,075
1,085	11,2	17	12,30	0,133	1,340	36,6	68	43,74	0,586	1,595	53,9	119	68,05	1,085
1,090	11,9	18	12,99	0,142	1,345	37,0	69	44,28	0,596	1,600	54,1	120	68,51	1,096
1,095	12,4	19	13,67	0,150	1,350	37,4	70	44,82	0,605	1,605	54,4	121	68,97	1,107
1,100	13,0	20	14,35	0,158	1,355	37,8	71	45,35	0,614	1,610	54,7	122	69,43	1,118
1,105	13,6	21	15,03	0,166	1,360	38,2	72	45,88	0,624	1,615	55,0	123	69,89	1,128
1,110	14,2	22	15,71	0,175	1,365	38,6	73	46,41	0,633	1,620	55,2	124	70,32	1,139
1,115	14,9	23	16,36	0,183	1,370	39,0	74	46,94	0,643	1,625	55,5	125	70,74	1,150
1,120	15,4	24	17,01	0,191	1,375	39,4	75	47,47	0,653	1,630	55,8	126	71,16	1,160
1,125	16,0	25	17,66	0,199	1,380	39,8	76	48,00	0,662	1,635	56,0	127	71,57	1,170
1,130	16,5	26	18,31	0,207	1,385	40,1	77	48,53	0,672	1,640	56,3	128	71,99	1,181
1,135	17,1	27	18,96	0,215	1,390	40,5	78	49,06	0,682	1,645	56,6	129	72,40	1,192
1,140	17,7	28	19,61	0,223	1,395	40,8	79	49,59	0,692	1,650	56,9	130	72,82	1,202
1,145	18,3	29	20,26	0,231	1,400	41,2	80	50,11	0,702	1,655	57,1	131	73,23	1,212
1,150	18,8	30	20,91	0,239	1,405	41,6	81	50,63	0,711	1,660	57,4	132	73,64	1,222
1,155	19,3	31	21,55	0,248	1,410	42,0	82	51,15	0,721	1,665	57,7	133	74,07	1,233
1,160	19,8	32	22,19	0,257	1,415	42,3	83	51,66	0,730	1,670	57,9	134	74,51	1,244
1,165	20,3	33	22,83	0,266	1,420	42,7	84	52,15	0,740	1,675	58,2	135	74,97	1,256
1,170	20,9	34	23,47	0,275	1,425	43,1	85	52,63	0,750	1,680	58,4	136	75,42	1,267
1,175	21,4	35	24,02	0,283	1,430	43,4	86	53,11	0,759	1,685	58,7	137	75,86	1,278
1,180	22,0	36	24,76	0,292	1,435	43,8	87	53,59	0,769	1,690	58,9	138	76,30	1,289
1,185	22,5	37	25,40	0,301	1,440	44,1	88	54,07	0,779	1,695	59,2	139	76,73	1,301
1,190	23,0	38	26,04	0,310	1,445	44,4	89	54,55	0,789	1,700	59,5	140	77,17	1,312
1,195	23,5	39	26,68	0,319	1,450	44,8	90	55,03	0,798	1,705	59,7	141	77,60	1,323
1,200	24,0	40	27,32	0,328	1,455	45,1	91	55,50	0,808	1,710	60,0	142	78,04	1,334
1,205	24,5	41	27,95	0,337	1,460	45,4	92	55,97	0,817	1,715	60,2	443	78,48	1,346
1,210	25,0	42	28,58	0,346	1,465	45,8	93	56,43	0,827	1,720	60,4	144	78,92	1,357
1,215	25,5	43	29,21	0,355	1,470	46,1	94	56,90	0,837	1,725	60,6	145	79,36	1,369
1,220	26,0	44	29,84	0,364	1,475	46,4	95	57,37	0,846	1,730	60,9	146	79,80	1,381
1,225	26,4	45	30,48	0,373	1,480	46,8	96	57,83	0,856	1,735	61,1	147	80,24	1,392
1,230	26,9	46	31,11	0,382	1,485	47,1	97	58,28	0,865	1,740	61,4	148	80,68	1,404
1,235	27,4	47	31,70	0,391	1,490	47,4	98	58,74	0,876	1,745	61,6	149	81,12	1,416
1,240	27,9	48	32,28	0,400	1,495	47,8	99	59,22	0,885	1,750	61,8	150	81,56	1,427
1,245	28,4	49	32,86	0,409	1,500	48,1	100	59,70	0,896	1,755	62,1	151	82,00	1,439
1,250	28,8	50	33,43	0,418	1,505	48,4	101	60,18	0,906	1,760	62,3	152	82,44	1,451

Specific Gravity at $\frac{59^0\,F}{39^0\,F}$ (vacuum)	Degrees Beaumé	Degrees Twaddle	100 parts by weight contain in chemically pure acid	1 litre contains in chem. pure acid	Specific Gravity at $\frac{59^0\,F}{39^0\,F}$ (vacuum)	Degrees Beaumé	Degrees Twaddle	100 parts by weight contain in chemically pure acid	1 litre contains in chem. pure acid	Specific Gravity at $\frac{59^0\,F}{39^0\,F}$ (vacuum)	Degrees Beaumé	Degrees Twaddle	100 parts by weight contain in chemically pure acid	1 litre contains in chem. pure acid
			Per cent H_2SO_4	kos H_2SO_4				Per cent H_2SO_4	kos H_2SO_4				Per cent H_2SO_4	kos H_2SO_4
1,765	62,5	153	82,88	1,463	1,821			90,20	1,643	1,833	65,6		92,75	1,700
1,770	62,8	154	83,32	1,475	1,822	65,1		90,40	1,647	1,834			93,05	1,706
1,775	63,0	155	83,90	1,489	1,823			90,60	1,651	1,835	65,7	167	93,43	1,713
1,780	63,2	156	84,50	1,504	1,824	65,2		90,80	1,656	1,836			93,80	1,722
1,785	63,5	157	85,10	1,519	1,825		165	91,00	1,661	1,837			94,20	1,730
1,790	63,7	158	85,70	1,534	1,826	65,3		91,25	1,666	1,838	65,8		94,60	1,739
1,795	64,0	159	86,30	1,549	1,827			91,50	1,671	1,839			95,00	1,748
1,800	64,2	160	86,90	1,564	1,828	65,4		91,70	1,676	1,840	65,9	168	95,60	1,759
1,805	64,4	161	87,60	1,581	1,829			91,90	1,681	1,8405			95,95	1,765
1,810	64,6	162	88,30	1,598	1,830		166	92,10	1,685	1,8410			97,00	1,786
1,815	64,8	163	89,05	1,621	1,831	65,5		92,30	1,690	1,8415			97,70	1,799
1,820	65,0	164	90,05	1,639	1,832			92,52	1,695					

12. Specific Gravity of Sulphurous Acid at 59° F.

(Scott.)

Specific Gravity	Per cent SO_2	Specific Gravity	Per cent SO_2	Specific Gravity	Per cent SO_2	Specific Gravity	Per cent SO_2
1,0028	0,5	1,0168	3,0	1,0302	5,5	1,0426	8,0
1,0056	1,0	1,0194	3,5	1,0328	6,0	1,0450	8,5
1,0085	1,5	1,0221	4,0	1,0353	6,5	1,0474	9,0
1,0113	2,0	1,0248	4,5	1,0377	7,0	1,0497	9,5
1,0141	2,5	1,0275	5,0	1,0401	7,5	1,0520	10,0

13. Specific Gravity of Acetic Acid at 59° F.

(Oudemans).

Specific Gravity	Per cent	Specific Gravity	Per cent	Specific Gravity	Per cent	Specific Gravity	Per cent	Specific Gravity	Per cent
1,9992	0	1,0298	21	1,0533	41	1,0691	61	1,0747	81
1,0007	1	1,0311	22	1,0543	42	1,0697	62	1,0746	82
1,0022	2	1,0324	23	1,0552	43	1,0702	63	1,0744	83
1,0037	3	1,0337	24	1,0562	44	1,0707	64	1,0742	84
1,0052	4	1,0350	25	1,0571	45	1,0712	65	1,0739	85
1,0067	5	1,0363	26	1,0580	46	1,0717	66	1,0736	86
1,0083	6	1,0375	27	1,0589	47	1,0721	67	1,0731	87
1,0098	7	1,0388	28	1,0598	48	1,0725	68	1,0726	88
1,0113	8	1,0400	29	1,0607	49	1,0729	69	1,0720	89
1,0127	9	1,0412	30	1,0615	50	1,0733	70	1,0713	90
1,0142	10	1,0424	31	1,0623	51	1,0737	71	1,0705	91
1,0157	11	1,0436	32	1,0631	52	1,0740	72	1,0696	92
1,0171	12	1,0447	33	1,0638	53	1,0742	73	1,0686	93
1,0185	13	1,0459	34	1,0646	54	1,0744	74	1,0674	94
1,0200	14	1,0470	35	1,0653	55	1,0746	75	1,0660	95
1,0214	15	1,0481	36	1,0660	56	1,0747	76	1,0644	96
1,0228	16	1,0492	37	1,0666	57	1,0748	77	1,0625	97
1,0242	17	1,0502	38	1,0673	58	1,0748	78	1,0604	98
1,0256	18	1,0513	39	1,0679	59	1,0748	79	1,0580	99
1,0270	19	1,0523	40	1,0685	60	1,0748	80	1,0553	100
1,0284	20								

Note: The specific gravities above 1,0553 indicate two solutions of different strength. In order to ascertain whether an acid is being dealt with, whose percentage of acetic acid exceeds the maximum of density (78%), it is only necessary to add some water. If the specific gravity increases, the acid was stronger than 78%, if it decreases, it was weaker.

14. Specific Gravity of Tartaric Acid at 59° F.

(Gerlach.)

Specific Gravity	Per cent	Specific Gravity	Per cent	Specific Gravity	Per cent	Specific Gravity	Per cent	Specific Gravity	Per cent
1,0045	1	1,0565	12	1,1175	24	1,1840	36	1,2568	48
1,0090	2	1,0661	14	1,1282	26	1,1959	38	1,2696	50
1,0179	4	1,0761	16	1,1393	28	1,2078	40	1,2828	52
1,0273	6	1,0865	18	1,1505	30	1,2198	42	1,2961	54
1,0371	8	1,0969	20	1,1615	32	1,2317	44	1,3093	56
1,0469	10	1,1072	22	1,1726	34	1,2441	46	1,3220	57,9

15. Specific Gravity of Formic Acid at 68° F., compared with water at 39° F.

(Richardson und Allaire.)

Specific Gravity	Weight Per cent CH_2O_2	Volume Per cent CH_2O_2	Specific Gravity	Weight Per cent CH_2O_2	Volume Per cent CH_2O_2	Specific Gravity	Weight Per cent CH_2O_2	Volume Per cent CH_2O_2
0,9983	0	0,00	1,0247	10	8,40	1,1425	60	56,13
1,0020	1	0,82	1,0371	15	12,80	1,1544	65	61,44
1,0045	2	1,64	1,0489	20	17,17	1,1656	70	66,80
1,0071	3	2,48	1,0610	25	21,73	1,1770	75	72,27
1,0094	4	3,30	1,0730	30	26,37	1,1861	80	77,67
1,0116	5	4,14	1,0848	35	31,10	1,1954	85	83,19
1,0142	6	4,98	1,0964	40	35,90	1,2045	90	88,74
1,0171	7	5,81	1,1086	45	40,82	1,2141	95	94,48
1,0197	8	6,68	1,1208	50	45,88	1,2213	100	100,00
1,0222	9	7,55	1,1321	55	51,01			

16. Specific Gravity of Solutions of Tannin at 59° F.

(Trammer.)

Specific Gravity	Per cent	Specific Gravity	Per cent	Specific Gravity	Per cent
1,0040	1,0	1,0160	4,0	1,0489	12
1,0060	1,5	1,0180	4,5	1,0572	14
1,0080	2,0	1,0200	5,0	1,0656	16
1,0100	2,5	1,0242	6	1,0740	18
1,0120	3,0	1,0324	8	1,0824	20
1,0140	3,5	1,0406	10		

17. Specific Gravity of Solutions of Soda at 59° F.

(Lunge.)

