

The art of bleaching piece-goods, cottons and threads, of every description, rendered more easy and general by means of the oxygenated muriatic acid; with the method of rendering painted or printed goods perfectly white or colourless. To which are added, the most certain methods of bleaching silk and wool; and the discoveries made by the author in the art of bleaching paper. Illustrated with nine large plates, in quarto, representing all the utensils and different manipulations of the bleaching process. An elementary work, composed for the use of manufacturers, bleachers, dyers, callico printers, and paper-makers / by Pajot des Charmes ... Translated from the French, with an appendix [by William Nicholson].

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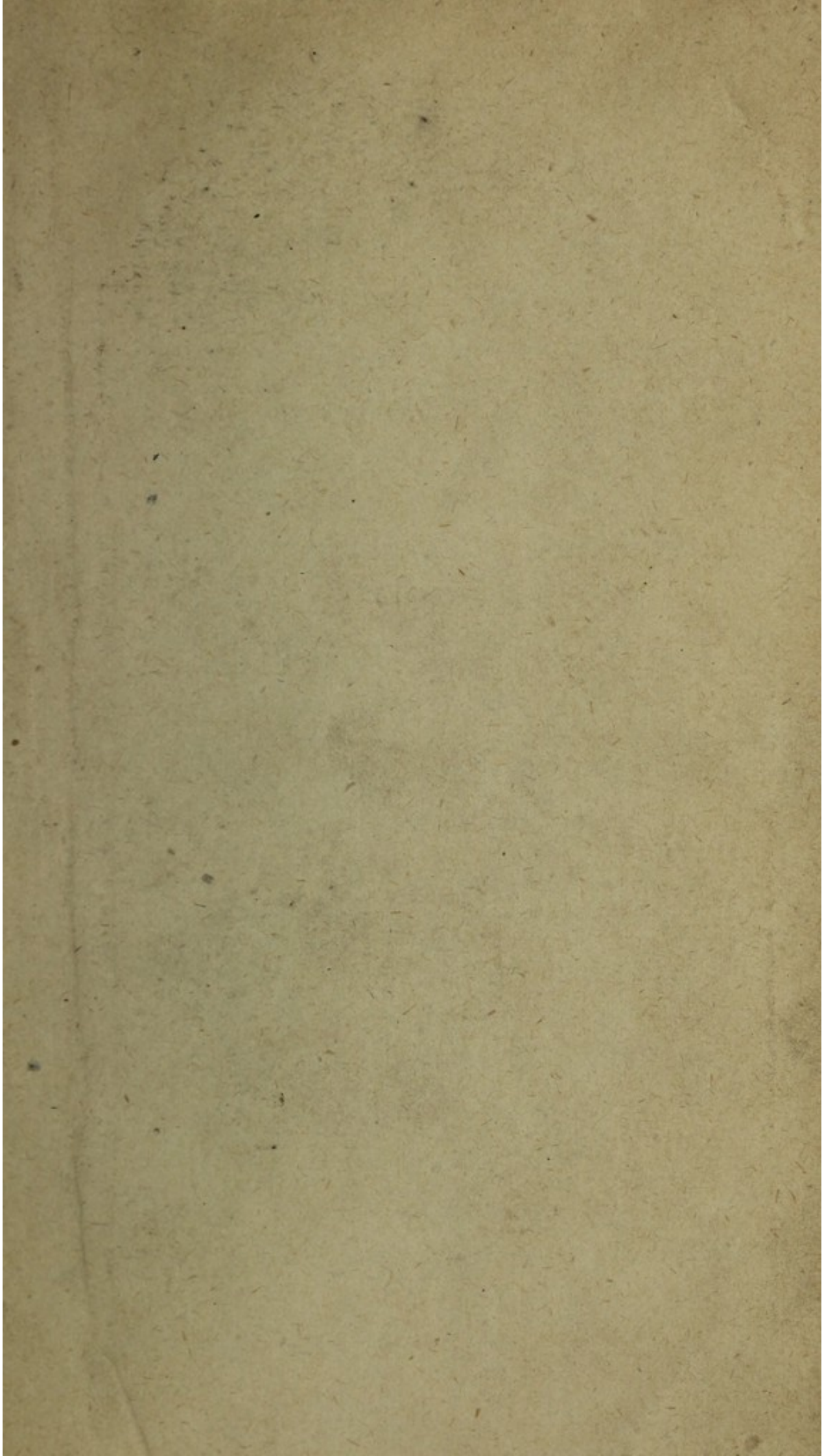
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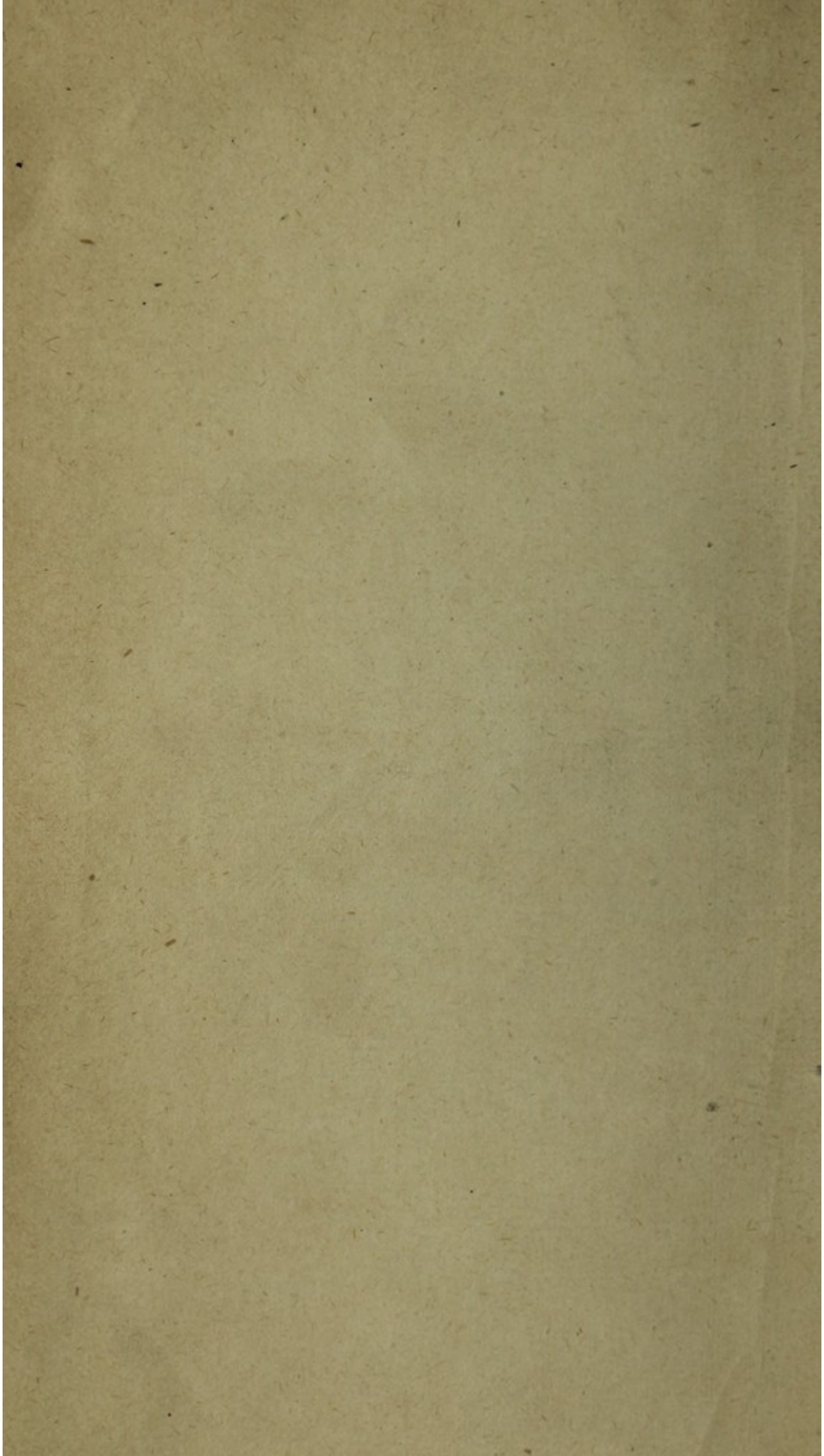


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THE
ART OF BLEACHING
PIECE-GOODS,
COTTONS, AND THREADS,
OF EVERY DESCRIPTION,

Rendered more easy and general by Means of the Oxygenated
Muriatic Acid ; with the Method of rendering painted or
printed Goods perfectly white or colourless. To which
are added, the most certain Methods of bleaching
Silk and Wool ; and the Discoveries made by
the Author in the Art of bleaching Paper.

ILLUSTRATED WITH NINE LARGE PLATES,
IN QUARTO,

REPRESENTING ALL THE UTENSILS AND DIFFERENT
MANIPULATIONS OF THE BLEACHING PROCESS.

AN ELEMENTARY WORK,
COMPOSED FOR THE USE OF MANUFACTURERS, BLEACHERS,
DYERS, CALICO PRINTERS, AND PAPER-MAKERS.

By PAJOT DES CHARMES,

FORMERLY INSPECTOR OF MANUFACTURES, MEMBER OF THE
LYCEUM OF ARTS, OF THE SOCIETY OF INVENTIONS AND
DISCOVERIES OF THE PHILOMATHIC SOCIETY, IN FRANCE.

TRANSLATED FROM THE FRENCH,
WITH AN APPENDIX.

LONDON:

PRINTED FOR G. G. AND J. ROBINSON, PATER-NOSTER-ROW.

ART OF BLEACHING

TEXTILES

COTTONS, AND THREADS,

OF EVERY DESCRIPTION.

Illustrated more than 100, and generally by Means of the Oxy-Muriatic Acid, with the Method of rendering plain or patterned Goods perfectly white or of a light Tint, which is effected, in both cases, without the loss of strength. Silk and Wool; and the various modes by which the Art is applied to Paper.

ILLUSTRATED WITH NINE LARGE PLATES

IN QUEST

REPRESENTING ALL THE DOMESTIC AND FOREIGN MANUFACTURES OF THE BLEACHING PROCESS.

AN ELEMENTARY WORK

COMPOSED FOR THE USE OF MANUFACTURERS, RETAILERS, AND GENTS, CALLING FOR THE ART OF BLEACHING.

BY PAJOT DES CHARMES,

FORMERLY INSPECTOR OF MANUFACTURES, MEMBER OF THE ACADEMY OF ARTS, OF THE SOCIETY OF INVENTORS, AND DISCOVERER OF THE SUBSTITUTION OF POTASH FOR SODA.

TRANSLATED FROM THE FRENCH

BY J. WELLOOME,



ADVERTISEMENT

BY THE TRANSLATOR.

PHILOSOPHICAL men, as well as manufacturers, will, no doubt, receive with satisfaction the following treatise on a new art of great importance to society, and truly honourable to philosophical chemistry. It is unnecessary to enlarge on the value of a process, which has been eagerly and universally adopted as soon as ever it was known, and its principal difficulties removed. Neither will it require any argument to shew the advantage which practical men must receive from a detailed and very faithful account of processes, conducted on a scale of sufficient magnitude for commercial purposes.

When we reflect on the state of those arts which are mentioned in the title page, and the numerous applications this new method is still capable of, as well as the utility of teaching it to all who are in any respect concerned in bleaching, it will scarcely be questioned, but that this elementary treatise must prove of great public benefit.

WILLIAM NICHOLSON.

Newman-street, June 13,
1799.

PRELIMINARY OBSERVATIONS,

BY THE AUTHOR.

THOUGH the illustrious Swedish chemist Scheele was the first who observed the property of the oxygenated muriatic acid, which was also a discovery of his own, of discharging vegetable colours, has acquired the strongest claim to the gratitude of the public, it is equally true, that the celebrated French chemist Berthollet has established an equal claim to the acknowledgments of the world, by his active and able exertions on an object of so much consequence to the commerce of the linen and cotton manufactures. The different memoirs which he has published on this subject, particularly that which is inserted in the second volume of the An-

nales de Chimie—the scientific application he has made of this acid to discolour the several vegetable substances which constitute the raw materials of manufactures—the particular developement, which the prosperity of those manufactures led him to consider as necessary to excite emulation among speculators, soon afforded very promising results, as might naturally be expected from the publication of so useful a process. Manufacturers in all parts of the nation were induced to consult chemical and philosophical men, in order to obtain information respecting it: the happy consequences which have rewarded their labours in this respect, are truly honourable to the zeal of the parties themselves, and have added to the reputation of their guide in this new department of research.