Spec. Grav.	Degrees Beaumé	Degrees Twaddle	Percentage by weight		1 cubic metre contains kilos		Spec. Grav.	Degrees Beaumé	Degrees Twaddle	Percentage by weight		1 cubic metre contains kilos	
			Na_2CO_3	Na_2CO_3 + 10 water	Na_2CO_3	Na_2CO_3 + 10 water				Na_2CO_3	Na_2CO_3 + 10 water	Na_2CO_3	Na_2CO_3 + 10 water
1,007	1	1,4	0,67	1,807	6,8	18,2	1,083	11	16,6	7,88	21,252	85,3	230,2
1,014	2	2,8	1,33	3,587	13,5	36,4	1,091	12	18,2	8,62	23,248	94,0	253,6
1,022	3	4,4	2,09	5,637	21,4	57,6	1,100	13	20,0	9,43	25,432	103,7	279,8
1,029	4	5,8	2,76	7,444	28,4	76,6	1,108	14	21,6	10,19	27,482	112,9	304,5
1,036	5	7,2	3,43	9,251	35,5	95,8	1,116	15	23,2	10,95	29,532	122,2	329,6
1,045	6	9,0	4,29	11,570	44,8	120,9	1,125	16	25,0	11,81	31,851	132,9	358,3
1,052	7	10,4	4,94	13,323	52,0	140,2	1,134	17	26,8	12,61	34,009	143,0	385,7
1,060	8	12,0	5,71	15,400	60.5	163,2	1,142	18	28,4	13,16	35,493	150,3	405,3
1,067	9	13,4	6,37	17,180	68,0	183,3	1,152	19	30,4	14,24	38,405	164,1	442,4
1,075	10	15,0	7,12	19,203	76,5	206,4							

18. Specific Gravity of Solutions of Common salt at 59° F.

(Gerlach.)

Spec. Grav.	Per cent NaCl	Spec. Grav.	Per cent NaCl	Spec. Grav.	Per cent NaCl	Spec. Grav.	Per cent NaCl
1,00725	1	1,05851	8	1,11146	15	1,16755	22
1,01450	2	1,06593	9	1,11938	16	1,17580	23
1,02174	3	1,07335	10	1,12730	17	1,18404	24
1,02899	4	1,08097	11	1,13523	18	1,19228	25
1,03624	5	1,08859	12	1,14315	19	1,20098	26
1,04366	6	1,09622	13	1,15107	20	1,20433	26,395
1,05108	7	1,10384	14	1,15931	21		

19. Specific Gravity of Solutions of Glauber's Salt at 66° F.

(Schiff.)

Specific Gravity	Per cent Na_2SO_4 + 10 aq.	Per cent Na_2SO_4	Specific Gravity	Per cent Na_2SO_4 + 10 aq.	Per cent Na_2SO_4	Specific Gravity	Per cent Na_2SO_4 + 10 aq.	Per cent Na_2SO_4
1,0040	1	0,441	1,0439	11	4,851	1,0849	21	9,261
1,0079	2	0,881	1,0479	12	5,292	1,0890	22	9,702
1,0118	3	1,323	1,0520	13	5,373	1,0931	23	10,143
1,0158	4	1,764	1,0560	14	6,174	1,0973	24	10,584
1,0198	5	2,205	1,0601	15	6,615	1,1015	25	11,025
1,0238	6	2,646	1,0642	16	7,056	1,1057	26	11,466
1,0278	7	3,087	1,0683	17	7,497	1,1100	27	11,907
1,0318	8	3,528	1,0725	18	7,938	1,1142	28	12,348
1,0358	9	3,969	1,0766	19	8,379	1,1184	29	12,789
1,0398	10	4,410	1,0807	20	8,820	1,1226	30	13,230

20. Specific Gravity of Solutions of Sodium Bisulphite at 59° F.

Specific Gravity	Degrees Beaumé	Percentage $NaHSO_3$	Percentage SO_2	Specific Gravity	Degrees Beaumé	Percentage $NaHSO_3$	Percentage SO_2
1,008	1	1,6	0,4	1,171	21	16,5	10,2
1,022	3	2,1	1,3	1,190	23	18,5	11,5
1,038	5	3,6	2,2	1,210	25	20,9	12,9
1,052	7	5,1	3,1	1,230	27	23,5	14,5
1,068	9	6,5	3,9	1,252	29	25,9	15,9
1,084	11	8,0	4,8	1,275	31	28,9	17,8
1,100	13	9,5	5,7	1,298	33	31,7	19,6
1,116	15	11,2	6,8	1,321	35	34,7	22,5
1,134	17	12,8	7,8	1,345	37	38	23,6
1,152	19	14,6	9,0				

21. Specific Gravity of Solutions of Sodium Acetate at 63° F.

(Gerlach.)

Specific Gravity	Per cent $NaC_2H_3O_2$	Per cent $NaC_2H_3O_2 + 3\,H_2O$	Specific Gravity	Per cent $NaC_2H_3O_2$	Per cent $NaC_2H_3O_2 + 3\,H_2O$
1,015	3,015	5	1,0960	18,090	30
1,031	6,030	10	1,1130	21,105	35
1,047	9,045	15	1,1305	24,120	40
1,063	12,060	20	1,1485	27,135	45
1,0795	15,075	25	1,1670	30,150	50

22. Specific Gravity of Solutions of Chloride of Lime at 59° F.

Specific Gravity	Degrees Bé	Grs effective chlorine per litre	Specific Gravity	Degrees Bé	Grs effective chlorine per litre	Specific Gravity	Degrees Bé	Grs effective chlorine per litre	Specific Gravity	Degrees Bé	Grs effective chlorine per litre
1,0000	0,0	trace	1,02	2,89	11,41	1,04	5,55	23,75	1,065	8,81	39,10
1,0018	0,26	1,0	1,025	2,97	12,0	1,0407	5,64	24,0	1,0664	8,99	40,0
1,0025	0,36	1,40	1,0226	3,19	13,0	1,042	5,86	25,0	1,0695	9,38	42,0
1,0036	0,52	2,0	1,024	3,41	14,0	1,044	6,08	26,0	1,07	9,44	42,31
1,005	0,73	2,71	1,025	3,52	14,47	1,045	6,21	26,62	1,0726	9,77	44,0
1,0054	0,78	3,0	1,0258	3,63	15,0	1,046	6,31	27,0	1,075	10,07	45,70
1,007	1,03	4,0	1,0275	3,86	16,0	1,0474	6,53	28,0	1,0756	10,14	46,0
1,009	1,29	5,0	1,029	4,09	17,0	1,049	6,73	29,0	1,0786	10,52	48,0
1,01	1,43	5,88	1,03	4,20	17,36	1,05	6,87	29,60	1,08	10,69	48,9
1,0108	1,54	6,0	1,031	4,33	18,0	1,0506	6,95	30,0	1,0817	10,89	50,0
1,0126	1,78	7,0	1,0325	4,54	19,0	1,0539	7,38	32,0	1,0848	11,28	52,0
1,014	2,02	8,0	1,034	4,77	20,0	1,055	7,52	32,68	1,085	11,3	52,27
1,015	2,13	8,48	1,035	4,88	20,44	1,057	7,79	34,0	1,09	11,92	55,18
1,016	2,27	9,0	1,0357	4,97	21,0	1,06	8,11	35,81			
1,0177	2,51	10,0	1,0374	5,20	22,0	1,0603	8,21	36,6			
1,0194	2,75	11,0	1,039	5,41	23,0	1,0633	8,59	38,0			

Diluted Solutions of chloride of lime, e. g. such as are used in bleaching, cannot be reliably determined by the areometer. The following method is sufficient for practical purposes, and is specially suitable for controlling the chemicking operations:

An Indigo solution is prepared with

15 g Indigo Carmine paste
10 g sulphuric acid 169° Tw., made up to 1 litre.

A portion of chloride of lime solution $^1/_2$° Bé mixed with an equal volume of above solution effects decolouration.

23. Specific Gravity of Solutions of Calcium Sulphocyanide at 62,6° F.

Specific Gravity	Degrees Bé	g $Ca(CNS)_2$ per litre	g CaO per litre	Specific Gravity	Degrees Bé	g $Ca(CNS)_2$ per litre	g CaO per litre
1,132	16,7	220	79,4	1,066	8,8	110	39,7
1,126	16,1	210	75,8	1,060	8,0	100	36,0
1,121	15,5	201,24	72,24	1,054	7,3	90	32,4
1,114	14,7	190	68,6	1,048	6,5	80	28,8
1,108	13,9	180	65,0	1,042	5,7	70	25,2
1,102	13,2	170	61,4	1,036	4,9	60	21,6
1,096	12,5	160	57,8	1,030	4,1	50	18,0
1,090	11,9	150	54,2	1,024	3,3	40	14,4
1,084	11,1	140	50,6	1,018	2,5	30	10,8
1,078	10,4	130	47,0	1,012	1,7	20	7,2
1,072	9,6	120	43,4	1,009	0,9	10	3,6

24. Specific Gravity of Solutions of Calcium Acetate at 59° F.

Specific Gravity	Degrees Bé	Per cent $Ca(C_2H_3O_2)_2$	Specific Gravity	Degrees Bé	Per cent $Ca(C_2H_3O_2)_2$
1,0260	3,4	5	1,1051	13,6	20
1,0530	7,1	10	1,1321	16,8	25
1,0792	10,5	15	1,1594	19,8	30

25. Specific Gravity of Solutions of Potash Alum at 63° F.

(Gerlach.)

Specific Gravity	Per cent $Al_2K_2(SO_4)_2$	Per cent $Al_2K_2(SO_4)_2 + 24\,H_2O$	Specific Gravity	Per cent $Al_2K_2(SO_4)_2$	Per cent $Al_2K_2(SO_4)_2 + 24\,H_2O$
1,0205	2,1792	4	1,0635	6,5369	12
1,0415	4,3548	8	1,0690	7,0824	13

26. Specific Gravity of Solutions of Aluminium Chloride at 59° F.

(Gerlach.)

Spec. Grav.	Per cent Al_2Cl_6	Spec. Grav.	Per cent Al_2Cl_6	Spec. Grav.	Per cent Al_2Cl_6	Spec. Grav.	Per cent Al_2Cl_6	Spec. Grav.	Per cent Al_2Cl_6	Spec. Grav.	Per cent Al_2Cl_6
1,00721	1	1,05845	8	1,11248	15	1,17092	22	1,23310	29	1,30066	36
1,01443	2	1,06591	9	1,12073	16	1,17953	23	1,24219	30	1,31086	37
1,02164	3	1,07337	10	1,12897	17	1,18815	24	1,25184	31	1,32106	38
1,02885	4	1,08120	11	1,13721	18	1,19676	25	1,26149	32	1,33126	39
1,03603	5	1,08902	12	1,14545	19	1,20584	26	1,27115	33	1,34146	40
1,04353	6	1,09684	13	1,15370	20	1,21493	27	1,28080	34	1,35224	41
1,05099	7	1,10466	14	1,16231	21	1,22406	28	1,29046	35	1,35359	41,126

27. Specific Gravity of Solutions of Aluminium Chlorate at 62,6° F.

Specific Gravity	Degrees Bé	g. Al_2O_3 per litre	Specific Gravity	Degrees Bé	g. Al_2O_3 per litre	Specific Gravity	Degrees Bé	g. Al_2O_3 per litre
1,302	33,5	65	1,205	24,5	45	1,095	12,4	20
1,277	31,3	60	1,182	22,2	40	1,073	9,8	15
1,252	29,0	55	1,160	19,8	35	1,050	6,7	10
1,235	27,4	51,8	1,138	17,4	30	1,026	3,5	5
1,227	26,6	50	1,116	15,0	25			

28. Specific Gravity of Solutions of Aluminium Sulphate at 59° F.

Spec. Grav.	Per cent $Al_2(SO_4)_3$	Spec. Grav.	Per cent $Al_2(SO_4)_3$	Spec. Grav.	Per cent $Al_2(SO_4)_3$	Spec. Grav.	Per cent $Al_2(SO_4)_3$
1,0170	1	1,0870	8	1,1467	14	1,2074	20
1,0270	2	1,0968	9	1,1574	15	1,2168	21
1,0370	3	1,1071	10	1,1668	16	1,2274	22
1,0470	4	1,1171	11	1,1770	17	1,2375	23
1,0569	5	1,1270	12	1,1876	18	1,2473	24
1,0670	6	1,1369	13	1,1971	19	1,2573	25
1,0768	7						

29. Specific Gravity of Solutions of Aluminium Acetate at 63° F.

Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre
1,100	13,0	40,8	1,050	6,7	20
1,098	12,8	40	1,038	5,0	15
1,086	11,3	35	1,025	3,4	10
1,074	9,9	30	1,012	1,6	5
1,062	8,3	25			

30. Specific Gravity of Solutions of Aluminium Sulphocyanide at 62,6° F.

Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre
1,209	24,9	35	1,135	17,1	22,5	1,059	7,9	10
1,194	23,4	32,5	1,119	15,3	20	1,044	5,9	7,5
1,179	21,9	30	1,104	13,5	17,5	1,029	4,0	5
1,164	20,2	27,5	1,089	11,8	15	1,015	2,2	2,5
1,149	18,7	25	1,074	9,9	12,5			

31. Specific Gravity of Solutions of Aluminium Nitrate at 62,6° F.

Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre
1,156	19,3	49,24	1,115	14,9	37	1,059	7,9	20
1,145	18,3	46	1,108	14	35	1,043	5,8	15
1,135	17,1	43	1,091	12	30	1,027	3,7	10
1,125	16	40	1,075	10	25	1,013	1,7	5

32. Specific Gravity of Solutions of Aluminium Nitroacetate at 62,6° F.

Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre
1,160	19,8	56,4	1,112	14,4	40	1,054	7,2	20
1,156	19,4	55	1,097	12,7	35	1,039	5,3	15
1,141	17,8	50	1,083	11,0	30	1,025	3,4	10
1,126	16,1	45	1,068	9,1	25	1,012	1,6	5

33. Specific Gravity of Solutions of Aluminium Tartrate at 62,6° F.

Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre	Specific Gravity	Degrees Bé	g Al_2O_3 per litre
1,390	40,5	130	1,255	29,3	85	1,120	15,4	40
1,375	39,4	125	1,240	27,9	80	1,105	13,6	35
1,360	38,2	120	1,225	26,4	75	1,090	11,9	30
1,345	37,0	115	1,210	25,0	70	1,075	10,0	25
1,330	35,8	110	1,195	23,5	65	1,060	8,0	20
1,315	34,6	105	1,180	22,0	60	1,045	6,0	15
1,300	33,3	100	1,165	20,4	55	1,030	4,1	10
1,285	32,0	95	1,150	18,8	50	1,015	2,1	5
1,270	30,6	90	1,135	17,1	45			

34. Diverse Salts of Antimony.

(W. S. Williams.)

Name	Formula	Percentage of Antimony Oxide (Sb_2O_3)	
		theoretic	actual
Double Fluoride of Antimony (Antimony Salt 75%)	$NaFl \cdot xSbFl_3$	75,0	73,0
Tartar emetic	$K(SbO)C_4H_4O_6 + {}^1/_2H_2O$	43,4	42,75
Tartrate of Antimony and Sodium	$Na(SbO)C_4H_4O_6 + {}^1/_2H_2O$	45,6	44,4
Antimony Salt pat. (Froelich)	$SbFl_3Na_3(SbO)(C_2O_4)_3 + xH_2O$	41,0	37,1
Lactate of Antimony	Acid Lactate of Antimony and Sodium	—	13,0
Lactate of Antimony liquid		—	12,5
Antimonine	$[(SbO)(C_3H_5O_3)]_2Ca_3(C_3H_5O_3)_4 2C_3H_6O_3$	26,2	13,0
Oxalate of Antimony and Potassium	$Sb(C_2O_4K)_3 + 6H_2O$	23,7	28,6
Trichloride of Antimony	$SbCl_3$	63,6	—
Trifluoride of Antimony	$SbFl_3$	80,3	—
Antimony Salt (de Haen)	$SbFl_3(AzH_4)_2SO_4$	47,0	—
Double Fluoride of Antimony (Antimony Salt 66%)	$SbFl_3 \cdot NaFl$	66,0	64,8

35. Specific Gravity of Solutions of Tartar Emetic at 63° F.

(Streit.)

Spec. Grav.	Per cent Tartar Emetic	Spec. Grav.	Per cent Tartar Emetic	Spec. Grav.	Per cent Tartar Emetic
1,005	0,5	1,015	2,5	1,031	4,5
1,007	1,0	1,018	3,0	1,035	5,0
1,009	1,5	1,022	3,0	1,038	5,5
1,012	2,0	1,027	4,5	1,044	6,0

36. Specific Gravity of solutions of Tin Chloride at 59° F.

(Gerlach.)

Specific Gravity	% $SnCl_2 + 2H_2O$	Specific Gravity	% $SnCl_2 + 2H_2O$	Specific Gravity	% $SnCl_2 + 2H_2O$	Specific Gravity	% $SnCl_2 + 2H_2O$
1,013	2	1,161	22	1,352	42	1,613	62
1,026	4	1,177	24	1,374	44	1,644	64
1,040	6	1,194	26	1,397	46	1,677	66
1,054	8	1,212	28	1,421	48	1,711	68
1,068	10	1,230	30	1,445	50	1,745	70
1,083	12	1,249	32	1,471	52	1,783	72
1,097	14	1,268	34	1,497	54	1,821	74
1,113	16	1,288	36	1,525	56	1,840	75
1,128	18	1,309	38	1,554	58		
1,144	20	1,330	40	1,582	60		

37. Specific Gravity of Solutions of Tin Nitrochloride at 59° F.

Specific Gravity	Degrees Bé	g Sn per litre	Specific Gravity	Degrees Bé	g Sn per litre	Specific Gravity	Degrees Bé	g Sn per litre
1,024	3,3	10	1,222	26,2	100	1,420	42,7	190
1,046	6,2	20	1,244	28,3	110	1,442	44,3	200
1,068	9,1	30	1,266	30,3	120	1,464	45,7	210
1,090	11,9	40	1,288	32,3	130	1,486	47,2	220
1,112	14,4	50	1,310	34,2	140	1,508	48,5	230
1,134	17,0	60	1,332	36,0	150	1,530	50,0	240
1,156	19,4	70	1,354	37,7	160	1,552	51,4	250
1,178	21,7	80	1,376	39,8	170	1,562	51,9	254,7
1,200	24,0	90	1,398	41,1	180			

38. Specific Gravity of Solutions of Tin Acetate at 59° F.

Specific Gravity	Degrees Bé	g Sn per litre	Specific Gravity	Degrees Bé	g Sn per litre	Specific Gravity	Degrees Bé	g Sn per litre
1,018	2,5	5	1,085	11,2	50	1,145	18,3	90
1,025	3,4	10	1,093	12,1	55	1,153	19,1	95
1,033	4,4	15	1,100	13,0	60	1,160	19,8	100
1,040	5,4	20	1,107	13,9	65	1,167	20,6	105
1,048	6,4	25	1,115	14,9	70	1,175	21,4	110
1,055	7,4	30	1,123	15,8	75	1,183	22,3	115
1,063	8,4	35	1,130	16,5	80	1,190	23,0	120
1,070	9,4	40	1,137	17,4	85	1,192	23,2	120,5
1,077	10,3	45						

39. Specific Gravity of Solutions of Tin Tartrate at 59° F.

Specific Gravity	Degrees Bé	g Sn per litre	Specific Gravity	Degrees Bé	g Sn per litre	Specific Gravity	Degrees Bé	g Sn per litre
1,015	2,1	5	1,115	14,9	30	1,214	25,4	55
1,035	4,7	10	1,135	17,1	35	1,233	27,2	60
1,055	7,4	15	1,155	19,3	40	1,252	29,0	65
1,075	10,0	20	1,175	21,4	45	1,260	29,7	66,87
1,095	12,4	25	1,195	23,5	50			

40. Specific Gravity of Solutions of Sulphate of Zinc at 59° F.

(Gerlach.)

Specific Gravity	Degrees Bé	Per cent $Zn\ SO_4$	Per cent $ZnSO_4+7H_2O$	Specific Gravity	Degrees Bé	Per cent $Zn\ SO_4$	Per cent $ZnSO_4+7H_2O$
1,0288	3,8	2,805	5	1,2315	27,0	19,637	35
1,0593	8,0	5,611	10	1,2709	30,7	22,443	40
1,0905	12,0	8,416	15	1,3100	34,2	25,248	45
1,1236	17,2	11,220	20	1,3532	37,6	28,054	50
1,1574	19,5	14,027	25	1,3986	41,0	30,859	55
1,1933	23,3	18,832	30	1,4451	44,4	33,664	60

41. Specific Gravity of Solutions of Copper Chloride at 62,6° F.

(Franz.)

Specific Gravity	Degrees Bé	Per cent $Cu\ Cl_2$	Specific Gravity	Degrees Bé	Per cent $Cu\ Cl_2$	Specific Gravity	Degrees Bé	Per cent $Cu\ Cl_2$
1,0182	2,4	2	1,1696	20,9	16	1,3618	38,1	30
1,0364	4,8	4	1,1958	23,6	18	1,3950	40,5	32
1,0548	7,4	6	1,2226	26,2	20	1,4282	43,3	34
1,0734	9,8	8	1,2501	28,8	22	1,4615	45,5	36
1,0920	12,2	10	1,2779	31,4	24	1,4949	47,8	38
1,1178	15,2	12	1,3058	33,8	26	1,5284	49,9	40
1,1436	18	14	1,3338	36	28			

42. Specific Gravity of Solution of Copper Sulphate at 63° F.

Specific Gravity	Per cent $CuSO_4+5H_2O$	Specific Gravity	Per cent $CuSO_4+5H_2O$	Specific Gravity	Per cent $CuSO_4+5H_2O$
1,0126	2	1,0649	10	1,1208	18
1,0254	4	1,0785	12	1,1354	20
1,0384	6	1,0933	14	1,1501	22
1,0516	8	1,1063	16	1,1659	24

43. Specific Gravity of Solutions of Nickel Bisulphite at 59° F.

Specific Gravity	Degrees Bé	g NiO per litre	Specific Gravity	Degrees Bé	g NiO per litre	Specific Gravity	Degrees Bé	g NiO per litre
1,169	20,7	79	1,105	13,6	50	1,052	7,0	25
1,158	19,6	75	1,094	12,3	45	1,042	5,7	20
1,147	18,5	70	1,084	11,0	40	1,031	4,3	15
1,136	17,3	65	1,073	9,8	35	1,021	2,9	10
1,126	16,1	60	1,063	8,4	30	1,010	1,4	5
1,115	14,9	55						

44. Specific Gravity of Solution of Acetate of Nickel at 63° F.

Specific Gravity	Degrees Bé	g NiO per litre	Specific Gravity	Degrees Bé	g NiO per litre
1,095	12,4	52	1,046	6,2	25
1,091	12,0	50	1,037	5,0	20
1,082	10,9	45	1,028	3,8	15
1,073	9,7	40	1,019	2,6	10
1,064	8,6	35	1,010	1,4	5
1,055	7,4	30			

45. Specific Gravity of Solution of Sugar of Lead at 68° F.

(F. Salomon)