The knowledge which I had acquired respecting the inconvenience and delay of the
common

common process of bleaching—the incalculable advantages which I saw must attend the method proposed by Berthollet—the new life which the manufactures of thread and piece-goods, and the commercial transactions dependent thereon, would certainly receive:—these views, added to the desire of knowledge, and a wish to contribute to the propagation of a discovery which promised an increase of our riches and our enjoyments, engaged me to verify the process described in the *Annales de Chimie*. My intention was, in the first place, to make myself master of the process, and then to propose, with confidence, this new method of bleaching to the manufacturers, merchants, and bleachers, in my department of inspection, to whom this species of industry might prove advantageous, and to give them every information in my power. But I soon found that it would be in vain to describe and publish this method, which
would

would be in a short time forgotten or confined to a few individuals, if it were not rendered more economical, less dangerous, and more amply described with regard to the manipulations, or practical part, so as to be rendered easy and perfectly adapted to the comprehension even of workmen totally unacquainted with chemical operations. For I knew that masters have seldom the time, or will take the trouble, to operate themselves, but most commonly confide their work to men upon whom they can depend. I therefore took the utmost pains to render the discovery of bleaching with the oxygenated muriatic acid of general use. As I had the good fortune to be successful in my trials, I shall endeavour in the following work to describe the processes, by the assistance of which I succeeded.

I first give an account of the principal difficulties I experienced in operating, according to
the

the directions in the memoir before-mentioned; difficulties which the author himself would not have failed to remove, if he had himself operated in the large way. I then describe the methods which I have thought proper to substitute, instead of several of those which are there pointed out: and, lastly, I describe, with the greatest precision and minuteness, the different operations which are indispensably necessary to give linen, hempen, cotton and mixed goods, a perfect bleaching, equal in colour to the best which are met with in the market, and are known in France by the names of the white goods of Troyes, Rouen, Senlis, &c.

the directions in the manner before-mentioned; difficulties which the author himself would not have failed to remove, if he had himself operated in the same way. I then describe the methods which I have thought proper to substitute, instead of several of those which are there pointed out; and, lastly, I describe, with the greatest precision and minuteness, the different operations which are indispensably necessary to give linen, hempen, cotton and mixed goods, a perfect bleaching, equal in colour to the best which are met with in the market, and are known in France by the names of the white goods of Troyes, Rouen, Seville, &c.

CONTENTS.

CHAPTER I.

AN Explanation of the Difficulties which attend the Method of Bleaching, described in the second Volume of the Annales de Chimie, when practised by inexperienced Operators - - - page 1

CHAP. II.

The Methods substituted instead of those enumerated in the foregoing Chapter - - - 6

CHAP. III.

The Composition of Lutes - - - 12

CHAP. IV.

The Method of disposing the Apparatus for Distillation - - - 19

CHAP. V.

Preparation of the Materials - - - 43

CONTENTS.

CHAP. VI.

The Distillation	- - -	52
------------------	-------	----

CHAP. VII.

Concerning the alkaline Lixivium or Lees	-	74
--	---	----

CHAP. VIII.

Respecting the Preparation to be given to the various Kinds of Goods	- - -	95
---	-------	----

CHAP. IX.

Concerning the first Immersion	- -	111
--------------------------------	-----	-----

CHAP. X.

Instructions with Regard to the Quantity of Lixiviations and Immersions	- - -	126
--	-------	-----

CHAP. XI.

An Account of the Quantity of Linen, and Cotton Thread, bleached at each Immersion, and the Colours acquired by those Substances	- -	134
--	-----	-----

CHAP. XII.

Of the First Dressings	- -	140
------------------------	-----	-----

CHAP. XIII.

Of the Last Dressings	- -	154
-----------------------	-----	-----

CHAP. XIV.

Concerning Proof Liquors	- -	170
--------------------------	-----	-----

CHAP. XV.

The Methods of remedying such Accidents as happen during the Course of Bleaching	- -	178
---	-----	-----

CHAP. XVI.

- The Method of taking out Spots of Rust or Iron-mould,
Tar, Fruit, Wine, &c. - - - 189

CHAP. XVII.

- The Expence of Bleaching different Kinds of Goods, of
Linen, Hemp, or Cotton, by the oxygenated muriatic
Acid, at per Ell, or per Pound - - 193

CHAP. XVIII.

- The Method of bleaching yellow Wax, nankeen Stock-
ings, and other Articles which have acquired a dark
Colour by keeping; Linen stained by Dampness, and
the Madder Grounds of printed Goods - 207

CHAP. XIX.

- The Method of discharging the Colour of painted or
printed Cottons, or Linens, and every Kind of Dye on
Cloth or Thread, before or after it is wrought up 218

CHAP. XX.

- The Methods of taking out the Dye from Silk and Wool
- - - - - 228

CHAP. XXI.

- Dying by the oxygenated muriatic Acid - 232

CHAP. XXII.

- Various Properties of the oxygenated muriatic Acid 236

CHAP. XXIII.

- On the Possibility of applying the Residues to Profit 250

CHAP. XXIV.

- The Method of bleaching Hemp and Flax in the unma-

nufactured State, as well as Thread and Piece-goods,
by the Assistance of Water only - 261

CHAP. XXV.

The Method of Bleaching written or printed Papers and
Rags, whether unbleached, dyed, or coloured - 266

CHAP. XXVI.

- - - - - 271

CHAP. XXVII.

Fabrication of crude Alkali (cendres Gravelées) with the
Lees of Wine - 276

CHAP. XXVIII.

The Method of bleaching Wool - 280

CHAP. XXIX.

The bleaching of Silk - 291

Explanation of the Plates - 296

Appendix - 345

THE ART
OF
BLEACHING COTTONS, THREAD, &c.
BY
THE OXYGENATED MURIATIC ACID,
RENDERED OF MORE EASY AND GENERAL USE *.

CHAP. I.

An Explanation of the Difficulties which attend the Method of Bleaching, described in the second Volume of the Annales de Chimie, when practised by inexperienced Operators.

ONE of the first difficulties, in the operation illustrated by the plate annexed to the memoir in the Annals of Chemistry, is to obtain in the depart-

* It was intended that this work should have been published, in 1791, by the General Administration of Commerce (in France); but the suppression of that board, in the course of the same year, prevented its appearance. Since that time, other circumstances have been unfavourable to the author's intention of publishing the results of his experiments on the new method of Bleaching.—*Note of the Author.*

departments such furnaces as are there prescribed to be used. They can scarcely be had but by sending to Paris, where they are made: and if it be even supposed that these furnaces might conveniently be made at a distance from the capital, they would still appear to be costly, suitable only to a single matrafs, not calculated to shew the process which takes place in the vessel, subject to be heated too speedily, and liable to render part of the lutes difficult to hold; lastly, they do not always secure the operation from the consequences of an absorption of the water of the tub into the intermediate vessel (notwithstanding the tube of safety), in such cases where the heat is not kept up and urged particularly towards the end of the distillation, or where any negligence has taken place in the agitation which is required for the speedy absorption of the gas, or where the tubes of communication are too small.

2. The greatest address and precaution are required for the proper application of the recurved tube, which on the one hand communi-

A short table of synonyms is added at the end of this work, for the use of those who may be unacquainted with the new nomenclature.—*P. D. C.*

The method of Bleaching, to which the present chapter bears reference, is described in my Chemical Dictionary, art. Bleaching.—*Note of the Translator.*

cates with the matrafs, and on the other with the intermediate vefsel. The flightest agitation, whether in attending the lutes, fupplying the furnace with coal, &c. is fufficient to break this tube, and likewise that which communicates to the tub. The difagreeable confequences of fuch an accident, when the apparatus is in a ftate of activity, and the difengagement of the gas muft continue to take place, are too obvious to need defcription. The fame accident may happen whenever the tube is put in its place, or taken out to clear the matrafs. To this we may add, the difengagement and frequent renewal of fo many ftoppers of cork, which are corroded by the gas and the acid during their paffage, and the adjustment of the lutes required to cover and defend them. The care and vigilance required to maintain the feveral lutes of the whole communication muft be extreme.

3. The pneumatic tub or vefsel having no cover, muft fuffer a large quantity of gas to efcape during the courfe, and particularly towards the end of the operation, which is not only attended with lofs, but renders it impoffible to remain for any length of time in the place of diftillation, without being greatly and even infufferably incommoded.

4. It is not a flight task to conftitute the fides

or borders of the inverted vessels in the pneumatic tub, to retain and concentrate the gas in a proper manner. The memoir affords no explanation of the manner of constructing or adjusting these parts, and, consequently, leaves a degree of uncertainty, which exposes such operators as may not be aware of the great importance of the perfect closure of these parts, to the probability of making very considerable mistakes.

5. The long succession of lixiviations and immersions prescribed in this memoir, which are indispensable according to that process, is productive of much loss of time and inconvenience.

6. The method of composing the lutes, particularly those which are proper for this distillation, not being explained, any one who is not acquainted with the means of doing this, or cannot conveniently procure them, will be much embarrassed, more particularly if his residence be in the country, where the practical chemists of the vicinity, if any, may either be unprovided in this respect, or not disposed to supply either the lute, or the instructions for making it.

7. Lastly, I have found, by my own experience, that, independent of the difficulties here enumerated, the single obstacle of keeping the lutes in a proper state during the whole course of the distillation,

distillation, together with the no less essential requisite of preventing the danger of immersions, are quite sufficient to repel the efforts of the most zealous and obstinate in this kind of operation.

Such are the leading impediments to which every one, whether he be a practical chemist or not, will find himself exposed in an attempt to follow in the large way the process of bleaching described in the second volume of the *Annales de Chimie*. It was, therefore, of essential consequence to diminish, or rather to remove these difficulties, without which this important art might be considered as of no value to the public. It will be seen in the account of the methods I have employed, whether I have succeeded in rendering the application and practice of this new process much more advantageous and practicable, by persons the least acquainted with chemical manipulations.

CHAP. II.

The Methods substituted instead of those enumerated in the foregoing Chapter.

I SHALL, in the first place, describe the furnace I have made use of, which I have endeavoured to render of the greatest possible utility, without increasing the expence of fuel.

A simple cask of the proper height, or four pieces of wood framed together (see plate I, fig. 1 and 2 *), support the furnace. The hearth is disposed upon boards defended by tiles placed on a bed of clay. The walls or sides are formed of bricks, likewise connected with clay. This furnace would be equally useful and solid, and perhaps lighter, if it were lined with plaister, like those portable furnaces commonly used in Paris, which it considerably resembles in its manner of support. It is usually double, and ought in fact to be so, when the operations are intended to be made on a scale of some extent; and consequently it is divided in the middle by a partition. At the front of the furnace above

* The descriptions of the plates, by literal reference, are found at the end of this work.—N.

there are two openings, which may be either round or square, adapted each to receive a square or cylindric capfule, with a ledge, and flat or rounded at bottom. Behind, and on the same level as the capfule, there is a vent or pipe which conveys the heat and vapour of the charcoal, which is burned in a chafing-dish, or upon a portable grate, beneath, or round the capfules, into a kind of reservoir, which being disposed a few inches higher than the capfules, serves to place a long square bafon of sheet-iron with projecting edges, which is kept filled with sea salt or muriate of foda to the height of an inch and a half, in order that it may be dried during the distillation. At the two opposite extremities are two small apertures, which are opened or closed as may be found expedient for the passage of the heat or smoke, and therefore operate like registers. In the empty space, at the back part of the furnace, beneath the drying place, there is an opening in the fide, into which troughs or boxes of sheet-iron are put, containing the mixtures of muriate of foda, and manganefe, ready prepared before hand. In this place they are kept dry, and in readinefs to be poured into the veffels, the evening before the distillation.

The opening through which the chafing-dish is introduced, which is likewise on the fide of

the furnace, is not quite so much raised as the bottoms of the capsules, which, though supported by their rims on a level with the top of the furnace, have nevertheless their bottoms placed on a small bar (*verguillon*). This opening may be shut during the distillation by a plate of iron, or any register whatever which does not permit the access of air from without, except at its lower part. The furnace, it may be perceived, is portable, and on that account can be placed in any part of the laboratory, as convenience or new arrangements may require.

If, in order to answer any particular purpose, or without attending to expence, the preference should be given to furnaces of baked earth, I would then advise the use of such as have their chimnies on the side, without a dome. Many furnaces of this kind have lately been constructed at Paris, by Laffineur, rue Mazarine. Their upper part, which is flat, and on a level with the chimney, allows the placing of capsules; and the chimney, which is at the front, renders it easy to take out the wood or charcoal which is put into a fire-place, provided with its ash-hole in the same manner as the other furnaces which have a dome. This furnace is round, portable, less costly, and appears to me to be, in other respects, much more convenient than that described

described in the *Annals*: besides which, they may be made of any required size.