Grammes in 100 cc	Specific Gravity	Grammes in 100 cc	Specific Gravity	Grammes in 100 cc	Specific Gravity	Grammes in 100 cc	Specific Gravity
1	1,0062	14	1,0870	27	1,1663	40	1,2440
2	1,0124	15	1,0932	28	1,1723	41	1,2499
3	1,0186	16	1,0094	29	1,1783	42	1,2558
4	1,0248	17	1,1056	30	1,1844	43	1,2617
5	1,0311	18	1,1118	31	1,1903	44	1,2676
6	1.0373	19	1,1180	32	1,1963	45	1,2735
7	1,0435	20	1,1242	33	1,2022	46	1,2794
8	1,0497	21	1,1302	34	1,2082	47	1,2853
9	1,0559	22	1,1362	35	1,2142	48	1,2912
10	1,0622	23	1,1422	36	1,2201	49	1,2971
11	1,0684	24	1,1482	37	1,2261	50	1,3030
12	1,0746	25	1,1543	38	1,2320		
13	1,0808	26	1,1603	39	1,2380		

46. Specific Gravity of Solutions of Chrome Chloride at 63° F.

Specific Gravity	Degrees Bé	g Cr_2O_3 per litre	Specific Gravity	Degrees Bé	g Cr_2O_3 per litre	Specific Gravity	Degrees Bé	g Cr_2O_3 per litre
1,008	1,2	5	1,098	12,9	60	1,197	23,8	120
1,016	2,3	10	1,115	14,9	70	1,213	25,3	130
1,032	4,3	20	1,131	16,6	80	1,229	26,8	140
1,048	6,5	30	1,148	18,6	90	1,245	28,4	150
1,065	8,7	40	1,164	20,2	100	1,261	29,8	160
1,082	10,9	50	1,180	22,0	110	1,276	31,2	170

47. Specific Gravity of Solutions of Chrome Bisulphite at 63° F.

Specific Gravity	Degrees Bé	g Cr_2O_3 per litre	Specific Gravity	Degrees Bé	g Cr_2O_3 per litre	Specific Gravity	Degrees Bé	g Cr_2O_3 per litre
1,160	19,8	80	1,100	13,0	50	1,050	6,7	25
1,150	18,8	75	1,090	11,9	45	1,040	5,4	20
1,140	17,7	70	1,080	10,6	40	1,030	4,1	15
1,130	16,5	65	1,070	9,4	35	1,020	2,7	10
1,120	15,4	60	1,060	8,0	30	1,010	1,4	5
1,110	14,2	55						

48. Specific Gravity of Solutions of Chrome Nitroacetate at 62,6° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,010	1,7	5	1,077	10,4	30	1,130	16,5	50
1,025	3,4	10	1,090	11,9	35	1,144	18,1	55
1,038	5,1	15	1,104	13,5	40	1,158	19,5	60
1,051	6,9	20	1,117	15,1	45	1,165	20,3	62
1,064	8,6	25						

49. Specific Gravity of Solutions of Normal (Green) Acetate of Chrome at 63° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,007	1	5	1,063	8,4	45	1,119	15,3	85
1,014	2	10	1,070	9,3	50	1,126	16,1	90
1,021	3	15	1,077	10,2	55	1,133	16,9	95
1,028	4	20	1,084	11,1	60	1,140	17,6	100
1,035	4,9	25	1,091	12,0	65	1,147	18,5	105
1,042	5,8	30	1,098	12,8	70	1,151	19	107
1,049	6,6	35	1,105	13,6	75			
1,056	7,5	40	1,112	14,5	80			

50. Specific Gravity of Solution of Basic (Violet) Acetate of Chrome at 59° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,006	1,0	5	1,063	8,4	50	1,122	15,7	95
1,013	2,0	10	1,069	9,3	55	1,129	16,4	100
1,019	2,7	15	1,076	10,1	60	1,136	17,2	105
1,025	3,4	20	1,083	11,0	65	1,143	18,0	110
1,031	4,2	25	1,089	11,8	70	1,150	18,8	115
1,037	5,0	30	1,096	12,5	75	1,157	19,5	120
1,043	5,8	35	1,102	13,2	80	1,161	19,9	122
1,050	6,7	40	1,108	13,9	85			
1,056	7,5	45	1,115	14,9	90			

51. Specific Gravity of Solutions of Chrome Mordant GAI at 59° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,012	1,7	10	1,176	21,5	160
1,023	3,1	20	1,187	22,7	170
1,034	4,6	30	1,198	23,8	180
1,045	6,0	40	1,208	24,8	190
1,056	7,6	50	1,219	25,9	200
1,067	9,0	60	1,230	26,9	210
1,078	10,4	70	1,241	28,0	220
1,089	11,8	80	1,252	29,0	230
1,099	12,9	90	1,263	30,0	240
1,110	14,2	100	1,274	31,0	250
1,121	15,5	110	1,285	32,0	260
1,132	16,7	120	1,296	32,9	270
1,143	18,1	130	1,307	33,9	280
1,154	19,2	140	1,318	34,9	290
1,165	20,3	150	1,325	35,4	296

52. Specific Gravity of Solutions of Chrome Mordant GA II at 59° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,015	2,1	10	1,125	16,0	120	1,235	27,4	230
1,025	3,4	20	1,135	17,1	130	1,245	28,4	240
1,035	4,7	30	1,145	18,3	140	1,250	29,4	250
1,045	6,0	40	1,155	19,3	150	1,266	30,3	260
1,055	7,4	50	1,165	20,3	160	1,276	31,3	270
1,065	8,7	60	1,175	21,4	170	1,287	32,2	280
1,075	10,0	70	1,185	22,5	180	1,298	33,2	290
1,085	11,2	80	1,195	23,5	190	1,309	34,1	300
1,095	12,4	90	1,205	24,5	200	1,320	35,1	310
1,105	13,6	100	1,215	25,5	210	1,328	35,7	317,4
1,115	14,9	110	1,225	26,5	220			

53. Specific Gravity of Solutions of Chrome Mordant GA III at 59° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,011	1,6	10	1,118	15,2	110	1,224	26,3	210
1,022	3,0	20	1,128	16,4	120	1,235	27,4	220
1,033	4,5	30	1,139	17,6	130	1,246	28,5	230
1,044	5,9	40	1,149	18,7	140	1,256	29,4	240
1,055	7,4	50	1,159	19,7	150	1,267	30,4	250
1.065	8,7	60	1,170	20,9	160	1,278	31,4	260
1,076	10,1	70	1,181	22,1	170	1,289	32,2	270
1,086	11,3	80	1,191	23,1	180	1,300	33,3	280
1,097	12,6	90	1,202	24,2	190	1,311	34,3	290
1,108	13,9	100	1,219	25,3	200	1,316	34,7	296

54. Specific Gravity of Solutions of Chrome Tartrate at 62,6° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,252	29,0	110	1 157	19,5	70	1,067	9,0	30
1,240	27,9	105	1,146	18,3	65	1,056	7,5	25
1,228	26,7	100	1,135	17,1	60	1,045	5,0	20
1,216	25,6	95	1,124	15,9	55	1,034	4,6	15
1,204	24,4	90	1,113	14,7	50	1,023	3,1	10
1,192	23,2	85	1,102	13,3	45	1,012	1,6	5
1,180	22,0	80	1,091	12,0	40			
1,169	20,8	75	1,079	10,5	35			

55. Specific Gravity of Solutions of Chrome Lactate at 62,6° F.

Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Cr_2O_3 per litre
1,218	25,8	86	1,147	18,5	55	1,078	10,4	25
1,205	24,5	80	1,136	17,2	50	1,067	9,0	20
1,193	23,3	75	1,124	15,9	45	1,055	7,4	15
1,182	22,2	70	1,113	14,7	40	1,044	5,8	10
1,170	20,9	65	1,101	13,2	35	1,022	3,0	5
1,159	19,7	60	1,090	11,9	30			

56. Specific Gravity of Solutions of Pyrolignite of Iron at 65° F.

Specific Gravity	Degrees Beaumé	g Fe_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Fe_2O_3 per litre	Specific Gravity	Degrees Beaumé	g Fe_2O_3 per litre
1,274	31,0	190	1,179	21,9	125	1,088	11,7	60
1,266	30,3	185	1,172	21,2	120	1,081	10,7	55
1,258	29,5	180	1,165	20,3	115	1,074	9,9	50
1,250	28,8	175	1,158	19,6	110	1,067	9,0	45
1,242	28,0	170	1,151	18,9	105	1,060	8,0	40
1,235	27,4	165	1,144	18,2	100	1,053	7,1	35
1,228	26,7	160	1,137	17,4	95	1,046	6,1	30
1,221	26,1	155	1,130	16,5	90	1,039	5,2	25
1,214	25,4	150	1,123	15,7	85	1,032	4,3	20
1,207	24,7	145	1,116	15,0	80	1,025	3,4	15
1,200	24,0	140	1,109	14,1	75	1,018	2,4	10
1,193	23,3	135	1,102	13,2	70	1,010	1,4	5
1,186	22,6	130	1,095	12,4	65			

57. Specific Gravity of Solutions of Ferrous Sulphate at 59° F.

Spec. Grav.	Per cent $FeSO_4 + 7H_2O$	Spec. Grav.	Per cent $FeSO_4 + 7H_2O$	Spec. Grav.	Per cent $FeSO_4 + 7H_2O$
1,011	2	1,054	10	1,143	25
1,021	4	1,065	12	1,174	30
1,032	6	1,082	15	1,206	35
1,043	8	1,112	20	1,239	40

58. Specific Gravity and Percentages of Diluted Alcohol at 15,56° C. (Tralles.)

Water = 0,9991.

Specific Gravity	% of Alcohol	Specific Gravity	% of Alcohol	Specific Gravity	% of Alcohol	Specific Gravity	% of Alcohol	Specific Gravity	% of Alcohol
0,9976	1	0,9741	21	0,9494	41	0,9104	61	0,8603	81
0,9961	2	0,9731	22	0,9478	42	0,9082	62	0,8575	82
0,9947	3	0,9720	23	0,9461	43	0,9059	63	0,8547	83
0,9933	4	0,9710	24	0,9444	44	0,9036	64	0,8518	84
0,9919	5	0,9700	25	0,9427	45	0,9013	65	0,8488	85
0,9906	6	0,9689	26	0,9409	46	0,8989	66	0,8458	86
0,9893	7	0,9679	27	0,9391	47	0,8965	67	0,8428	87
0,9881	8	0,9668	28	0,9373	48	0,8941	68	0,8397	88
0,9869	9	0,9657	29	0,9354	49	0,8917	69	0,8365	89
0,9857	10	0,9646	30	0,9335	50	0,8892	70	0,8332	90
0,9845	11	0,9634	31	0,9315	51	0,8867	71	0,8299	91
0,9834	12	0,9622	32	0,9295	52	0,8842	72	0,8265	92
0,9823	13	0,9609	33	0,9275	53	0,8817	73	0,8230	93
0,9812	14	0,9596	34	0,9254	54	0,8791	74	0,8194	94
0,9802	15	0,9583	35	0,9234	55	0,8765	75	0,8157	95
0,9791	16	0,9570	36	0,9213	56	0,8739	76	0,8118	96
0,9781	17	0,9559	37	0,9192	57	0,8712	77	0,8077	97
0,9771	18	0,9541	38	0,9170	58	0,8685	78	0,8034	98
0,9761	19	0,9526	39	0,9148	59	0,8658	79	0,7988	99
0,9751	20	0,9510	40	0,9126	60	0,8631	80	0,7939	100

In order to find the percentage of weight from the known percentage of volume, the specific gravity of absolute alcohol (0,7949 according to Gay-Lussac, 0,7939 according to Tralles) is divided by the specific gravity of the spirit to be tested, and the quotient is multiplied by perçentage of volume of this spirit.