2. Instead of the matrafs, the intermediate vessel, and the tubes which communicate from this last vessel to the distilling and the pneumatic apparatus, I have substituted a tubulated retort, to which I have adapted a recurved neck of glass or lead, the beak of which is placed and luted to a small leaden support in the form of a funnel; and this last piece is adjusted to the end of a tube, of the same metal, within the pneumatic tub, whose lower extremity is bended to a right angle, and performs the office of the glass tube in the apparatus of Berthollet. This tube, as well as the additional neck of the retort, may likewise be made either of pottery, stone ware, or, which is still better, of porcelain.

Instead of the retort, and its neck of glass or lead, I have used, with no less but even with more advantage, a body or bottle tubulated at the shoulder. Above the neck of this body or vessel is applied a pipe, which at the same time forms the communication and the interior tube. I shall hereafter shew the method of disposing this apparatus.

3. The pneumatic vessel, to which I adjust a cover, is divided into three parts by two false bottoms, fixed in the vessel itself by means of
its

its conical figure, or upon a hoop, or masses of wood, fixed with pins. I shall also, in the proper place, give an account of the manner of fixing and disposing these false bottoms, as well as of other kinds of vessels, not without their peculiar conveniences.

4. I have considerably diminished the lixiviations and immersions. In the chapter which treats of these subjects, it will be seen in what manner I have proceeded in simplifying these important operations.

5. I shall also describe the method of composing two lutes, which I have found very useful; one made with the cake of linseed, and the other known in chemistry by the name of fat lute. The latter, though more expensive and difficult to make, appears to me to deserve the preference.

6. By suppressing the intermediate vessel, and by the substitution of a retort or tubulated bottle instead of the matrafs, together with the recurved neck or tubes of lead instead of the tubes of glass; when once the connecting part is well luted, in the manner hereafter to be described, no further trouble or inconvenience follows from the lutes, because there is but one to take care of, namely, that of the beak of the neck placed on the tube which passes into the pneumatic vessel.

vessel. This lute being renewed, if thought fit, at each distillation, and a little attention being paid to apply it well, is never found to fail. The operator is, therefore, at liberty to employ his time in the lixiviations and immersions. It will hereafter be seen in what manner I have succeeded in removing the danger of these immersions.

In this early stage of our description, it is easy to perceive how much less troublesome our apparatus must prove, than that to which we have referred in the first chapter. Nevertheless, as it is of consequence that the inhabitants of the country, to whom my attention has been principally directed in this work, should be in no respect exposed to failure in the smallest particular, I shall proceed to give the most minute accounts of the uses and arrangement of the apparatus; and, in the first place, I shall treat of the lutes.

CHAP. III.

The Composition of Lutes.

FAT LUTE.

THE observations I shall offer on this particular lute are partly extracted from Baumé's Chemistry. I have thought it proper to add some useful observations for the sake of beginners. Take any quantity of good grey or blue clay: I have always found fullers-earth (*argile à foulon*) excellent for the purpose. The clays of Gentilly and of Vanvres, near Paris, are likewise very good. The clay is to be dried in thin cakes, which may be speedily done in an oven after the bread is drawn; the dried clay is to be pounded finely, and sifted; a certain quantity of this clay, together with a sufficient dose of boiled linseed oil, must then be beaten in an iron or bell-metal mortar for a long time, until the smallest lumps have disappeared, and the whole mass shall form a paste, of an uniform colour, rather solid and tenacious, but, nevertheless, not adhering to the hands: this is called fat lute.

A large quantity of this lute may be prepared beforehand, more especially when the operations
are

are to be performed in the large way, and almost continually. That which has been made for a twelvemonth is more pliant and better, but it must be kept in a cellar, in a covered earthen pot. When it has become too dry to be handled, it may be easily softened, by first warming it, and afterwards beating it in the iron mortar, with as much of the boiled linseed oil as may be found necessary.

The lute, which has served for one distillation, may be used again, after the burned or decomposed parts have been separated: these parts may be known by the white or yellowish colour, and the dry or brittle consistence which the lute assumes at those places. Lute which is worked up again is so far from being worse, that it is more flexible and tenacious. In this manner, the old fat lute, or that which has already been used, may be advantageously mixed with new lute. It is particularly essential that the burned portions should be rejected from this mixture; if this be not done, the lute will not dry as it ought, and, so far from being soft and flexible, it will be harsh, short, and continually disposed to give way, by sticking to the fingers.

When the quantity to be mixed, or kneaded up again, is very small, the trouble of beating it in the mortar may be avoided, because the operation

ration is performed very well, by kneading the matter with the hands. For this purpose, a portion of the lute already kneaded in the mortar, and soaked with oil, may be taken and rolled in the vessel containing the pounded and sifted earth ; the portion of earth which adheres may then be worked in ; and, by a repetition of this manipulation, the mass will speedily become enlarged, and must be strongly compressed, rolled out, and doubled again, until it is found that it possesses the requisite softness and tenacity, and does not crack when doubled.

If it should happen that the lute should become too soft by excess of oil, and clay is not at hand to correct this fault, the mass will soon acquire firmness by exposing it to the open air upon parchment, or upon a plate. It must not be laid upon paper, because it is very difficult to separate this material entirely ; and if any particles should remain, there would be reason to fear that, when incorporated in the mixture, they would either prevent the perfect adhesion of the lute, or would allow the passage through that kind of void, or pore, which the fragments of paper would form. It is, moreover, to be remarked, that this lute cannot be too smooth and uniform. It ought not to afford any perception of inequality when it is handled, or kneaded,

kneaded, nor indicate the presence of foreign substances, such as sand, straw, earthy particles, &c. which are capable of preventing the intimate connection of its parts.

I strongly insist on the perfection of this lute, because it is the soul of distillation.

Boiled linseed oil is thus made: two pounds of common linseed oil being put into a saucepan, or proper vessel, of copper, iron, or pottery, add three ounces of red litharge, finely powdered and sifted; after stirring the whole well together, place the vessel on the fire, heating it gradually, until the litharge is completely dissolved. It is necessary to stir the mixture very frequently with a wooden spatula, until the whole solution, which at first acquires a brick-dust colour, is completed: it is then to be removed from the fire, and, when cold, transferred into a stone or earthen vessel, and kept well corked. This is the boiled linseed oil above directed to be used in making the fat lute.

When this oil, which is blackish after boiling, is well made, it congeals in the vessel as soon as it is cold. When it is required to be poured out, it may be rendered fluid by bringing it near the fire. To save the trouble of heating it, it may be poured, as soon as made, into a plate or shallow vessel, or left in the vessel used for boiling

ing

ing it. It is seldom necessary to heat it for the mere purpose of mixture; the quantities required for this purpose may be taken up with the fingers, or in any other manner.

It is proper to observe, that the vessel in which the oil is boiled must be sufficiently high, to afford a space for the swelling of the fluid; for, as soon as the heat begins to act, it will rise and overflow the vessel, if particular attention be not paid to it. As soon as this process begins, the vessel must instantly be taken off the fire, and the mixture strongly agitated by plunging the spatula in it, at the same time blowing strongly at its surface with the mouth; by which means the ebullition will be checked. After this event has happened two or three times, it may with certainty be concluded, that the oil will be sufficiently consistent to form a good fat lute. By cooling, it immediately congeals, as has been remarked, to the consistence of plaister, of a black colour, inclining to brown.

The lute made of linseed oil cake is thus made:

The cake is first to be broken and pounded in an iron or bell-metal mortar, and afterwards sifted through a filken sieve; starch is then to be boiled up, to the consistence of size or glue; a small piece of this, being powdered with the
flour

flour of the oil-cake, is to be worked in a plate, or with the hands ; more of the flour may then be added, and the kneading continued until the mass is absolutely without any lump, or inequality, and its consistence has become nearly the same as that of the fat lute ; after which it is to be kept in a plate, or covered wooden bowl, in the cellar, for use. The same care must be taken with this, as with the fat lute, not to wrap it in paper, but in parchment, if thought necessary.

This lute dries and hardens much on its outer surface, which remains uninjured at the place where it is applied ; but it is decomposed more speedily than the fat lute, on account of its peculiar property to become hard and shrink with a strong heat. In this state, in consequence of the action of acids, it assumes a yellow colour, and is then good for nothing : it must be renewed.

A very good lute is likewise made with equal parts of the flour of almonds, of linseed, and of starch, kneaded together. It must be understood, that the latter is to be boiled to the consistence of starch.

To these different lutes we may add that which is composed of lime and white of egg,
c which

which has the property of acquiring a considerable degree of hardness.

Among all these lutes, that to which I have constantly given the preference, and is always kept in sight in the present work, is the fat lute. The lute of white of egg and lime, retained by a cloth and a bandage, may be advantageously used as a covering to the fat lute*.

The fat lutes adhere very much to the hands, during the kneading, or working; but it is not difficult to wash off the remains after the operation: nothing more is necessary, than to use warm water and soap, or soap leys, after having previously wiped off the greater part with blotting paper.

* Faujas de St. Fond, in his *Voyage en Ecosse*, mentions the following lute, communicated to him by the celebrated Dr. Black, of Edinburgh. That chemist considered it as impermeable to every species of gas.

This lute is composed simply of the paste of almonds, in the state it possesses after extraction of the oil; it is softened with a small quantity of water, in which glue has been dissolved: the glue may even be dispensed with.—*Note of the Author.*

CHAP. IV.

The Method of disposing the Apparatus for Distillation.

IT has already been remarked, that our distillation may be performed either in a retort, or a tubulated body or bottle. There can be no difficulty in properly placing these vessels. The junction of the neck or tube, communicating with the pneumatic vessel, is the only object which requires particular care. The manner of joining these two parts, by means of lute alone, will be explained below.

As the use of the retort requires more attention with regard to its form, and the application of the additional part, the following details will be of use to prevent accidents.

When the retorts are new, and have not before been luted to any additional part, it is advisable either to rub a small quantity of warmed wax on the parts where the lute is to be applied, that is to say, the neck of the retort, as well as the correspondent part of the additional piece, or to suffer a small quantity of starch or paste to dry upon those parts ; without

this precaution the lute could not be easily applied ; it would slide and roll upon the glass instead of adhering.

Care must afterwards be taken to fix round the neck of the retort a mass of lute, somewhat greater than is supposed to be necessary to fill the additional part to the place where it is to be fixed, in order that by the forcing of that piece upon the neck of the retort, the lute may extend and apply itself more intimately. The same attention must also be paid to the mass of lute, which is required to secure the beak of the additional piece in its connection with the pneumatic apparatus. These observations are of more importance, in order that the two pieces may, by this compression, be made to operate as if they formed one entire vessel.

To apply these lutes with ease and convenience, the retort is to be held in one hand, in such a manner as that its belly or lower part may not touch or rest upon any thing whatever, because the slightest blow upon this very thin part will break it.

Before the lutes are applied, care must be taken to introduce the neck of the retort into the additional piece, and mark with lute or wax upon the additional piece the place where the extremity of the retort touches it internally;
and

and in like manner, on the retort itself, the place where the extremity of the additional piece touches its neck. By means of these marks it is easy to estimate the thickness of the masses of lute, by placing the two vessels near each other in the respective positions they ought to have when fixed. Lastly, they are united together by sliding the recurved additional piece upon the neck of the retort, which is to be held firmly by its neck, resting the hand on the surrounding part, if the retort is small; or holding it by the recurved part, if it be large, or the additional piece should be too long and heavy. The greatest attention must be paid not to turn the parts round, during this operation, more than is absolutely necessary to bring them together; and if this can be done without any turning at all, it will be still better, as the lute will hold more effectually. The neck of the retort must be entered into the additional piece as far as it is capable of compressing the lute, or nearly to the marks made upon the pieces before they were put together. In this situation the lute, which forms a mass round the edge of the additional piece, must be raised so as to cover both surfaces, after having first pressed it as firmly as possible into the joint; smoothing it upon the two pieces, so as to prevent the smallest

opening or crack. It is advisable after all to spread a thin coating of the boiled linseed oil over the lute, which not only renders it smoother and more perfect, but by the density it acquires from evaporation it forms a kind of varnish or pellicle, which supports the lute, and prevents the fissures which might be formed during the actual operation. Whenever in the course of the work the lute should appear too dry, it must be supplied with a thin coating of oil.

While the lute is thus spread and applied on the external part of the additional piece and the neck of the retort, the compound apparatus is to be held by the additional piece only, and the retort left to be supported untouched in the air, by its insertion at the neck only.

Instead of luting the additional piece to the retort, simply at the extremity of the neck of this last, and at the place where the wider part of that piece touches the retort, we might apply the lute upon the whole surface comprehended between those parts. But I have found that it is sufficient if these two parts be made secure. A retort luted in this manner forms one single and entire body with its additional neck; and with very little care and attention, the lute will seldom or ever have occasion to be renewed before one or two months' service.

The

The tube on which the recurved additional piece rests during the distillation, and through which the gas is introduced into the pneumatic tube, is, as I have remarked, entirely of lead. If it be not cast, it ought to be carefully joined with strong solder; and, for fear this last should fail, it will be prudent to cover it with a coating of yellow wax, pitch, or melted pitch.

At the beginning of my experiments, I made these tubes of the same size as those of the barometer; I afterwards had them of eight or nine lines ($\frac{3}{4}$ inch English), and did not find that the distillation was less advantageous. The greater diameter even seemed to be preferable, because the gas was transmitted with more facility, and the absorption seemed to be more effectually opposed.

That part of the tube (if soldered as before mentioned) which passes under the lower false bottom, ought to be carefully bended with a round corner, before it is coated with the wax or pitch; and in the bending it is safer to cause the soldered part to lie within the angle. It is likewise proper to stop the mouth of the tube with paper, or a cork, during the time of waxing or tarring, in order to prevent any introduction of those substances into its cavity, taking care to withdraw this temporary stopper before

the apparatus is applied to actual use. It is not absolutely necessary to coat any other part of the tube, but that which is to be placed within the pneumatic apparatus, because it is easy to stop any other part, out of which the gas might issue, with soft wax or lute.

The extremity of this tube, in which the recurved neck of the additional piece is to be inserted, must have the form of a small funnel, not only for the purpose of affording the most convenient support, and the more ready adaption to the various sizes of those necks, but also because it more readily supports the only kind of lute which in this work we suppose to be used. This lute is never deranged, if care be taken to press it against the internal surfaces of this small funnel, and of the glass or lead of the additional piece, so as to unite them as much as possible, it being always understood that the lute is good, and possesses the properties before described in treating of that substance.

I have remarked that the use of the retort with its additional neck might be dispensed with, by simply using a body or bottle with a neck (even a wine bottle may be used in case of necessity, provided its bottom be either very thin, or very gradually heated). In the orifice of the neck of these vessels, is to be adapted a tube of lead,

lead, properly bended, and of a due size. This method is in fact very advantageous and economical; but care must be taken to join the tube, if it be of sheet-lead, particularly in the parts below the bottle which are liable to become heated, a short time before the end of the distillation; to join it, I say, without folder, by fusing the two edges together. For in process of time the folder, though ever so strong, yet because it contains tin, is liable to excessive corrosion by the oxygenated muriatic acid, which, notwithstanding its heat, is not found to attack lead in any perceptible degree.

But it may, perhaps, be more convenient to cast such a tube at one heat, as well as the additional piece in the apparatus, with the retort; unless, indeed, it should be practicable to have it made of stoneware or porcelain, the latter of which is the least permeable to the gas. Or we might, with more advantage, make use of a thick tube of common glass, which might be easily bended in a charcoal fire, and might be adapted to the tubulated bottle, as well as the leaden tube. But the danger of its breaking, and the difficulty of procuring others in case of need, together with the expence, have led me to reject this, as well as the tubes of pottery or porcelain.

In order that the tube adapted to the neck
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of the bottle may accurately fit, and prevent all escape of the oxygenated muriatic acid, it is defended by lute in such a manner, that it shall not be thrust into the neck of the bottle, without extruding a portion of that substance; and a border of luting must then be applied round the place of junction, which will effectually prevent the escape of any vapour which might issue through the first luting. Lastly, the whole surface of this external luting is to be smeared with boiled linseed oil; after which the distillatory apparatus may be considered as perfectly secure.

If a tube of glass be used, it may be so adapted by grinding with emery as to fit the neck of the glass body, and require no luting. The same might be done with a tube of porcelain, if the material were sufficiently fine.

With regard to the other neck which I have recommended, as well in the bottle as in the retort, it serves not only to introduce the materials when the leaden tube is previously luted in, but likewise to admit the external air, if by chance an absorption should be perceived to take place; that is to say, if the water, by a diminution of the heat, which leaves a kind of vacuum, should rise from the pneumatic apparatus into the body: though even in this case
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there would be no reason to fear its breaking, notwithstanding its being considerably heated, as at the end of the operation. I have expressly made the trial several times, and always without any accident. The fluid becomes gradually heated in its passage along the sides of the tube or neck of the distilling apparatus, before it enters and mixes with the matter in the body itself; and again, if the tubulated bottle and tube be made use of, the water rising through the latter and falling in the middle of that contained in the vessel, cannot directly touch the sides before it becomes mixed. But, at all events, if the smallest absorption be feared, it will be sufficient to raise the stopper and return it to its place the instant after the introduction of the atmospheric air. Instead of a glass stopper, a cork may be used, which must be carefully luted round the neck, if there be any reason to think that the vapour should find its way through, in consequence of the neck being not perfectly round.

With regard to the pneumatic vessel, the following is the method of placing and fixing the false bottoms. (See plate I. and II. and plate IX. figs. 1, 2, 3, 4, 5, and 6.)

A common wooden hoop is plained flat on the side which is to bear the false bottom, and
fixed

fixed within the cask with pegs which do not pass quite through the staves. The false bottom, secured together by two dove-tails, is placed upon this hoop, and fixed there by similar pegs, which penetrate part of the bottom itself, and by that means prevent it from either rising or turning. The cavities between the false bottom and the sides are then to be closed round with caulker's stuff (*brai sec*), or melted pitch. It must be remembered, that the vertical axis with its cross arms is to be placed beneath each false bottom. The arms are fixed in a mortice by means of two pins, which prevent them from vibrating or getting loose. The leaden pipe in which the extremity of the additional neck is to be inserted, is not to be put into its place till the first false bottom is immovably fixed. A notch is supposed to have been cut in this bottom to admit the tube; and when it is duly placed, the vacant space is to be made good, first with tow and then with melted pitch.

Instead of the wooden hoop, which affords a solid support for the false bottom, it may answer the purpose very well, if cleats or blocks of wood, three inches thick, be pinned on, at different parts of the circumference; or, which is still better, if the trouble be taken to fit the
false

false bottom so well, that it may bear simply upon the inclination of the staves, which naturally oppose its descent. This method would certainly be the quickest, and is not very difficult to be done.

When the false bottom is thus fixed, it must be retained in its place by pins placed at certain distances, and afterwards made tight by caulking.

In order that the tube may not be exposed to vary in its position, a mark must be made on the edge of the funnel which terminates one of its extremities, by which it is easy to ascertain the position of the bended part below, and place the same in the most favourable situation. It will be convenient to fix the pipe in this proper situation, by means of two pegs, which must be drawn out previous to the last fixing of the false bottoms.

When the first or lowest false bottom is secured in its place, the second arm of the agitator is to be fastened to the axis, and the other false bottom is to be placed and made fast in the same manner as the first.

It is particularly necessary to place these two partitions in such a manner, as that the holes of communication may not be in the same vertical line, but as far as possible from each other, that
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is to say, diametrically opposite. This disposition is necessary in order that the gas may have time to concentrate in one part, before it escapes to the other. For the same reason, it is proper to direct the lower opening of the leaden tube to that extremity of the diameter which is opposite the pipe of communication from the first to the second bottom, in case one distilling vessel only is used. If two or more communicate with each pneumatic apparatus, the openings of the tubes must be respectively disposed at equal distances, as far as possible from each other, and from the opening in the false bottom next above them.

If instead of false bottoms the preference should be given to inverted tubs (*cuvettes*), the following method may be used to make the rims or sides, and to fix them immoveably. (See plate LX. fig. 1, 2, 3, 4, 5, and 6.)

The rim may be made in two ways; either by short staves, fixed with wooden hoops as usual, scarfed or hooked together at their two extremities, or else, by simply fixing a broad wooden rim, like that of a sieve, round the bottom of this inverted vessel, by means of small wooden pins with heads.

Both these methods are good. The second has the advantage of taking less room and being cheaper.

cheaper. If this method be used, the points of the pins must be made a little thicker than the stem, in order that they may be less disposed to draw out of the holes bored in the bottom. With regard to the joining of the two ends of this kind of broad hoop, it may be effected very firmly by sewing them together with a flat strip of osier, as is done in the better sort of chip boxes, or it may be very well managed by means of two pins with heads, which may be driven through the overlapping part, and secured at the other side by driving a small wedge into the tail of each pin. With regard to the empty spaces or openings which may be between the rim and its bottom, they must be stopped with glaziers' putty (*mastic du vitrier*), which may be smoothed with oil. This putty is of excellent service when the muriatic acid is used without potash; but it is soon destroyed if potash be put into the pneumatic vessel. In this case the internal part of the places of junction must be pitched or caulked, as has been already shewn.

The method of making these inverted vessels with staves and hoops, has the advantage of being close, and not requiring any particular caulking.

Lastly, instead of these inverted vessels, the operation

operation may be performed merely by flat boards without rims, provided, however, that the upper board be some inches broader on every side than the lower, in order that the bubbles of gas may be forced in their ascent to strike each board in succession, and remain for a short time in contact with it. The essential circumstance in this arrangement will be to keep the upper part of the vessel well closed, which is to be defended at the hole which admits the axis of the agitator by a central tube to retain the gas ; and the partial escape which might take place between that axis and the covering, must be more effectually prevented by a cloth soaked in alkaline lees. This method, besides its convenience, requires less care in fixing, but it renders it necessary to work the agitator more frequently, in order to hasten the absorption of the gas in the water. I have determined to relate all the methods which I have successfully practised, in order that those who may undertake any work of this nature, may determine for themselves, not only with regard to general motives of preference, but likewise the facility with which their own situation or circumstances may enable them to carry the same into execution.

The next object is to fix these inverted vessels
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in the pneumatic apparatus. This is a very simple operation, and consists merely in fixing pieces of wood or brackets, three inches in length, under each of the two bars which connect the pieces of the bottoms of the inverted vessels together. The bracket pieces are fastened to the side of the vessel with oak pegs, and the cross-bars which rest upon them are secured by pins of the same material driven above them and on each side, in such a manner that the central perforation is in its true place, and the whole is incapable of being removed or disturbed.

In this operation, as I have already recommended with regard to the false bottoms, it is advisable to place the revolving axis in its proper situation, in order to ascertain that it is not likely to be impeded in its action. It is best, indeed, to avoid fixing either the two inverted vessels or the two false bottoms, if these be used, until the clear movement of the agitator has been ascertained; without which precaution, there might probably be occasion to displace them, either in whole, or in part, to remove the impediments which might prevent the free motion of the parts.

From the description I have here given, it may be seen that my pneumatic vessels have

only two false bottoms or inverted vessels. I think it advisable not to use more, because I have remarked that three of these vessels requiring a greater depth, the distillation became much more laborious, particularly when I made use of the intermediate apparatus. 1. The lutes did not so well resist the pressure of the vapour. 2. It was not disengaged with the same speed, and consequently the operation was more tedious. It is better, therefore, to use shallower vessels, and enlarge their dimensions in the diametral direction, as I have constantly found. The proportions which have appeared to me to be advantageous for a small common workshop, are $1\frac{1}{2}$ foot in height, 32 inches in diameter below, and 36 inches diameter above, all inside measure.

With regard to the kind of wood for constructing the vessels, it has appeared to me to be almost a matter of indifference. I used fir, oak, and chestnut, without observing that either the one or the other were productive of any inconvenience to the quality or clearness of the liquor, unless that, at the first or second distillation, the degree of force was a little altered, by soaking into the wood. That kind of wood may, therefore, be used which can the most readily be procured. I must, however, observe, that the large
casks

casks in which oil is brought from Languedoc, which are mostly made of chestnut-tree, are very convenient when cut in two to form the pneumatic vessels. They have even an advantage over the oak and fir casks, because they are closer in the joints, better hooped with iron and wooden hoops, and impregnated with the oil, in consequence of which they are not subject to become dry, how long soever they may be out of use, provided they are kept in a close place; whereas the tubs of fir wood require to be almost constantly filled with water. Oak does not contract so soon as fir.