59. Specific Gravity of Solutions of Glycerine.

Per cent water	Spec. Grav. by Champion et Pellet	Degrees Bé by Berthelot	Per cent water	Spec. Grav. by Champion et Pellet	Degrees Bé by Berthelot	Per cent water	Spec. Grav. by Champion et Pellet	Degrees Bé by Berthelot
0,0	1,2640	31,2	8,0	1,2427	29,3	15,0	1,2242	27,4
1,0	2,2612	30,9	9,0	1,2400	29,0	16,0	1,2217	27,2
2,0	1,2585	30,7	10,0	1,2375	28,8	17,0	1,2190	26,9
3,0	1,2560	30,4	11,0	1,2350	28,6	18,0	1,2165	26,7
4,0	1,2532	30,2	12,0	1,2322	28,3	19,0	1,2137	26,4
5,0	1,2505	30,0	13,0	1,2295	28,0	20,0	1,2112	26,2
6,0	1,2480	29,8	14,0	1,2270	27,7	21,0	1,2085	25,9
7,0	1,2455	29,6						

60. Testing Water for its Degree of Hardness.

Total Degree of Hardness. 100 cc water are filled into a glass stoppered cylinder of about 200 cc capacity. To this some normal soap solution is gradually added until the froth, formed when shaking the cylinder, remains standing above the liquid for 5 minutes. If the water shows more than 12° hardness, 10 cc of the liquid are diluted to 100 cc distilled water, and then tested as described above. The consumed number of cc of soap solution indicates, according to the table below, the total degree of hardness of the water.

Constant Degree of Hardness. 500 cc of the sample to be tested are boiled for 15 minutes. If any salts are precipitated in boiling, the same are filtered, and the solution filled up again to 500 cc with distilled water. Of this liquid 100 cc are poured into a glass-stoppered cylinder, and the test then carried out as described above.

German degrees of hardness indicate milligrammes of CaO in 100 grs water; French degrees of hardness refer to milligrammes of $CaCO_3$ in 100 grs water; English degrees of hardness indicate grains of $CaCO_3$ in 1 gallon water.

61. Table for determining the Hardness of Water.

cc Soap	German Degrees of Hardness	cc Soap	German Degrees of Hardness	cc Soap	German Degrees of Hardness	cc Soap	German Degrees of Hardness
3,4	0,5	15,9	3,7	26,2	6,5	37,4	9,7
4,2	0,7	16,6	3,9	26,9	6,7	38,1	9,9
5,0	0,9	17,0	4,0	27,6	6,9	38,4	10,0
5,4	1,0	17,4	4,1	28,0	7,0	38,7	10,1
5,8	1,1	17,8	4,2	28,4	7,1	39,4	10,3
6,6	1,3	18,1	4,3	29,1	7,3	40,1	10,5
7,4	1,5	18,5	4,4	29,8	7,5	40,8	10,7
8,2	1,7	18,9	4,5	30,0	7,7	41,5	10,9
9,0	1,9	19,7	4,7	31,2	7,9	41,8	11,0
9,4	2,0	20.4	4,9	31,6	8,0	41,9	11,1
9,8	2,1	20,8	5,0	31,9	8,1	42,4	11,2
10,5	2,3	21,2	5,1	32,6	8.3	42,8	11,3
11,3	2,5	21,9	5,3	33,3	8,5	43,1	11,4
12,1	2,7	22,6	5,5	34,0	8,7	43,4	11,5
12,8	2,9	23,3	5,7	34,7	8,9	43,7	11,6
13,2	3,0	24,0	5,9	35,0	9,0	44,0	11,7
13,6	3,1	24,4	6,0	35,3	9,1	44,4	11,8
14,3	3,3	24,8	6,1	36,0	9,3	44,7	11,9
15,1	3,5	25,5	6,3	36,7	9,5	45,0	12,0

62. Comparative Table of German, English and French Degrees of Hardness.

German	English	French	German	English	French	German	English	French
0,5	0,62	0,9	3,92	4,9	7,0	8,5	10,63	15,18
0,56	0,7	1,0	4,0	5,0	7,17	8,8	11,0	15,75
0,7	0,87	1,26	4,48	5,60	8,00	8,96	11,20	16,00
0,8	1,0	1,43	4,5	5,63	8,06	9,0	11,25	16,08
1,0	1,25	1,79	4,8	6,00	8,60	9,5	11,88	17,0
1,12	1,41	2,0	5,0	6,25	8,95	10,0	12,50	17,9
1,5	1,88	2,69	5,04	6,30	9,00	10,08	12,6	18,0
1,68	2,10	3,0	5,5	6,88	9,85	10,4	13,0	18,6
2,0	2,5	3,58	5,6	7,00	10,00	10,5	13,13	18,78
2,24	2,8	4,0	6,0	7,5	10,74	10,64	13,3	19,0
2,4	3,0	4,3	6,5	8,13	11,64	11,0	13,75	19,68
2,5	3,13	4,48	6,7	8,38	12,00	11,2	14,00	20,0
2,8	3,5	5,0	7,0	8,75	12,55	11,5	14,38	20,59
3,0	3,75	5,37	7,28	9,10	13,43	11,76	14,07	21,0
3,2	4,0	5,73	7,84	9,8	14,00	12,0	15,0	21,5
3,36	4,2	6,0	8,0	10,0	14,30			
3,5	4,38	6,27	8,4	10,5	15,0			

63. Table for determining the Quantity of Acetic Acid required to correct the Water.

To 1 litre water a trace of Methyl Orange is added, and normal hydrochloric acid 1:10 (10 cc hydrochloric acid 34½° Tw. per litre) poured into it until a change of colour is noticeable. The table shows what quantity of acetic acid of different strength is required for correcting 100 litres water, the first column referring to normal hydrochloric acid 1:10 used.

Normal Hydrochloric Acid 1:10 cc per litre Water	Grammes of acetic acid necessary to correct 100 litres Water							Normal Hydrochloric Acid 1:10 cc per litre Water	Grammes of Acetic Acid necessary to correct 100 litres Water						
	8° Bé	7° Bé	6° Bé	5° Bé	4° Bé	3° Bé	2° Bé		8° Bé	7° Bé	6° Bé	5° Bé	4° Bé	3° Bé	2° Bé
1	1,3	1,5	2	2,4	3	3,5	6	21	27,3	31,5	42	50,4	63	73,5	126
2	2,6	3	4	4,8	6	7	12	22	28,6	33	44	52,8	66	77	132
3	3,9	4,5	6	7,2	9	10,5	18	23	29,9	34,5	46	55,2	69	80,5	138
4	5,2	6	8	9,6	12	14	24	24	31,2	36	48	57,6	72	84	144
5	6,5	7,5	10	12	15	17,5	30	25	32,5	37,5	50	60	75	87,5	150
6	7,8	9	12	14,4	18	21	36	26	33,8	39	52	62,4	78	91	156
7	9,1	10,5	14	16,8	21	24,5	42	27	35,1	40,5	54	64,8	81	94,5	162
8	10,4	12	16	19,2	24	28	48	28	36,4	42	56	67,2	84	98	168
9	11,7	13,5	18	21,6	27	31,5	54	29	37,7	43,5	58	69,6	87	101,5	174
10	13	15	20	24	30	35	60	30	39	45	60	72	90	105	180
11	14,3	16,5	22	26,4	33	38,5	66	31	40,3	46,5	62	74,4	93	108,5	186
12	15,6	18	24	28,8	36	42	72	32	41,6	48	64	76,8	96	112	192
13	16,9	19,5	26	31,2	39	45,5	78	33	42,9	49,5	66	79,2	99	115,5	198
14	18,2	21	28	33,6	42	49	84	34	44,2	51	68	81,6	102	119	204
15	19,5	22,5	30	36	45	52,5	90	35	45,5	52,5	70	84	105	122,5	210
16	20,8	24	32	38,4	48	56	96	36	46,8	54	72	86,4	108	126	216
17	22,1	25,5	34	40,8	51	59,5	102	37	48,1	55,5	74	88,8	111	129,5	222
18	23,4	27	36	43,2	54	63	108	38	49,4	57	76	91,2	114	133	228
19	24,7	28,5	38	45,6	57	66,5	114	39	50,7	58,5	78	93,6	117	136,5	234
20	26	30	40	48	60	70	120	40	52	60	80	96	120	140	240

Normal Hydrochloric Acid 1 : 10 cc per litre Water	Grammes of Acetic Acid necessary to correct 100 litres Water							Normal Hydrochloric Acid 1 : 10 cc per litre Water	Grammes of Acetic Acid necessary to correct 100 litres Water						
	8° Bé	7° Bé	6° Bé	5° Bé	4° Bé	3° Bé	2° Bé		8° Bé	7° Bé	6° Bé	5° Bé	4° Bé	3° Bé	2° Bé
41	53,3	61,5	82	98,4	123	143,5	246	71	92,3	106,5	142	170,4	213	248,5	426
42	54,6	63	84	100,8	126	147	252	72	93,6	108	144	172,8	216	252	432
43	55,9	64,5	86	103,2	129	150,5	258	73	94,9	109,5	146	175,2	219	255,5	438
44	57,2	66	88	105,6	132	154	264	74	96,2	111	148	177,6	222	259	444
45	58,5	67,5	90	108	135	157,5	270	75	97,5	112,5	150	180	225	262,5	450
46	59,8	69	92	110,4	138	161	276	76	98,8	114	152	182,4	228	266	456
47	61,1	70,5	94	112,8	141	164,5	282	77	100,1	115,5	154	184,8	231	269,5	462
48	62,4	72	96	115,2	144	168	288	78	101,4	117	156	187,2	234	273	468
49	63,7	73,5	98	117,6	147	171,5	294	79	102,7	118,5	158	189,6	237	276,5	474
50	65	75	100	120	150	175	300	80	104	120	160	192	240	280	480
51	66,3	76,5	102	122,4	153	178,5	306	81	105,3	121,5	162	194,4	243	283,5	486
52	67,6	78	104	124,8	156	182	312	82	106,6	123	164	196,8	246	287	492
53	68,9	79,5	106	127,2	159	185,5	318	83	107,9	124,5	166	199,2	249	290,5	498
54	70,2	81	108	129,6	162	189	324	84	109,2	126	168	201,6	252	294	504
55	71,5	82,5	110	132	165	192,5	330	85	110,5	127,5	170	204	255	297,5	510
56	72,8	84	112	134,4	168	196	336	86	111,8	129	172	206,4	258	301	516
57	74,1	85,5	114	136,8	171	199,5	342	87	113,1	130,5	174	208,8	261	304,5	522
58	75,4	87	116	139,2	174	203	348	88	114,4	132	176	211,2	264	308	528
59	76,7	88,5	118	141,6	177	206,5	354	89	115,7	133,5	178	213,6	267	311,5	534
60	78	90	120	144	180	210	360	90	117	135	180	216	270	315	540
61	79,3	91,5	122	146,4	183	213,5	366	91	118,3	136,5	182	218,4	273	318,5	546
62	80,6	93	124	148,8	186	217	372	92	119,6	138	184	220,8	276	322	552
63	81,9	94,5	126	151,2	189	220,5	378	93	120,9	139,5	186	223,2	279	325,5	558
64	83,2	96	128	153,6	192	224	384	94	122,2	141	188	225,6	282	329	564
65	84,5	97,5	130	156	195	227,5	390	95	123,5	142,5	190	228	285	332,5	570
66	85,8	99	132	158,4	198	231	396	96	124,8	144	192	230,4	288	336	576
67	87,1	100,5	134	160,8	201	234,5	402	97	126,1	145,5	194	232,8	291	339,5	582
68	88,4	102	136	163,2	204	238	408	98	127,4	147	196	235,2	294	343	588
69	89,7	103,5	138	165,6	207	241,5	414	99	128,7	148,5	198	237,6	297	346,5	594
70	91	105	140	168	210	245	420	100	130	150	200	240	300	350	600

63. Reactions of the principal textile fibres.

Reagent	Animal fibres		Vegetables fibres					Artificial Silk			
	Wool	Silk	Cotton	Linen	Hemp	Jute	Ramie	Chardonnet	Pauly	Viscose	
Combustion	slow, characteristic smell, alkaline vapours		rapid, smell less noticeable, acid vapours								
Caustic Soda	soluble	in the heat	insoluble, the ligneous fibres turn yellow		yellow	brown					Apart from the animal fibres, caustic soda dissolves strongly hydrated cellulose.
Plumbate of Sodium[3])	black										Reaction of wool (Sulphur)
Sulphuric Acid $168^1/_2$ ° Tw.	insoluble	soluble	readily soluble	slowly soluble				readily soluble			
Fuming Nitric Acid	yellow insoluble	yellow soluble	insoluble, the ligneous fibres turn yellow		yellow	brown		yellow solution			
Cuprous Ammonia[1])	insoluble in the cold	soluble	soluble		doubtful	insoluble	insoluble	insoluble	soluble		
Ammoniacal Nickel[2])		soluble brown						insoluble	green solution	insoluble	
Sulphate of Aniline					yellow						Reaction of ligno-cellulose
Chlorine and Sulphite or Ammonia[4])						reddish brown					Reaction of jute and Manila-Hemp
Iodine and Sulphuric Acid[5])			blue		yellow						Important reaction for microscopic tests of vegetable fibres
Diphenylamine and Sulphuric Acid								blue			Reaction of nitric acid

[1]) Freshly prepared solution of hydrate of copper-oxide (thoroughly washed) in a little concentrated ammonia.