It must also be observed that the white deal must not be used, because it transmits water like a sponge. The yellow deal is to be preferred, because it undergoes less alteration from the fluid, no doubt on account of the resin it contains. But if the use of the white deal, or any other spongy wood cannot be avoided, it will be proper to paint the vessel within and without with one or two good coatings of white lead. I have had the great satisfaction to observe, that this treatment not only prevents the water from passing through, but likewise that the oxygenated muriatic acid does not attack this colour, or if it does attack it, a long course of time must be required for that purpose.

Melted pitch or tar likewise afford a good defence for such wooden materials as have this defect. A mixture of yellow wax and resin is likewise of excellent service as a coating for the whole internal surface of the pneumatic vessel, including the inverted vessels and the agitator.

Besides the false bottoms, or inverted vessels we have described, each apparatus must likewise have its cover chamfered, to fit the circumference, with apertures to admit the tubes and the central axis; together with two others, namely, one of considerable size, to receive a funnel through which water is poured as occasion requires, and the other smaller, to be opened on such occasions, in order that the air may escape. The cover being nailed, or rather fastened with wooden pins, in its place, is afterwards secured by glueing slips of paper over the line where it is applied to the vessel.

Instead of the wooden pneumatic vessel, it might be more advantageous to use similar vessels of grit-stone (*grès*), rolled or cast-lead, or cement of lorient *. Manufacturers must form
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* The author does not appear to speak from experience in this place. It is not probable that any manufacturer would be tempted to incur the expence of stone vessels; but it is nevertheless proper to remark, that every stone which could
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an estimate of the advantages to be derived from the expences they incur. If leaden vessels be used, it will be proper to defend the foldered places with one or more coats of white lead, or putty, or resin, or pitch mixed with bees-wax. I have tried these preservatives against the destruction of the folder, and found them answer very well.

As it is useful to possess a knowledge of the height and quantity of water contained in the tub, there is a tube of glass fixed against its outer side, the lower end of which is bended and enters the vessel about five or six inches from its bottom. This part, into which the tube is stuck by firm pressure, is to be previously defended by lute, which is afterwards trimmed and laid smooth upon the sides of the tube and the vessel.

Lastly, as it is essentially necessary to ascertain, from time to time, the strength of the liquor, and to draw it off upon occasion, I have usefully availed myself of a brass cock, covered with several coatings of white lead for this pur-

with facility be wrought, contains lime or clay, or both; the former of which would no doubt be speedily corroded by the liquor, on which it would also have a pernicious effect. It is not likely that clay would be more durable. So that on the whole there is no temptation to use, and many reasons to reject, the earths.—*T.*

pose. By means of this cock, it is easy to draw off any small quantity of the fluid at pleasure. It has likewise the advantage of readily filling the narrow-mouthed stone-ware, or glass vessels, in which the liquor may be kept when there may be any to spare, or in case it is thought fit to preserve a quantity always in readiness.

When it is required to draw off the acidulated water with speed and in abundance, it is convenient to use one or more wooden tubes or spigots, which may be opened separately, or all at once, into appropriate vessels. But it is most convenient that they should have stoppers of cork only, because those of wood, though covered with tow, are very apt to burst the wooden tubes by their swelling; besides which they very seldom fit with accuracy, unless turned with extraordinary care.

With regard to the intermediate vessels mentioned in the *Annales de Chimie*, in case the operator is determined to use them, it is proper to avoid using stoppers of cork to close the orifices, and support the tubes at the same time. For this substance being very speedily acted upon by the corrosive gas, exposes the lutes and closures to frequent derangement, as well as the tubes which pass through them. At the beginning of my operations, I supplied the place
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of these stoppers as follows, when the necks were of a larger diameter than the tubes. I made stoppers of glass, with flanches on the sides. These were ground with emery upon the necks themselves, and they were perforated quite through with a hole, no larger than was proper to admit the passage of a glass or leaden tube. This tube was coated with lute of sufficient thickness, that it could not pass through the hole without forming a protuberant piece, which I pressed and smoothed against the tube as well as the orifice. Or if the stoppers of cork should, nevertheless, from convenience be chosen, the necks may be covered with lute, and the stoppers forced in. In case the interval be small, the parts may be heated a little, covered with virgin-wax, and then forced into the neck, and the small vacuities which may remain may be filled up with the same wax, melted and poured out of a spoon. Instead of lute, yellow wax may also be used to fix the tube of safety; and the same operation may be performed with regard to the glass or leaden tube, which communicates from the tub to the intermediate vessel. Stoppers and tubes luted in this manner, are, in some measure, fixed for ever; for when the wax is once hardened, they are in no further danger.

If the operator be so situated, that he can order the intermediate vessels of whatever form he chuses, it will be advisable to have the orifices of no greater diameter than just to suffer the tubes to pass through. No other defence will then be necessary, than that they should be covered with lute at the time of placing them, which will render them sufficiently firm. The rim, or border of these orifices, ought likewise to be large enough to support the mass of lute which it is proper to apply round the tube.

It may not, perhaps, be impossible, that skilful workmen, of which there are many at the glass-houses, should execute tubulated retorts with a recurved neck, in the form of an adouter. Such vessels would be particularly convenient. The tubulated bottles exhibited in fig. 1 and 2, plate IX, may be substituted instead of retorts, with the greatest advantage. In my latest operations on bleaching, I have always preferred them, because more convenient, less costly, and less subject to accidents.

As it is of utility to know the method of grinding the stoppers here described, as well as those of the tubulated retorts or bottles which may be wanted, because the stoppers are usually sold in the original rough state, at such works as
are

are not in the vicinity of glass grinders, and consequently cannot be used in the works we have described, I shall point out the method I have made use of. The tool which I have constructed for this purpose, plate II, fig. 1, consists merely in a kind of vice or clamps, in which the nob of the stopper may be fixed, and of which the handle being inserted in the centre of a brace, receives and communicates the rotatory motion impressed upon this last by the hand.

As the orifices, neither of retorts, bottles, &c. nor of their stoppers, are accurately round, it is necessary, in order to reduce the first irregularities, that a kind of stopper made of iron should be used in the first place before the stopper itself. Common sand-stone, powdered and sifted, may be used in the first place, and afterwards fine sand which has been sifted through a closer sieve; or otherwise the sand may be used first, and when the whole internal face of the neck has lost its polish, it must be ground a short time with fine sifted or washed emery. If sand or grit-stone cannot easily be procured, emery of different degrees of fineness may be made use of. Care must be taken to wet the stopper from time to time before it is covered with sand, or to drop it from a spoon with one hand, between the stopper and the neck, while the

the other is employed in turning the brace. It is likewise necessary to wet the stopper when the grinding matter is too pasty, or the rotation takes place by starts. If this be not attended to, there will be great danger of breaking either the stopper or the tube.

This method of grinding is expeditious enough. A quarter of an hour, or half an hour at most, is sufficient for each stopper; but if greater expedition be required, it will be necessary that two persons should apply to the work, one to turn, while the other applies the grinding materials and water.

CHAP. V.

Preparation of the Materials.

THE knowledge of disposing the distilling apparatus to the greatest advantage, is not the only point in which those who are desirous of practising this new method of bleaching, with the oxygenated muriatic acid, should be instructed. It is very essential to prepare the materials for producing this acid, which are, as is well known, the muriate of soda, manganese, and the sulphuric acid, or simply the muriatic acid and manganese. But this last mixture is less convenient to be obtained, and is likely to prove expensive, if the manufactory be not so situated as to obtain the acid at a low price. I shall therefore speak at length of the first mixture only, and shall simply observe, with respect to the second, that there is no risk when it is used of breaking the distilling vessels by the drying, and the incrustation of the materials; and also that the vapour of the muriatic acid, when poured out, is particularly offensive and injurious to respiration. It is likewise less easy to procure the muriatic than the sulphuric acid, because

because the fabrication of this last in France is more widely established.

The proportions of the mixture of muriatic acid and manganese, which I found to answer very well, are five ounces and a half or six ounces of crystallised manganese to one pound of the acid; that is to say, about two pounds and a half of manganese for seven pounds of the muriatic acid at 25°. This is the proportion suitable to the pneumatic vessel, of which the capacity has been already described.

The grey muriate of soda * dried on an iron plate, in the part of the furnace described in a preceding chapter, and stirred from time to time till it appears white, is to be pounded and sifted through a sieve of moderate fineness. It is essential that this should be done, in order that it may mix more intimately with the manganese, without which the sulphuric acid could not decompose it with the same facility, and a less quantity of gas would be produced. The distilling vessel being likewise strongly heated towards the end of the distillation, there would be reason to fear that the coarse salt might fall more speedily to

* The regulations of the salt duties in Great Britain are such, if I mistake not, as prevent this coarse salt from being used in Great Britain. T.

the bottom than the manganese, and form a crust which would endanger its breaking.

The observations here made with regard to the grey muriate of soda, are equally applicable to the white muriate.

The manganese must also be pounded very fine, and sifted through the same sieve as the muriate. The good quality of this mineral substance is known from its crystallization, in fine brilliant needles slightly adherent to each other. Not that it is to be supposed that the other kinds may not produce as much oxygen, but the crystallized specimens are to be preferred. For it is more easily pounded, is usually more pure, and less difficult to be cleared of quartz, spar, &c. and likewise, from its crystallization, it presents a larger surface to the action of the acid.

The white muriate of soda has not appeared to me to be preferable to the grey. It is true that it contains less impurity, but it likewise contains an equal quantity of water, and is dearer. The grey muriate of soda, on the contrary, besides its being much cheaper, contains a certain quantity of muriate with an earthy basis, which letting go its acid at a certain heat, such as takes place towards the end of the distillation, permits

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the operator to use a less quantity of sulphuric acid to decompose the muriate of soda.

The sulphuric acid, if it be purchased in the rectified state, ought to mark at least 60° below Zero, on the Areometer for salts and acids of Mossy, which is the instrument I shall always refer to in the course of this memoir *. As it is necessary to dilute the acid with its own weight of water, which then causes it to mark about 38 or 40° , it would be much better either to make it of this strength at first, or to procure it without being rectified, because, as Berthollet well observes, it would be ready for use, and less expensive in the charges of rectification and carriage.

If the rectified sulphuric acid be used, it is proper to observe that the acid must be poured into the water, and not the water upon the acid, on account of the heat and effervescence which is produced by the mixture. These are much less in the first case. It is advisable, moreover, in the mixture of these two liquids, to pour the acid gently, and along the sides of the glass at two

* I have not been able to learn the principles upon which this instrument is constructed. It is much to be regretted that instruments for ascertaining specific gravities, are not constantly made to denote the numbers in the usual tables where water is taken as unity.—T.

or three different times, with an interval of several minutes, taking care to turn the face on one side, to avoid the drops which may fly about. As the union of these two fluids produces, in a very short time, such a degree of heat, that it becomes impossible to touch the bottom of the vessel with the hand, it is best to make the mixture in vessels of stone-ware, or earth well baked, with handles, and a neck, if it be possible to procure them of this kind, in order that they may be lifted with ease and convenience, when it is required to pour the diluted acid upon the mixture of muriate and of manganese in the distilling vessels. Common earthen vessels may be used, but they are more readily penetrated by the acid, which splits and decomposes them in process of time.

The proportions, according to which I would advise the process to be performed with the greatest speed and economy of time, are four pounds of muriate of soda, twenty ounces of crystallized manganese * (less of this being requisite than of such as is not crystallized), and forty-four ounces of sulphuric acid at 60°, di-

* Our best manganese is brought from the duchy of Deux-ponts, from a place named Hombourg; it is usually mixed with quartz and other matters.—*Note of the Author.*

luted with three pounds and a quarter of water. I have sometimes used only forty ounces of water, and did not find the operation the less effectual. These proportions are adapted to a vessel containing fourteen vessels of water, each containing sixteen Paris pints, and the materials are exposed to distillation in a retort, one foot in height from the lower part of its neck, and eight inches in diameter or width in its body *. I must observe besides, that the most elevated retorts are to be preferred, because their roof and necks are less liable to be heated, and the lutes on that account are less liable to crack or be decomposed. The bottles, or tubulated balloons to be used instead of the retorts, should have nearly the same proportions. Instead of white glass, the common green bottle-glass may be used with almost equal advantage. For though it is less transparent, it is always sufficiently so to allow the operator to see what passes within the vessels. The only change such vessels will undergo is, that the bottom, which ought to be chosen thin, is liable to be decomposed, or converted into the porcelain of Reau-

* This height is necessary, in order that one third, or one fourth part at least, may remain for the swelling or effervescence of the contents.—*Note of the Author.*

mur, if the muriate of soda should encrust the bottom so as to leave no humidity between them. But this change does not render them less serviceable.

The present is certainly the place to speak of the attempt I have made, to procure the sulphuric acid without the intermedium of nitre, and to describe the apparatus I made use of for that purpose. It consisted of a pitcher or pot of stone-ware, perforated at bottom, the neck of which communicated with two small two-necked glass bodies connected together, and each half filled with water. Under each of these glass vessels was lighted charcoal, to keep the water in a state of evaporation, and under the earthen pot there was likewise fire to heat and enflame the sulphur, which was put into the pot through the opening opposite the neck. This opening, which draws in the external air for the combustion of the sulphur, was closed with a stopper, perforated like the nozel of a garden-pot.

The sulphur, thus enflamed, soon filled the vacant part of the glass vessels with its whitish cloudy vapour. This vapour, meeting that of the water, combined with it, and fell in acidulous drops on the lower water, over which the

vapour of the sulphur circulating for a time, does also probably combine with it to a certain point. Another proof that this condensed water did combine with the vapour of the sulphur is, that the same vapour, received in drops beyond the second glass vessel by means of a recurved adopter, came out in the acid state, reddening the tincture of turnsol, and effervescing with alkalis when concentrated. I have twice repeated this experiment with success, and with scarcely any inconvenience.

I likewise attempted to burn sulphur and heat water, in two separate vessels communicating with a third. The two vapours combining together in the receiving vessel, likewise produced by their condensation a fluid, which afforded the same indications of acidity as that of the former experiment.

When sulphur was burned in an earthen vessel, and its vapour communicated into an earthen jar, in which water almost boiling was poured, the results were the same.

It is probable that if these experiments were repeated more at large, with a suitable apparatus, a longer series of glass vessels, and proper furnaces, the success would be more complete. I intend at some future time to re-

fume

fume this process, and shall hasten to communicate my success to the public, if success should attend my endeavours *.

* Chaptal made a great number of experiments in the large way, for the purpose of discovering the means of acidifying sulphur, without the expence of nitre. Upon the whole they were unsuccessful. The manufacturer who may be disposed to enter into this research, is advised first to read Chaptal's paper in the *Annales de Chimie*, II. 86. or the full abstract of the same paper in my dictionary of Chemistry, art. Sulphur. 7.

CHAP. VI.

The Distillation.

THERE are two methods of making the oxygenated muriatic liquor, namely, with smell and without. Each has its advantages and inconveniences. I shall describe both methods, beginning with the liquid which has smell.

In the first place, we must suppose the cover of the wooden vessel to be fixed with its pegs, and pasted round with strips of paper. For this last purpose, the paste of wheat flour is preferable to starch, because more tenacious.

The wooden vessel must also be supplied with river water, either before or after the pasting of the slips of paper, which seldom require to be renewed. The water in the tubs, of the size already described, must rise to the height of about sixteen inches, or within an inch or two of the top, which may be easily known by the index tube on the outside. Every inch in vessels of that size answers nearly to sixteen Paris pints (or very nearly the same number of English quarts).

Whenever this vessel is filled with water after
the

the covering is fixed and closed, whatever may be its construction, it is of importance, that the small aperture in the covering, near that provided for the insertion of the funnel, should be unclosed, to permit the escape of the internal air. This is the more essential (though the hole may be a mere gimlet hole), particularly in the construction with false bottoms, because the stream of water being constant, when once the lower partition is filled, if the air above the second cannot escape, the water, instead of entering the vessel, will be driven back beneath the slips of paper, or along the axis of the agitator.

When the vessel is filled with water to the proper height, the retort must be placed in its bed, upon a thickness of half an inch at most, of fine sand or dry sifted ashes, and the neck of its adopter must be adjusted in the funnel of the leaden tube. The retort is then to be steadily fixed by pouring sand round it, to fill the vacant space between it and the capsule of the furnace. In this situation the muriate and the manganese, being previously mixed as equally as possible, are to be poured through the neck into the retort, by means of a glass, leaden, wooden, or paper funnel, perfectly dry. The goodness of the mixture is seen by its uniform blackness

E 3

throughout,

throughout, no particles of the white muriate being in this case separately visible.

After the introduction of the muriate and the manganese into the retort, great care must be taken to clean the stopper and the neck, in order that no vapour may find its way through, when once the sulphuric acid is poured in. It is necessary, therefore, that the neck and its stopper, being previously wetted, should close the retort, as it were, hermetically. For the slightest odour would be sufficient to retard the operation, by rendering the workshop extremely inconvenient. This odour of the oxygenated muriatic acid very readily diffusing itself through the whole space of the laboratory.

When the neck of the retort or bottle, for the same observation applies to both, the beak of the adapter must be properly luted to the leaden funnel. For this purpose a piece of lute is to be rolled out in the hands, and applied round the neck of the adapter, strongly pressing it as well on the sides of the funnel as against those of the adapter, and finishing by softening each side and uniting the whole with the finger dipped in boiled linseed oil.

In the usual course of regular practice, the pneumatic vessel or vessels are filled with water, the distilling vessels duly placed and luted, and the

the mixture of muriate and manganese introduced the evening before the day of distillation, after having cleaned and cleared the same vessels from their residues *. By means of this preparatory work, there remains nothing more to be done at the beginning of the day-work, than to pour in the sulphuric acid, which during the night has had time to cool, in the earthen or stone-ware vessels, in which it was previously mixed with water. Not that it would not be advantageous to pour it while yet warm, after having diminished its temperature, by plunging the vessel in cold water; but there would be reason to fear, that the proper degree of heat might not easily be adjusted, and that the distilling vessel might be endangered by the sudden application.

It might also be practicable to advance the distillation, by pouring in the sulphuric acid in the evening, immediately after the introduction of the mixture of muriate and of manganese; but there would be reason in this case to fear that the greatest part of the gas afforded by the distillation might be lost by derangement of the lutes, if the operation were not overlooked dur-

* A sufficient number of distilling vessels ought always to be in readiness, to be disposed for the distillation of the following day. *Author.*

ing the interval. This management would not in fact be fuitable to a manufactory, in which the work was not continued both day and night.

With regard to the sulphuric acid, it is to be introduced gently through a glafs or leaden funnel, in order that the air which escapes may not throw up drops of the acid on the face or hands of the operator. When the acid is poured in, the neck must be stopped by turning the stopper with a flight preffure.

If the acid has been poured in warm, and the muriate is very dry, and well mixed, the sulphuric acid not more diluted than has been prefcribed, and the manganefe of a good quality, bubbles of air will be heard to pafs into the wooden vefsel, through the leaden tube, at the end of two or three minutes. If the above requifites be wanting, the escape will not take place till fomewhat more than a quarter of an hour. In either cafe it is neceffary, a few inflants after the pouring of the acid, to place a chafing difh with lighted charcoal beneath the vefsel which holds the retort.

About half an hour after the pouring of the acid, a confiderable effervescence takes place, which fometimes fwells the materials as high as the neck of the retort, if this laft be too fmall for its charge. The bubbles of the froth are
large,

large and covered with a kind of pellicle, formed by a portion of the mixture carried up during the agitation. This intumescence lasts about two hours, during which time the bubbles of oxygenated muriatic acid gas are most abundantly disengaged in the water. They even succeed with such rapidity, that the intervals are not distinguishable, and an incessant noise is heard in the pneumatic vessel, which very often lasts three or four hours, according to the management of the fire, and the goodness and accurate mixture of the materials. The agitation produced by this rapid escape is commonly such, that it is scarcely necessary to move the agitator.

The fire is not to be renewed till the expiration of two hours, even though it may have gone out in the mean time. After this, it is not to be renewed till the end of an hour and a half, and after that period at the end of an hour, and so forth, without any perceptible increase of its intensity. It will be sufficient after these periods to keep up the fire, excepting that during the last two hours the fire must be maintained without suffering the charcoal to be almost burned away, as in the former cases, before it is renewed. The chafing dish must be raised upon bricks, to bring it nearer the retort, during the
last

last hour. I must observe, with regard to this chafing dish, that the grate must not be too open, lest the charcoal should be too rapidly consumed. After the intumescence of the mixture has ceased, the rapid escape of bubbles does not diminish for a long time, in consequence of an effervescence which constantly proceeds. It is true that this continually diminishes, and towards the end of the distillation the bubbles which pass into the tube appear only at intervals, notwithstanding the matter in the retort may, by the gradual augmentation of the heat, be brought into the state of ebullition. This heat is such, that eight or nine hours after the commencement of the operation, the hand can scarcely be endured near the aperture, or the neck of the retort, or other distillatory vessel, though between the fourth and sixth hours the same parts are scarcely warm. The distillation of one or more retorts or bodies into a single vessel, according to the doses before mentioned, takes usually eleven or twelve hours, and even less; the time for stopping the distillation is known from the escape of the bubbles being very slow, and the noise less perceptible. This slight noise is even a mark to form a judgment of the concentration of the gas, and the degree of saturation of the water. In order to hear the bubbles,

bubbles, it is often necessary to apply the ear against the tub. Moreover, the adopter of the retort begins to be heated, and the lute upon its neck becomes a little softened. Another indication that the process is near its termination is had from the long vibrations of the water in the indicatory tube, placed on the outside of the tub, and likewise in the tube of safety, when an intermediate vessel is used.

If a proper regard be not paid to the signs here enumerated, and the distillation be not stopped, there will not only be a loss of time and fuel, and a distillation of mere water; but the steam when an intermediate vessel is used, will drive the water through the tube of safety, and itself immediately follow, if not instantly remedied by diminishing or removing the fire, and cooling the neck of the retort and its adopter with a wet cloth, or, which is better, by drawing the stopper of the retort for an instant.

As soon as the distillation is stopped, the impregnated fluid of the pneumatic vessel is to be drawn off into tubs, or other vessels, proper to receive the goods which are previously disposed therein. If it be not convenient to use it immediately, the liquor may be left in the tub without fear of any perceptible diminution of its virtue, provided the cover and its joinings be well

well closed with lute and strips of paper pasted on, and likewise that the space between the axis of the agitator and the cover be similarly secured. It may likewise be drawn off in stoneware bottles well closed with corks, covered with lute at the place of their contact. In this manner the liquid may be preserved till wanted. I have kept it for several months without its goodness having been impaired.

I must observe in this place, that if it be wished that the liquor at the upper part of the vessel should be equal in strength to that of the lower, without retarding the distillation (which may be uselessly prolonged for upwards of twenty-four hours, by an effect of the concentration of the gas in the bottom of the vessel, and the resistance it then opposes to its introduction, which singularly contributes to increase the heat of the retort); I have found no better method, than that of drawing off the liquor, either into earthen pitchers or vessels filled with merchandize ready for immersion. I have done this after a limited time, and repeated proofs of the good quality of the fluid. At the end of eight hours distillation, I drew off one fourth of the contents of the vessel; a second fourth two hours afterwards; a third fourth after ten hours and a half, or eleven hours; and the rest after
twelve

twelve hours distillation, which formed the conclusion.

When the liquor is entirely drawn off from the vessel, it must again be immediately filled with water, or at least to the height of five or six inches above the return of the leaden tube, otherwise the gas, which continues to escape from the distilling vessel and then affords no resistance, might attack the pneumatic vessel itself.

The fire must be taken from beneath the retort as soon as the distillation is finished, not only to prevent the effect of the gaseous vapours, which still continue slowly to escape, from acting on the sides of the tub, but likewise to dispose the retorts or bodies to receive a quantity of warm water, which is to be poured in up to the neck. There is no reason to fear an excess of quantity, and the hotter the vessels are the better. It is essential, however, that it be not poured in cold, for fear of breaking the glass. The adopter is then to be unluted from the neck of the leaden tube, if the operator chuses; and in order that no vapour may escape into the workshop, a bit of lute or a cork may be applied to the beak of the adopter. The sand bath easily permits the retort to be raised and returned again to its place, as well as the application

plication of the lute or stopper to the neck of the adopter, this last being raised with one hand while the cork is put in with the other.

Nevertheless, as the lutes which connect the adopter with the retort are somewhat softened towards the end of the operation, it would be more prudent to leave every thing in its place, for fear of deranging those lutes. This danger is greater when the adopter is of lead, because the great length of this additional piece tends to force the luting still more on that account. If it be required to proceed immediately to a new distillation, the retort or bottle with its capsule or pan must be immediately taken from the furnace, and another substituted in its place ready prepared during the former distillation. This necessarily requires a double set of vessels.