[2]) Freshly prepared solution of hydrate of nickel-oxide (precipitated and well washed) in a little ammonia.

[3]) The plumbate of sodium added to the alkaline solution of wool gives a black precipitate (sulphur).

[4]) The chlorine gas is allowed to act upon the moistened fibre, which is then slightly rinsed and soaked in a solution of neutral sodium sulphite or in ammonia. In the first case a temperary magenta colouring is observed, in the second case it is brownish.

[5]) A drop of iodine solution is allowed to act for 1 or 2 min upon the microscopic preparation, the excess is removed by means of a blotting paper and replaced by sulphuric acid. The concentration of the two reagents must be as indicated in v. Höhnel's, Mikroskopie der technisch verwendeten Faserstoffe". We cannot state details here.

64. Weakening of the Cotton Fibre by organic acids, under the influence of hot air and steam.

(Albert Scheurer.)

	Weakening in percentages					
	0	A hung for 3 days in a hot room	B twice steamed for 2 minutes	C steamed continuously for 20 minutes	D steamed for 2 hours in the usual manner	E steamed dry for 1 hour
White unprinted goods . .	0					
Weak oxalic acid (= 10 g per litre)	0	23	15	16	15	18
Strong oxalic acid (= 20 g per litre)	0	27	17	22	51	27
Weak lactic acid	0	18	18	12	12	15
Strong lactic acid	0	10	18	17	14	14
Weak tartaric acid	0	13	16	16	15	15
Strong tartaric acid	0	13	11	16	22	18
Weak citric acid	0	12	13	10	18	16
Strong citric acid	0	10	17	15	12	12

65. Soap Analysis.

Water. A certain quantity of soap, say 3 g, is mixed with about 10 g perfectly dry quartz sand in a porcelain dish, and the whole weighed. After adding a little alcohol to accelerate the evaporation of the remaining water, the mixture is dried until a constant weight is obtained. The loss indicated by the difference in weight represents water.

Fatty Acid. The following method is sufficient for all practical purposes: A quantity of soap, say 3 g, accurately weighed, is dissolved with water in a porcelain dish. The fatty acid is then precipitated with an excess of normal sulphuric acid, and melted with 10 g pure and perfectly dry wax. The wax cake which easily separates on cooling, is rinsed in cold water, and then dried, first with filter paper and then in the exsiccator until a constant weight is obtained.

Total Alkali. The filtrate obtained by the fatty acid test is neutralized with normal soda lye and Phenolphtaleine. The number of cc soda lye used, deducted from the number of cc normal sulphuric acid shows the sum total of alkali, 1 cc normal sulphuric acid being equivalent with 0,031 g Na_2O.

Another method is to titrate 100 cc soap solution containing 2—3 g soap direct with normal acid and Methyl Orange until a red tinge appears: 1 cc normal acid is equal to 0,031 g Na_2O.

Free Alkali. Qualitative Test. If a freshly cut surface of the soap is touched with a few drops of mercury chloride solution, a brownish yellow to reddish brown colour will appear, according to the amount of free alkali.

Glycerine. 20—25 g soap are dissolved in 100 cc water, then the fatty acid is precipitated with sulphuric acid till acid reaction sets in, and removed with wax. The filtrate is neutralized with potash, evaporated to dryness, powdered and extracted with pure alcohol. The extracted solution is filtered into a glass of known tare and heated on a water bath or, better still, to 122—140° F., until constant weight is obtained. The residue is glycerine.

Unsaponified Fat. Very finely powdered and dried soap, about 20—25 g, are extracted with ligroine in the Soxhlet extraction apparatus for 3—4 hours, the ligroine evaporated and the fat weighed. Traces of soap being soluble in ligroine, a portion of the soap separated in the flask must be poured off, washed, and the correction of the solubility of soap in ligroine be made: 100 cc ligroine dissolve 0,01 g olive oil soap.

66. Turkey Red Oil Analysis.

Primary Test. The oil must react slightly alkaline or neutral. Mixed with water, a perfect emulsion must be obtained from which oil drops are seperated only after standing for some time. These oil drops must be perfectly soluble in ammonia, otherwise unsaponified fat is present.

Water. According to Stein 10 g oil are melted with 25 g dry wax in about 75 cc saturated salt solution. The cake is dried and weighed. The increased weight of wax represents oil free from water; the difference between 10 and the amount of oil used is water.

Total Fat. 100 cc of the oil to be tested are mixed in a narrow graduated cylinder with 20 cc hydrochloric acid conc., and then made up to 500 cc with saturated salt solution. The whole is heated whilst being frequently shaken. On cooling the fat swims on the salt solution. The number of cc indicates the sum total of fat sufficiently accurately for practical purposes.

67. Indigo Analysis.

1 g of the dried indigo to be analysed is weighed into a short wide tube, then 7 cc conc. sulphuric acid 168° Tw. are added, and the whole heated for $^1/_2$ hour in steam of about 203° F. The solution is then poured into 100 cc cold water, and then filtered into a marked wash bottle of 1 litre. After washing the filter with hot water until the latter is perfectly colourless, the solution and washwater are filled up to 1 litre.

20 cc of this solution are diluted with 300 cc distilled water in a white porcelain dish of $^1/_2$ litre capacity and titrated with a permanganate solution containing $^1/_2$ g $KMnO_4$ per litre, the permanganate solution being added in drops whilst constantly stirring the indigo solution. The titration is finished when the blue has changed into gold yellow without any green reflexion.

For comparison a very pure indigo of known percentage is always analysed simultaneously with the new sample. This enables one to find the percentage of the latter by a simple equation; e. g. if:

A = indigo of known percentage requires 17,2 cc permanganate solution
B = indigo of unknown percentage requires 16,6 cc permanganate solution

and if:

A = contains 99 % indigo, it follows that
$B : 99 = 16,6 : 17,2$
$B = 95,5\ \%$

The titration is generally controlled by a dye test.

The same solutions which served for the titration are used for dyeing. The indigo of known percentage, the type, is dyed in three different strengths, viz: 10 g of wool yarn or cloth are dyed with 100, 98 and 96 cc respectively.

The number of cc to be used in dyeing the indigo of unknown strength is found by multiplying by 100 the quotient of the titration, thus:

$$17,2 : 16,6 = 1,036 \times 100 = 103,6 \text{ cc.}$$

As the dyebaths must not contain more than 4 % free sulphuric acid, the superfluous acid of the indigo solutions must be neutralized with 0,1 cc soda (0,1 : 10) for every 1 cc indigo solution. The varying amounts of Glauber's salt thereby produced are equalized by 2,7 cc Glauber's salt solution (1 : 10) for every deficient cc soda. The dyebath containing the highest percentage of soda will, of course, require no addition of Glauber's salt, e. g.

A = type of indigo of known percentage }
B = sample of indigo of unknown percentage } solution 1 : 1000.

1. for 100 cc A, are required 10,0 cc soda solution and 0,8 cc Glauber's salt solution
2. „ 98 cc A, „ „ 9,8 cc „ „ „ 1,3 cc „ „ „
3. „ 96 cc A, „ „ 9,6 cc „ „ „ 1,9 cc „ „ „
4. „ 103,6 cc B, „ „ 10,3 cc „ „ „ 0 cc „ „ „

For a second dyeing test the baths are prepared as above, but to each bath are added 50 cc Flavazine S. Thus green shades are produced which are more easily compared than blues as regards purity of shade.

The dye tests are to be carried out simultaneously under exactly equal conditions of temperature, time etc. The result will corroborate or correct the figures arrived at by titration.

68. Table of the Tension of Steam at Temperatures from 104° F. (40° C.) Upwards.

Temperature	Tension in mm	in Atmospheres	Pressure on 1 □ cm in Kos	Temperature	Tension in mm	in Atmospheres	Pressure on 1 □ cm in Kos
+ 40°	54,906	0,072	0,07465	+ 105°	906,41	1,193	1,23236
45	71,391	0,094	0,09706	110	1075,37	1,415	1,46219
50	91,982	0,121	0,12505	115	1269,41	1,673	1,72592
55	117,478	0,154	0,15972	120	1491,28	1,962	2,02755
60	148,791	0,196	0,20323	125	1743,88	2,294	2,37098
65	186,945	0,246	0,25417	130	2030,28	2,671	2,76037
70	233,093	0,306	0,31692	135	2353,73	3,097	3,20013
75	288,517	0,380	0,39227	140	2717,63	3,575	3,69400
80	354,643	0,466	0,48217	145	3125,55	4,112	4,24050
85	433,041	0,570	0,58877	150	3581,23	4,712	4,86904
90	525,450	0,691	0,71440	155	4088,56	5,380	5,55881
95	633,778	0,834	0,86168	160	4651,62	6,120	6,32434
100	760,000	1,000	1,03330				

69. Measures and Weights.

A. The Metrical System.

1 metre (m) = 10 decimetres (dm) = 100 centimetres (cm) = 1000 millimetres (mm).
1 litre (l) = 1000 cubic centimetres (ccm).
1 ton (t) = 1000 kilogrammes (kg).
1 kilogram (kg) = 1000 grammes (g).

B. English Measures and Weights.

1 yard = 3 feet = 0,9144 m.
1 foot = 12 inches.
1 inch = 2,540 cm.
1 gallon = 4 quarts = 8 pints = 32 gills = 4,5436 litres.
1 pound (lb) = 16 ounces (oz) = 453,59 g.
1 ton = 20 hundredweight (cwt) = 2240 lbs. = 1016 kg.

70. Table

showing **Percentage** of colour and corresponding quantity in **grammes** per **100 kilo** goods, and **lbs oz** and **grains** per **100 lbs** goods.

1 lb = 16 oz = 7000 grains = 454 grammes; 1 oz = 437½ grains; 1 gramme = 15,43 grains.

0,001 = $^1/_{1000}$%, 0,01 = $^1/_{100}$%; 0,10 = $^1/_{10}$%.

	per 100 kilo	per 100 lbs		per 100 kilo	per 100 lbs		per 100 kilo	per 100 lbs
%	grammes	lb oz grains	%	grammes	lb oz grains	%	grammes	lb oz grains
0,001	1	7	0,29	290	4 280	0,66	660	10 245
0,002	2	14	0,30	300	4 350	0,67	670	10 315
0,003	3	21	0,31	310	4 420	0,68	680	10 385
0,004	4	28	0,32	320	5 53	0,69	690	11 18
0,005	5	35	0,33	330	5 123	0,70	700	11 88
0,006	6	42	0,34	340	5 193	0,71	710	11 158
0,007	7	49	0,35	350	5 263	0,72	720	11 228
0,008	8	56	0,36	360	5 333	0,73	730	11 298
0,009	9	63	0,37	370	5 403	0,74	740	11 368
0,01	10	70	0,38	380	6 35	0,75	750	12 —
0,02	20	140	0,39	390	6 105	0,76	760	12 70
0,03	30	210	0,40	400	6 175	0,77	770	12 140
0,04	40	280	0,41	410	6 245	0,78	780	12 210
0,05	50	350	0,42	420	6 315	0,79	790	12 280
0,06	60	420	0,43	430	6 385	0,80	800	12 350
0,07	70	1 53	0,44	440	7 18	0,81	810	12 420
0,08	80	1 123	0,45	450	7 88	0,82	820	13 53
0,09	90	1 193	0,46	460	7 158	0,83	830	13 123
0,10	100	1 263	0,47	470	7 228	0,84	840	13 193
0,11	110	1 333	0,48	480	7 298	0,85	850	13 263
0,12	120	1 403	0,49	490	7 368	0,86	860	13 333
0,13	130	2 35	0,50	500	8 —	0,87	870	13 403
0,14	140	2 106	0,51	510	8 70	0,88	880	14 35
0,15	150	2 176	0,52	520	8 140	0,89	890	14 105
0,16	160	2 246	0,53	530	8 210	0,90	900	14 175
0,17	170	2 316	0,54	540	8 280	0,91	910	14 245
0,18	180	2 386	0,55	550	8 350	0,92	920	14 315
0,19	190	3 18	0,56	560	8 420	0,93	930	14 385
0,20	200	3 88	0,57	570	9 53	0,94	940	15 18
0,21	210	3 158	0,58	580	9 123	0,95	950	15 88
0,22	220	3 229	0,59	590	9 193	0,96	960	15 158
0,23	230	3 299	0,60	600	9 263	0,97	970	15 228
0,24	240	3 369	0,61	610	9 333	0,98	980	15 298
0,25	250	4 —	0,62	620	9 403	0,99	990	15 368
0,26	260	4 70	0,63	630	10 35	1	1 kilo	1
0,27	270	4 140	0,64	640	10 105			
0,28	280	4 210	0,65	650	10 175			

71. Conversion of Kilogrammes into lbs English.

Kilogrammes into	cwts	qrs	lbs	oz	Approximate conversion into lbs	Kilogrammes into	cwts	qrs	lbs	oz	Approximate conversion into lbs
1	0	0	2	3¼	2⅕	40	0	3	4	3	88
2	0	0	4	6½	4⅖	50	0	3	26	3¾	110¼
3	0	0	6	9¾	6⅝	60	1	0	20	4½	132
4	0	0	8	13	8⅞	70	1	1	14	5¼	154
5	0	0	11	0¼	11	80	1	2	8	6	176
6	0	0	13	3½	13⅕	90	1	3	2	6½	198
7	0	0	15	7	15½	100	1	3	24	7	220½
8	0	0	17	10¼	17⅝	200	3	3	20	15	441
9	0	0	19	13½	19⅞	300	5	3	17	6	661½
10	0	0	22	0¾	22⅛	400	7	3	13	14	882
20	0	1	16	1½	44¼	500	9	3	10	5	1102½
30	0	2	10	2½	66⅜						

72. Conversion of grammes into oz and grains.

1 grms = 15,43235 grs
2 ,, = 30,86470 ,,
3 ,, = 46,29705 ,,
4 ,, = 61,72940 ,,
5 ,, = 77,16175 ,,
6 ,, = 92,59410 ,,
7 ,, = 108,02645 ,,
8 ,, = 123,45880 ,,
9 ,, = 138,89115 ,,
10 ,, = 154,32350 ,,
11 ,, = 169,75585 ,,
12 ,, = 185,18820 ,,
13 ,, = 200,62055 ,,
14 ,, = 216,05290 ,,
15 ,, = 231,48525 ,,
16 ,, = 246,91760 ,,
17 ,, = 262,34995 ,,
18 ,, = 277,78230 ,,
19 ,, = 293,21465 ,,
20 ,, = 308,64700 ,,
21 ,, = 324,07935 ,,
22 ,, = 339,51170 ,,
23 ,, = 354,94405 ,,
24 ,, = 370,37640 ,,
25 ,, = 385,80875 ,,
26 ,, = 401,24110 ,,
27 ,, = 416,67345 ,,
28 ,, = 432,10580 ,,
$28^{35}/_{100}$ grms = $437^{1}/_{2}$ grms = 1 oz
29 grms = 447,53 grs = 1 oz 10 grs
30 ,, = 462,97 ,, = 1 ,, 25 ,,
31 ,, = 478,40 ,, = 1 ,, 41 ,,
32 ,, = 498,83 ,, = 1 ,, 56 ,,
33 ,, = 509,26 ,, = 1 ,, 72 ,,
34 ,, = 524,69 ,, = 1 ,, 87 ,,
35 ,, = 540,13 ,, = 1 ,, 102 ,,
36 ,, = 555,56 ,, = 1 ,, 118 ,,
37 ,, = 570,99 ,, = 1 ,, 133 ,,
38 ,, = 586,42 ,, = 1 ,, 149 ,,
39 ,, = 601,86 ,, = 1 ,, 164 ,,
40 ,, = 617,29 ,, = 1 ,, 180 ,,
41 ,, = 632,72 ,, = 1 ,, 195 ,,
42 ,, = 648,15 ,, = 1 ,, 210 ,,
43 ,, = 663,59 ,, = 1 ,, 226 ,,
44 ,, = 679,02 ,, = 1 ,, 241 ,,
45 ,, = 694,45 ,, = 1 ,, 257 ,,
46 ,, = 709,88 ,, = 1 ,, 272 ,,
47 ,, = 725,32 ,, = 1 ,, 288 ,,
48 ,, = 740,75 ,, = 1 ,, 303 ,,
49 ,, = 756,18 ,, = 1 ,, 319 ,,
50 ,, = 771,61 ,, = 1 ,, 334 ,,

51 grms = 787,04 grs = 1 oz 350 grs
52 ,, = 802,48 ,, = 1 ,, 365 ,,
53 ,, = 817,91 ,, = 1 ,, 380 ,,
54 ,, = 833,34 ,, = 1 ,, 395 ,,
55 ,, = 848,77 ,, = 1 ,, 411 ,,
56 ,, = 864,21 ,, = 1 ,, 427 ,,
57 ,, = 879,64 ,, = 2 ,, 005 ,,
58 ,, = 895,07 ,, = 2 ,, 020 ,,
59 ,, = 910,50 ,, = 2 ,, 036 ,,
60 ,, = 925,94 ,, = 2 ,, 051 ,,
61 ,, = 941,37 ,, = 2 ,, 066 ,,
62 ,, = 956,80 ,, = 2 ,, 082 ,,
63 ,, = 972,23 ,, = 2 ,, 097 ,,
64 ,, = 987,67 ,, = 2 ,, 113 ,,
65 ,, = 1003,10 ,, = 2 ,, 128 ,,
66 ,, = 1018,53 ,, = 2 ,, 144 ,,
67 ,, = 1033,96 ,, = 2 ,, 159 ,,
68 ,, = 1049,39 ,, = 2 ,, 174 ,,
69 ,, = 1064,83 ,, = 2 ,, 190 ,,
70 ,, = 1080,26 ,, = 2 ,, 205 ,,
71 ,, = 1095,69 ,, = 2 ,, 220 ,,
72 ,, = 1111,12 ,, = 2 ,, 236 ,,
73 ,, = 1126,56 ,, = 2 ,, 252 ,,
74 ,, = 1141,99 ,, = 2 ,, 267 ,,
75 ,, = 1157,42 ,, = 2 ,, 282 ,,
76 ,, = 1172,85 ,, = 2 ,, 298 ,,
77 ,, = 1188,29 ,, = 2 ,, 313 ,,
78 ,, = 1203,72 ,, = 2 ,, 329 ,,
79 ,, = 1219,15 ,, = 2 ,, 344 ,,
80 ,, = 1234,58 ,, = 2 ,, 360 ,,
81 ,, = 1250,02 ,, = 2 ,, 375 ,,
82 ,, = 1265,45 ,, = 2 ,, 390 ,,
83 ,, = 1280,88 ,, = 2 ,, 406 ,,
84 ,, = 1296,31 ,, = 2 ,, 421 ,,
85 ,, = 1311,74 ,, = 2 ,, 437 ,,
86 ,, = 1327,18 ,, = 3 ,, 015 ,,
87 ,, = 1342,61 ,, = 3 ,, 030 ,,
88 ,, = 1358,04 ,, = 3 ,, 045 ,,
89 ,, = 1373,47 ,, = 3 ,, 061 ,,
90 ,, = 1388,91 ,, = 3 ,, 076 ,,
91 ,, = 1404,34 ,, = 3 ,, 092 ,,
92 ,, = 1419,77 ,, = 3 ,, 107 ,,
93 ,, = 1435,20 ,, = 3 ,, 123 ,,
94 ,, = 1450,64 ,, = 3 ,, 138 ,,
95 ,, = 1466,07 ,, = 3 ,, 154 ,,
96 ,, = 1481,50 ,, = 3 ,, 169 ,,
97 ,, = 1496,93 ,, = 3 ,, 184 ,,
98 ,, = 1512,37 ,, = 3 ,, 200 ,,
99 ,, = 1527,80 ,, = 3 ,, 215 ,,
100 ,, = 1543,23 ,, = 3 ,, 230 ,,

73. Conversion of lbs into Kilogrammes.

1 lbs Engl.	=	0,454 Ko.	21 lbs Engl.	=	9,526 Ko.	41 lbs Engl.	=	18,598 Ko.
2 „ „	=	0,907 „	22 „ „	=	9,979 „	42 „ „	=	19,051 „
3 „ „	=	1,361 „	23 „ „	=	10,433 „	43 „ „	=	19,505 „
4 „ „	=	1,814 „	24 „ „	=	10,886 „	44 „ „	=	19,958 „
5 „ „	=	2,268 „	25 „ „	=	11,340 „	45 „ „	=	20,412 „
6 „ „	=	2,722 „	26 „ „	=	11,794 „	46 „ „	=	20,866 „
7 „ „	=	3,175 „	27 „ „	=	12,247 „	47 „ „	=	21,319 „
8 „ „	=	3,629 „	28 „ „	=	12,701 „	48 „ „	=	21,773 „
9 „ „	=	4,082 „	29 „ „	=	13,154 „	49 „ „	=	22,226 „
10 „ „	=	4,536 „	30 „ „	=	13,608 „	50 „ „	=	22,680 „
11 „ „	=	4,990 „	31 „ „	=	14,062 „	60 „ „	=	27,216 „
12 „ „	=	5,443 „	32 „ „	=	14,515 „	70 „ „	=	31,752 „
13 „ „	=	5,897 „	33 „ „	=	14,969 „	80 „ „	=	36,288 „
14 „ „	=	6,350 „	34 „ „	=	15,422 „	90 „ „	=	40,824 „
15 „ „	=	6,801 „	35 „ „	=	15,876 „	100 „ „	=	45,360 „
16 „ „	=	7,258 „	36 „ „	=	16,330 „	200 „ „	=	90,720 „
17 „ „	=	7,711 „	37 „ „	=	16,783 „	300 „ „	=	136,080 „
18 „ „	=	8,165 „	38 „ „	=	17,237 „	400 „ „	=	181,440 „
19 „ „	=	8,618 „	39 „ „	=	17,690 „	500 „ „	=	226,800 „
20 „ „	=	9,072 „	40 „ „	=	18,144 „			

74. Conversion of grains, oz, lbs, qrs, cwts, into Kilogrammes.

7,716175 grains = 0,5 grammes
15,432350 „ = 1,0 „
154,323500 „ = 10,0 „
437½ grains = 1 oz = 28,3 grammes
16 oz = 1 lbs = 453,59 „
28 lbs = 1 qrs = 12 kilos 712 grammes
4 qrs = 1 cwt = 112 lbs = 50 kilos 803 grammes
20 cwts = 1 ton = 1016,06 kilos.