When the distilling vessel is cold, or nearly so, the whole of its contents must be shaken, by holding this vessel by the neck with one hand, and applying the other to its bottom. The stopper must then be taken out, and the vessel speedily inverted, shaking the residue to facilitate its escape. In this last situation the retort is to be held by its neck with one hand, and its side gently resting against the other. The vessels into which the water and residual matter of the retorts are poured, should rather be of stoneware,

ware, pottery, or lead, than of wood, unless these last be oil vessels, which are less subject to dry in the part above the fluid. If this circumstance be not attended to, there will be danger of losing great part of the contents.

It is most convenient to disengage the retorts or bodies while they are still warm, which continues to be the case the next morning after distillation, in consequence of the heat of the sand bath. If they be left to cool entirely, the sulphate of soda will crystallize, and it will be necessary to dissolve in hot water such larger portions as cannot pass through the neck. But this inconvenience is not likely to happen, unless the quantity of water last added be too small, and the residues have been left undisturbed for several days. The same observation is applicable to that kind of incrustation which is formed by the muriate, if not properly pulverised, dried, or mixed; this cannot be separated from the bottom of the retort, but by means of hot water poured at different successive times. It is likewise essential to leave no crust or deposition of muriate, or other matter, in the vessels which are emptied, unless the same be moveable, in which case the risk is less. But if the urgency of business should then require that the same vessels be used without entirely

tirely clearing them, it will be necessary to range this residual matter on one side, where it will be less exposed to the heat, and will afford a greater degree of facility for the nitric acid to act upon it.

In order that the vapour which exhales from the distilling vessels may not prove inconvenient, it is necessary to pour in a small quantity of alkaline lixivium in the first place, which instantly destroys the smell. This may be done immediately after the end of the distillation, and the weak alkaline solution may supply the place of the water used for diluting the residues. At the instant of pouring this lixivial water, a strong effervescence takes place; for which reason it is proper to pour it in by several successive portions, waiting a little between each time.

The oxygenated muriatic acid obtained in this manner has a most keen and penetrating odour. It cannot be breathed even for a few instants, without the danger of a most obstinate and violent cough. Its action is sometimes so strong that the operator will fall down senseless, if he should determine to continue his work with his nose over the vessels. Running of the nose, asthmatic affection of the breast, headach, tears and smarting of the eyes, bleeding at the nose, the sensation known by the name of the
teeth

teeth set on edge, pains in the small of the back, and even spitting of blood, are the ordinary inconveniences to be expected, when the pure oxygenated muriatic acid is used as is prescribed in the *Annales de Chimie*. It is even impossible to support for several successive days an employment so destructive to the health, if the lutes be not carefully attended to, and the vessels for immersion of goods be not covered and placed in a shed, through which a strong current of air passes. I am moreover persuaded that there is not, perhaps, any person who has suffered so much as myself in this respect, on account of the earnestness with which I attempted to bring this process of bleaching to perfection, or rather to make it more generally useful. The strong expectoration to which I was exposed, agitated the system so much, that I found it impossible to retain any food on my stomach, and was for forty-eight hours, without intermission, not only deprived of sleep, but continually emitting saliva, with acid and corrosive humours from the eyes and nose in such abundance, particularly from the eyes, that it was sometimes five or six hours before I could open them to support the light. My situation, at those periods, was so disagreeable, that I could not lie a moment on my back, and a very short

time on my side. The erect position was least painful; but I was soon obliged to sit or lie down, in consequence of the pain I felt, at every attack of the cough, in the muscles of the back and thighs.

The difficulty, or rather the impossibility, of supporting such painful exertions for any length of time, induced me to contrive a mask of card, with glass eyes, which allowed me, for a certain space, to work with my face over the vessels for the immersion of goods, to turn, press, and wring the pieces without fear of any serious inconvenience. I likewise occasionally made use of a handkerchief, moistened with alkaline lixivium, which I bound round my head to defend my nose and mouth from the effect of the odour, but these means were merely palliatives.

As it is of great consequence that the operator should be defended against such accidents, or at least be able to diminish their consequences, it may be of some advantage to know, that I have had the pleasure to experience, that the black extract of liquorice, which I chewed before I exposed myself to respire this vapour, almost always produced a good effect, by diminishing the cough, and in some instances preserving me from it. I therefore was particularly careful to use this extract, previous to exposing myself

myself to the danger of respiring the gas, at the same time taking care not to omit the use of my moistened handkerchief, or mask.

A solution of sugar in warm or cold water, sipped or drank slowly, likewise appeased the cough very much after a certain time. The warm solution was rather the most effectual. I likewise occasionally sipped or drank milk for the same purpose.

Being at length, however, worn out with suffering, and unable to pursue my experiments on bleaching with the requisite convenience, I endeavoured to make the acid without smell, avoiding, at the same time, any considerable increase of expence. The following process succeeded best of any that I tried. It consists simply in adding to the quantity of water proper for each pneumatic vessel, a quarter of a pound, at most, of carbonate of pot-ash, or of soda, for every pound of muriate of soda which has been taken in the mixture of the matter for distillation. This quantity is sufficient, absolutely, to prevent the smell of the acid, and permit the operator to work with his face uncovered over the neutralized fluid, without risking the smallest inconvenience. The water may be disposed, for this purpose, in two different manners; either by previously dissolving the clari-

fied pot-ash in the reservoir of water appropriated to fill the vessels, or it may be simply poured into the latter vessels after it has been dissolved, settled, and strained by itself. This latter method is preferable to the other. For this purpose, after having dissolved the alkali in a small portion of water, it is to be poured in at different times at the commencement, and towards the end of filling the pneumatic vessels. These precautions must be more especially attended to when the vessel has false bottoms, because the solution of pot-ash, in that case, mixes less readily with the water. I must here remark, that the false bottoms, instead of being placed horizontally, must be somewhat inclined towards that side, in which the aperture of communication, through which the gas passes, is made. This inclination prevents any of the fluid from remaining in the vessel at the time of drawing off, which might happen if there were not a decided slope towards the place of communication.

If it should, however, be desired to prepare a solution of pot-ash proper to fill the vessels, it must be diluted till it marks no more than one degree beneath zero on the areometer of Mossy already mentioned. But this arrangement is attended with trouble; and requires more vessels,

fels, and consequently more room, without producing any advantage superior to that which is derived from pouring the strong solution of pot-ash to the water at the time of filling, according to the directions already given.

It sometimes happens, that the last portions of the impregnated fluid, at the time of drawing off, have a slight degree of smell; either because the agitators have not been sufficiently attended to, or because the salts are constantly disposed to fall to the bottom of the vessel. To avoid this inconvenience, about a fourth or an eighth part of the alkaline solution may be reserved, not to be poured into the vessel till half an hour before the distillation is stopped. The agitator is then to be turned, and the superior liquid will be without smell as well as the rest, because the combination takes place instantly. The same effect will follow, if the solution of pot-ash be put into the bottles or vessels used to draw off the liquid: nothing more being required in this case, than to pour a few glasses of the lixivium into the receiving vessel, which, when filled, must be covered up or corked. In order that the separate solution of pot-ash, which is poured into the pneumatic vessel at the time of filling it with water, may not be subject to remain in part upon the false bottoms, to the

prejudice of the water beneath, it is poured through wooden or leaden pipes, terminating above in a conical part or funnel, and of such a length as respectively to communicate with the several cavities into which the vessel itself is divided. By this expedient it is rendered certain, that the pot-ash, which is required to be deposited in the several compartments, will be specially poured into each. But as the alkaline solution does not immediately and intimately mix with the whole of the water, but is disposed to flow insensibly from the upper compartments to the lower, by reason of its weight, care must be taken to pour no greater quantity into the lowest compartment than four-sixths of the saline solution, reserving the two other sixths for the second or first compartment, and forbearing to pour them in till the whole, or at least the greatest part of the water has been poured into the vessel.

The necessary attention for distilling the acid, as well as the doses of the materials, are the same whether the odour be prevented or not. The only difference consists in their effects, as we shall hereafter see. The colour of both solutions is absolutely the same. That which contains pot-ash seems rather less limpid, particularly the first portions drawn off, on account
of

of the saline deposition which is stirred up by the rapid motion of the fluid as it issues out. A similar effect happens when the vessel has been newly painted; in which case, the liquor decomposes the paint by seizing the oil, and from this cause flows out with a soapy, or milky appearance.

Instead of pouring the pot-ash into the vessel, as has been described, I have very often used the following method. To prevent the effluvia from rising from the vessel in which the goods were to be immersed, I simply poured my solution of pot-ash into one or two pots, and afterwards sprinkled it upon the surface of the liquor contained in the bleaching vessel. This aspersions was sufficient to check the suffocating exhalation of the muriatic acid gas. I frequently used powdered chalk for the same purpose, and with equal effect.

I must observe, that I did not resolve upon making this new liquor without smell, until after I had repeatedly ascertained, that it is impossible to resist, for any length of time, the difficulties which result from the method and the proportions described in the *Annales de Chimie*. I am even of opinion, that this method of bleaching would be renounced altogether, if the operators were literally to follow those instructions,

in preference to my method, or some other method on similar principles.

I must particularly remark in this place, that the agitator must by no means be neglected. It is necessary to turn it several times together at the end of every half or quarter of an hour, to favour the absorption of the gas in the water, and to destroy its odour by facilitating its combination with the pot-ash. If this be not done, in either case, the gas beneath the first false bottom will pass too speedily into the second. This passage must be prevented as much as possible, until it is supposed that the water in the lower compartment is nearly saturated.

It must also be remarked, that when a pneumatic vessel has once been used to make one of these liquors, it must not be changed in its application; for nothing more speedily destroys the vessel and the agitator, than alternately using them for both. On the contrary, when the same vessel is constantly used for the same liquor, the action of the muriatic acid is scarcely, in any respect, perceptible.

Lastly, I must remark that the strength of the liquor may be increased at pleasure, as Berthollet also observes, by putting less water into the vessels. I have several times obtained it at such a degree of concentration, as to mark between

tween ten and twelve of the areometer of Mossy. In this state its colour was evidently of a lemon yellow, a little inclining to green. This liquor contained no pot-ash, and was designed for particular uses.

CHAP. VII.

Concerning the alkaline Lixivium or Lees.

THE method of making the lees is not a matter of indifference, whether we attend to the saving of time, or of alkali. The following is that which I would, from my own experience, advise, and which I have since learned is the method used in Ireland. It is well known, that the white colour of the Irish linens is highly esteemed. The method has always succeeded perfectly well with me.

Upon a kind of iron platform, composed of two or three concentric rings, connected together by cross pieces of the same metal, as may be seen in the figures, 1, 2, 3, 4, Plate III, which rests on the bottom of a boiler set in a furnace for the saving of fuel, are placed the piece-goods, thread, &c. in folds or parcels. When these different kinds of goods are to be immersed together in the alkali, the piece-goods must always be placed at the bottom. When the boiler is thus charged, the alkaline solution, at the strength of a degree and a half under zero
of

of the areometer, must be poured in till the mass of goods are soaked, and covered to the depth of at least an inch or two without pressing them too much down. Or the alkaline solution may be poured in, accordingly as the goods are placed in the copper. This last method would be preferable, in my opinion, in all cases where there was no reason to fear that the goods might lie too close. To prevent these from rising and floating above the surface of the lees, a flat cover is fitted to the boiler, which serves to retain the heat, and prevent any dirt from falling upon the goods.

A judgment is formed that the pieces are in a state to be taken out of the fluid, when this last under the cover in the middle of the heap is too hot to admit of the hand being held in it, or when it fimmers round the circumference of the boiler and throws up white bubbles, which circulate towards the centre. It is not necessary that the lees should boil; the essential conditions are, that it should be sufficiently strong, abundant, and hot; and that it should properly penetrate the goods which are submitted to its action. I have frequently thought it sufficient, between the two immersions in the bleaching liquor, to plunge the goods (previously washed and straitened out) for a few minutes into the
lixivium,

lixivium, which was very far from possessing the degree of heat above mentioned. The cloths and piece-goods, which were treated in this manner, bleached perfectly well.

In order to obtain a criterion respecting the time consumed in one boiling of the lixivium, I must observe, that 3,600 French pints (or about 900 English wine gallons) of the alkaline solution, in a boiler set in the manner just described, will be rendered just boiling hot in three quarters of an hour at most; and if pit-coal be used, the quantity of fuel required, for this purpose, will be one-third part less than if wood be used.