1 oz = 437½ grs = 28,3502 grammes
2 „ = 875 „ = 56,6991 „
3 „ = 1312½ „ = 85,0486 „
4 „ = 1750 „ = 113,3981 „
5 „ = 2187½ „ = 141,7482 „
6 „ = 2625 „ = 170,0972 „
7 „ = 3062½ „ = 198,4466 „
8 „ = 3500 „ = 226,7962 „
9 „ = 3937½ „ = 255,1457 „
10 „ = 4375 „ = 283,4952 „
11 „ = 4812½ „ = 311,8448 „
12 „ = 5250 „ = 340,1942 „
13 „ = 5687 „ = 368,5438 „
14 „ = 6125 „ = 396,8933 „
15 „ = 6562½ „ = 425,2428 „
16 „ = 7000 „ = 453,5923 „

1 milligramme = 0,001 grammes
1 centigramme = 0,01 „
1 decigramme = 0,1 „
1 decagramme = 10,000 „
1 hectogramme = 100,000 „
1 kilogramme = 1000,000 „

75. Conversion of grammes per litre into ounces per gallon.

	Per litre	Per gall.				
grm.	1 =	$4^1/_2$	grms. =	$^1/_6$	oz.	
grms.	2 =	9	" =	$^1/_3$	"	
"	3 =	$13^1/_2$	" =	$^1/_2$	"	
"	4 =	18	" =	$^2/_3$	"	
"	5 =	$22^1/_2$	" =	$^5/_6$	"	
"	6 =	27	" =	1	"	
"	7 =	$31^1/_2$	" =	$1^1/_6$	"	
"	8 =	36	" =	$1^1/_3$	"	
"	9 =	$40^1/_2$	" =	$1^1/_2$	"	
"	10 =	45	" =	$1^2/_3$	"	
"	11 =	$49^1/_2$	" =	$1^5/_6$	"	
"	12 =	54	" =	2	"	
"	13 =	$58^1/_2$	" =	$2^1/_6$	"	
"	14 =	63	" =	$2^1/_3$	"	
"	15 =	$67^1/_2$	" =	$2^1/_2$	"	
"	16 =	72	" =	$2^2/_3$	"	
"	17 =	$76^1/_2$	" =	$2^5/_6$	"	
"	18 =	81	" =	3	"	
"	19 =	$85^1/_2$	" =	$3^1/_6$	"	
"	20 =	90	" =	$3^1/_3$	"	
"	30 =	135	" =	5	"	
"	40 =	180	" =	$6^2/_3$	"	
"	50 =	225	" =	$8^1/_3$	"	
"	60 =	270	" =	10	"	
"	70 =	315	" =	$11^2/_3$	"	
"	80 =	360	" =	$13^1/_3$	"	
"	90 =	405	" =	15	"	
"	100 =	450	" =	$16^2/_3$	"	
"	200 =	900	" =	$33^1/_3$	"	= 2 lbs $1^1/_3$ oz.
"	300 =	1350	" =	50	"	= 3 „ 2 "
"	400 =	1800	" =	$66^2/_3$	"	= 4 „ $2^2/_3$ "
"	500 =	2250	" =	$83^1/_3$	"	= 5 „ $3^1/_3$ "

76. Fluid Measures.

pints quarts gallons litres
2 = 1
8 = 4 = 1 = 4,543

1 Imp. gallon = 8 pints = 32 gills = 160 oz = 4 = kil. 540 grms.
1 „ = 4 „ = 20 „ = 0 = „ 0,67 „

In English works 2 noggins = 1 gill (10 fl. oz.)
2 gills = 1 pint

In Scotch works 4 gills = 1 pint
(of 5 fl. oz. each) (20 fl. oz)

1 U. S. gallon = 3,785 litres
1 Imp. „ = 4,5436 litres = 4543 cubic centimetres
1. „ water = 10 lbs Engl.
1000 Imp. gallons = 10015 lbs Engl. = 4543 kilo
210 „ water = 1 ton = 35,943 cubic feet
1 „ „ = $277^1/_4$ cubic inch. = 0,16 cubic feet = 10 lbs

1 Imp. pipe = 572,48 litres
1 U. S. pipe = 476,94 „

1 litre = 100 centilitres = 1 cubic decimetre = 1,76 Imp. pint = 2,114 U. S. pints.
1 hectolitre = 10 decalitres = 100 litres.

77. Conversion of gallons, pints and gills into lbs and oz.

1 gallon = 10 lbs
100 gallons = 1000 ,,
1 pint = $1^{1}/_{4}$ lbs
2 pints = $2^{1}/_{2}$,,
3 ,, = $3^{3}/_{4}$,,
4 ,, = 5 ,,
5 ,, = $6^{1}/_{4}$,,
6 ,, = $7^{1}/_{2}$,,
7 ,, = $8^{3}/_{4}$,,
8 ,, = 10 ,,

1 pint = = 2 gills = $1^{1}/_{4}$ lbs
1 quart = 2 pints = 4 ,, = $2^{1}/_{2}$,,
1 gallon = 4 quarts = 8 pints = 32 ,, = 10 ,,

78. Conversion of litres into gallons and pints.

Litres		Gallons	Pints	Gills
1	=		1	3,0430
2	=		3	2,0864
3	=		5	1,1296
4	=		7	0,1728
5	=		8	3,2160
6	=	1	2	2,2592
7	=	1	4	1,3024
8	=	1	6	0,3456
9	=	1	7	3,3888
10	=	2	1	2,4320
11	=	2	3	1,4752
12	=	2	5	0,5184
13	=	2	6	3,5616
14	=	3	0	2,6048
15	=	3	2	1,6480
16	=	3	4	0,6912
17	=	3	5	3,7344
18	=	3	7	2,7776
19	=	4	1	1,8208
20	=	4	3	0,8640
21	=	4	4	3,9072
22	=	4	6	2,9504
23	=	5	0	1,9936
24	=	5	2	1,0368
25	=	5	4	0,0800
50	=	11	0	0,1600
75	=	16	4	0,2400
100	=	22	0	0,3200

79. Conversion of Cubic Centimetres into English Measures.

1 cubic centimetres = 17 minims.
2 ,, = 34 ,,
3 ,, = 51 ,,
4 ,, = 68 ,, or 1 drachm 8 minims
5 ,, = 85 ,, ,, 1 ,, 25 ,,
6 ,, = 102 ,, ,, 1 ,, 42 ,,
7 ,, = 119 , ,, 1 ,, 59 ,,
8 ,, = 136 ,, ,, 2 drachms 16 ,,
9 ,, = 153 ,, ,, 2 ,, 33 ,,
10 ,, = 170 ,, ,, 2 ,, 50 ,,
20 ,, = 340 ,, ,, 5 ,, 40 ,,
30 ,, = 510 ,, ,, 1 ounce 0 drachm 30 minims.
40 ,, = 680 ,, ,, 1 ,, 3 ,, 20 ,,
50 ,, = 850 ,, ,, 1 ,, 6 ,, 10 ,,
60 ,, = 1020 ,, ,, 2 ,, 1 ,, 0 ,,
70 ,, = 1190 ,, ,, 2 ,, 3 ,, 50 ,,
80 ,, = 1360 ,, ,, 2 ,, 6 ,, 40 ,,
90 ,, = 1530 ,, ,, 3 ,, 1 ,, 30 ,,
100 ,, = 1700 ,, ,, 3 ,, 4 ,, 20 ,,
1000 ,, = 1 litre = 34 fluid ounces nearly, or $1^{3}/_{4}$ pints.

80. Conversion of gallons into litres.

1 Imp. gallon	=	4,5436 litres	40 Imp. gallons	=	181,744 litres
2 Imp. gallons	=	9,0872 "	50 "	=	227,180 "
3 "	=	13,6308 "	60 "	=	272,616 "
4 "	=	18,1748 "	70 "	=	318,052 "
5 "	=	22,718 "	80 "	=	363,488 "
6 "	=	27,2616 "	90 "	=	408,924 "
7 "	=	31,8052 "	100 "	=	454,360 "
8 "	=	36,3488 "	200 "	=	908,720 "
9 "	=	40,8924 "	300 "	=	1363,080 "
10 "	=	45,436 "	400 "	=	1817,440 "
20 "	=	90,872 "	500 "	=	2271,800 "
30 "	=	136,308 "	1000 "	=	4543,600 "

81. Water quantities.

1 pint = 34,65 cubic inches = $1^{1}/_{4}$ lbs
1 quart = 69,31 " = $2^{1}/_{2}$ "
1 gallon = $277^{1}/_{4}$ " = 10 "
1 bushel = $2{,}218^{1}/_{5}$ " = 80 "
1 cubic inch = — " = 0361 "
1 " foot = 1,728 " = 62,5 "
1 " " = 6,25 gallons
1 cylindrical foot = 4,893 "
1 cubic yard = 168,264 "
1 ton of water = 35,76 cubic feet = 224 Gallons
1 bushel of water would fill a box 12″ × 12″ × $15^{2}/_{5}$″
1 peck " " " 8″ × 8″ × $8^{2}/_{3}$″
1 gallon " " " 6″ × 6″ × $7^{3}/_{4}$″
1 quart " " " 4″ × 4″ × $4^{1}/_{3}$″
Water occupies the least space when at 4° C. or 39° F.

82. Conversion of Metres into Yards

1	metre	=	1,0936 Yards
2	"	=	2,187 "
3	"	=	3,281 "
4	"	=	4,374 "
5	"	=	5,468 "
6	"	=	6,562 "
7	"	=	7,655 "
8	"	=	8,749 "
9	"	=	9,843 "
10	"	=	10,936 "
20	"	=	21,873 "
30	"	=	32,809 "
40	"	=	43,745 "
50	"	=	54,682 "
60	"	=	65,618 "
70	"	=	76,554 "
80	"	=	87,491 "
90	"	=	98,427 "
100	"	=	109,363 "
200	"	=	218,727 "
300	"	=	328,090 "
400	"	=	437,453 "
500	"	=	546,816 "

83. Conversion of Yards into Metres

1	yard	=	0,91439 Metres
2	"	=	1,8288 "
3	"	=	2,7432 "
4	"	=	3,6576 "
5	"	=	4,5720 "
6	"	=	5,4864 "
7	"	=	6,4008 "
8	"	=	7,3152 "
9	"	=	8,2296 "
10	"	=	9,1440 "
20	"	=	18,2880 "
30	"	=	27,4320 "
40	"	=	36,5760 "
50	"	=	45,7200 "
60	"	=	54,8640 "
70	"	=	64,0080 "
80	"	=	73,1520 "
90	"	=	82,2960 "
100	"	=	91,4400 "
200	"	=	182,8800 "
300	"	=	274,3200 "
400	"	=	365,7600 "
500	"	=	457,2000 "

84. Decimal Measures.

Metre Denominations			Equivalents in the standard of Canada
	cubic metres	litres	Imp. gallons and decimal parts of same
kilolitre	1	1000	220,244
hectolitre	$^1/_{10}$	100	22,0244
decalitre	$^1/_{100}$	10	2,2024
litre	$^1/_{1000}$	1	0,2202
decilitre	$^1/_{10\,000}$	$^1/_{10}$	0,0220
centilitre	$^1/_{100\,000}$	$^1/_{100}$	0,0022

85. How to determine the capacity of a square dye-vessel.

What is the capacity of a square dye-vessel if it is for instance 8 × 3 × 3 feet?

Determine the cubic content and then multiply by 6,25 as a cubic foot of water contains 6,25 gallons.

1 gallon of water equals 10 lbs therefore 1 cubic foot of water equals $62^1/_2$ lbs or 1000 oz and 446,4 gallons equal 4464 lbs.

Dimensions of the dye-vessel.
8 feet long
3 „ wide
3 „ high
or 8 × 3 × 3 = 72 cubic feet × 6,25 gallons = 446,4 **gallons.**

Alphabetical Index.