When the goods are to be taken out of the copper, the cords or chains which are fixed to the exterior circle of the stage are to be raised, and hooked to the fall or rope of a crane placed on one side of the boiler; by turning which crane the whole of the goods are raised out of the copper, and after they have drained for a certain time, the mass is conveyed and placed upon two cross-pieces over a tub designed to receive the subsequent drainings; after which, the several pieces are pressed or wrung, and afterwards rinsed in a stream, if the manufacturer possesses that convenience; or, otherwise, they are washed by means of the revolving cylinder,

linder, or other machinery. These operations are to be repeated as often as the goods are taken out of the alkaline lixivium, according to the nature of the merchandize; for it may easily be imagined, that piece-goods, hosiery, and thread, will require different kinds of manipulation.

As it is of essential consequence to lose as little as possible of the lixivium in this process, it will be proper to wring or press the goods before they are rinsed. Piece-goods may be advantageously wrung by means of a fixed hook, and a handle or wooden cross, to which a similar hook is adapted that moves with the handle. See Plate IX. fig. 9. These hooks being placed respectively at the two sides of a trough intended to receive the waste lees, the piece itself must be passed and repassed a number of times over the hooks, as is represented in the figure, until either the whole piece is thus wound up, or as much of it as can be conveniently wrung at a time.

With regard to thread, it may be pressed or wrung with the pin; and hosiery may be treated in the same manner. But it is more advisable to wring this last article separately by hand, unless the operator possesses a press suited to both the last-mentioned articles. By this engine the
goods

goods may be cleared of the alkaline lee, with more ease and expedition, and with much less injury.

In order to economise the fire in the fusion of the alkali made use of in new lees, as soon as the old has been drawn out of the boiler, which may be done by means of a syphon, or a cock, as may be most convenient, the necessary quantity of water may be immediately poured in with the pot-ash or crude soda broken in small pieces, if the purified salt be not used. In this manner the solution may be accomplished for the following day. The heat of the boiler, and its fire-place, supposing a small quantity of the fire to remain, the registers of the furnace being shut, and the boiler covered up, will be sufficient to melt the alkali in the course of the night. It is necessary to break the pot-ash into pieces of the size of a nut before it is thrown in, particularly that kind which is known in France by the name of pot-ash of York, the pieces of which are as hard as stones, and cannot easily be broken but by a mallet upon a stone pavement. The Spanish soda is equally hard.

The method of passing the goods through the heated alkaline lixivium, as here described, is particularly suited for works upon a large scale.

But

But when the manufacturer intends to confine himself to the bleaching of small articles, such as hose, night-caps, thread, &c. without meddling with the larger piece-goods, it will be equally advantageous to use a simple boiler, properly disposed in a common fire-place, with a barrel and winch above it, as is exhibited in Plate II. fig. 4, 5, and 6. For the saving of fuel, this boiler may be set in brick-work; and like the great boiler before described, it may have a surrounding cavity for evaporating the old lees, which will be very useful if it be no more than four inches in height, and of the same width.

New lees, which have already been used for the immersion of one piece of cloth, are not to be rejected on that account. As the solution loses somewhat of its strength on account of the matter which it extracts from the cloth, and with which it enters into combination, it must be restored by adding one-third or one-fourth of lixivium from the reservoir, which likewise supplies that portion which was carried away in the goods, and partly recovered by draining, rinsing, or pressure. The first lixivium, after two boilings, can only be poured on dyed goods, because it is then loaded with extractive matter, which in a great measure saturates it, and renders it black and viscid to such a degree, that it
some-

sometimes takes a curdled or gelatinous appearance on cooling.

The second lixivium may commonly be used three or four times for the same objects, taking care to strengthen it every time with one-third or one-fourth part of new lees; after which it is to be thrown, like the others, into the reservoir. The third and fourth lixiviums may likewise be used several times, but without adding new lees, because they take up but little colouring matter. It is easily ascertained by the taste, whether they have any remaining active saline parts. Many persons, particularly laundresses, ascertain whether their alkaline lees has lost its force, by rubbing it between their finger and thumb. They estimate its quality according to the degree of lubricity it exhibits. The quality of the two first lixiviums may be ascertained to a certain point by the use of the areometer. When they mark three degrees under zero, they are certainly too much loaded with extractive matter, and will produce no other effect on the goods, than to give them a brown colour, to the absolute loss of time. It is advisable to keep the lees at the same degree of force, either by addition, or by changing them altogether, for the first two or three immersions of the same goods; diminishing the strength, however, one-third or one-

one-fourth as soon as the pieces have acquired an uniform colour, which will happen, at farthest, at the second immersion in the bleaching liquid. When the goods have arrived at this state, weaker lixiviums may be advantageously used, because there remains scarcely any thing more of impurity to be carried off; and the subsequent process may be considered merely as a brightning of the colour, by detaching the small portion of impurity which may remain fixed in the texture of the thread itself.

The old saturated lees being taken out of the boilers, are to be added to the other lees of the same kind, arising from the drainings into reservoirs appropriated for that purpose. This fluid is of use to soak piece-goods or thread, in order to clear them of their dressing, or the impurity attached to the latter during the spinning. With regard to the lees which are obtained by pressure or wringing of the goods, if they be not too highly coloured, they may, as well as all the others, be added to the lees in the boiler.

As soon as one boiling or immersion is made, if the lixivium be in a good state, whether by the addition of fresh lees or not, the next immersion may be immediately proceeded upon in order to take advantage of the heat, in case

the course of business requires it; but for this purpose it is necessary to have another frame or platform ready prepared, with the proper quantity of goods for immersion. But if there only remain a small number of pieces which require to be plunged in the alkali, they may be thrown into the same bath without restoring it, or even heating it up again. Nothing more will be necessary than to cover up the boiler, and leave the goods immersed for a sufficient time, that they may be well penetrated with the alkaline solution. I have often found this manner of proceeding very convenient for piece-goods, hose, or thread, in small quantities, without making use of the frame or platform.

It must not be overlooked, that whenever the goods are taken out, the copper must be examined with a staff, in order to discover and take out any small articles which might be forgotten, and would be in danger of burning if they were to remain at the bottom of the copper during the time of the subsequent process or charge.

It must also be remarked, that it seldom happens that any piece which may have been subjected to two fresh successive lixiviations, even though it may have been a dyed piece, will receive any advantage from a further repetition. The third immersion, to which it might be subjected,

jected, with the hope of clearing it of an additional portion of impurity, will be found to produce scarcely any effect, and the liquid will take up little or no colour. It sometimes happens, that the second lixivium, even though of considerable strength, is equally ineffectual.

It is of great importance that the alkaline lees should be always as clear and limpid as possible. Their value may be estimated by observing the readiness with which they absorb the colouring matter from the goods. The tubs, in which they are kept, ought, therefore, to be made of fir; because those of oak, or chestnut, though very carefully treated with lime water, always become more or less coloured in process of time. It is true, that the colour of the lees is of, comparatively, little consequence for the first two or three immersions of dyed goods (*des pièces bises*). But this is not the case when the goods have once acquired an even colour, and require only to be brightened. It is then highly essential, for the saving of time and labour, that the lees should be as clear and limpid as possible.

The new lixivium, or lees, is good whenever it marks one degree and a half beneath zero; and I have observed, that it is not necessary it should be stronger. At a higher degree of
6 2 strength,

strength, it would soon become as foul or coloured as the weaker solution ; and it is useless to consume the alkali to no purpose, and communicate a dark colour to the goods, which by that means become more difficult to wash or rinse. Care must also be taken to rinse them after the lees, until the water, if the operation be performed in the washing apparatus, flows off very clear ; or, on the contrary, if the goods be exposed to a stream of water, they must not be taken out till it has been ascertained, in various parts of the pieces, that the water, upon wringing, comes out very clear. If this precaution be not attended to, the pieces, thus imperfectly rinsed, would be in danger of becoming yellow instead of white, by immersion in the bleaching liquor ; and even to acquire a very tenacious and disagreeable ruddy tinge, either partially, if the rinsing have been partial, or totally, if it have been entirely neglected.

The activity of the fixed alkali, or pot-ash, may be increased, by throwing into the boiler in which this salt is put for solution, one-third or one-fourth of its weight of well burned and very white lime, of the best quality ; which is to be tied up in a bag or cloth. By this management, the calcareous earth is less capable of rendering the lees turbid ; or if it should escape, it will
fall

fall to the bottom when the solution cools. The lime may also be separately dissolved or diffused, and the pot-ash dissolved in this solution instead of pure water; a method which may be preferable to the other. It is scarcely necessary to add lime to the foreign pot-ash, most of them contain a certain quantity; particularly those which are imported from the north of Europe, or from America.

The use of lime has appeared to me to produce a greater effect at the commencement, than towards the end of the bleaching. At this latter period, the different operations to which the merchandize has already been subjected, the causticity of the lees, and the small grains of calcareous earth which they may contain in spite of every precaution, would be likely to impair the strength of the goods, particularly during the operations of wringing, or the press. But the use of lime has appeared to me to be of advantage at the beginning, because I have found reason to conclude, that the goods which are thus treated acquire a decided whiteness in less time than the others.

As it may happen, that the boilers used for the lixiviations may leak at the place of the rivetting, and manufacturers may find themselves embarrassed at a distance from proper

workmen, I conclude, that the following method of repairing them may be acceptable. It consists in beating a certain quantity of lime, flaked by exposure to the air, and sifted with a small quantity of the white cheese called *à la pie**. The mixture is to be stirred or beaten without ceasing; and the lime must be successively added, until the mixture begins to acquire a certain consistence. The damaged part of the copper being then well cleaned and wiped, this cement is to be very firmly applied, spreading and extending it at the edges as well as possible. The cement soon hardens, and the copper may be used as before. By this means every kind of small fracture, or opening, may be easily stopped without displacing the boiler.

The same kind of lime sifted, and mixed in a similar manner with leaven, may be used with equal advantage. I have had occasion to use both these cements, and it appears that the salts exercise no action upon them; or, if they act at all, it must be in a manner scarcely perceptible.

As it may be of advantage, in certain places, instead of using pot-ash, to give the preference

* I am not acquainted with this kind of cheese; but it may easily be supposed, that experiment will point out, which of the several kinds the manufacturer may have at his disposal may be the best. I suppose a very small quantity of water is to be added.—7.

in France to the alkali, known by the name of *salin*, which can now be bought one-third part cheaper than formerly, before the impost of *peage* was suppressed; I shall describe the manner of calcining it, in order to deprive it of the colouring matter with which it is combined. The common baker's oven may easily be used, at least provisionally, instead of a calcining furnace. It is to be heated as if for bread, taking care only to place the wood on one side, in order that the part of the floor which remains free, may be well heated by the circulation of the flame. The crude *salin* is to be thrown into this vacant part by means of a shovel or any peel; for which purpose, the common peel, belonging to the oven, may answer very well. The alkali may, without inconvenience, be disposed to the height of two or three inches over the whole clear surface of the floor of the oven, as far as to the distance of five or six inches from the mouth; and in order that the coal of the small wood may fall thereon as little as possible, by sparkling, rolling, or bounding, the largest pieces, or faggots, must be placed nearest to the salt. At the commencement of the operation it is necessary to turn up the alkali, and renew its surfaces from time to time; for which purpose, the bended part of the poker may be very useful.

ful. This precaution is the more essential, because it prevents the salt from adhering to the bottom of the oven by the aqueous fusion. Some samples of this salt, at the first impression of the fire, decrepitate more or less, which arises from the muriate of soda, or sulphate of pot-ash, which is almost constantly found in every kind of incinerated vegetables; and it is sometimes the consequence of adulteration, to which that of Lorraine is more particularly subject. The oven is to be more and more heated, and the salt stirred until it ceases to emit fumes, and begins to lose its smoaky or black appearance, and becomes white throughout internally, as well as externally.

When the salt is first put into the oven, the heat ought not to be greater than for baking bread. It may be of advantage to begin the operation immediately after the bread is drawn, because the heat which is already in the oven, will render the consumption of fuel less than would otherwise have been required for the calcination.

After the salt has once become white, the fire is to be kept up as steadily as possible, without increasing it; and the greatest care must be taken, lest the salt, by too strong heat, should form itself into clots or masses. Whenever this happens,

happens, the pieces must be broken small with the rake or poker ; for the internal part of such lumps, though white on the outside, would very probably retain its dark colour. If the salt be imperfectly, or not at all calcined, it will afford a solution of a yellow-blackish colour, similar to that of old lees highly charged with colouring matter, as is the case with that which has been used for the first immersion of piece-goods, or thread. The effect of such a solution would be very different from that of the clear and limpid solution, which it is absolutely necessary to prepare for these operations.

When the salt appears white throughout, and ignited in certain places, when it is turned over, it will be proper to take it out of the oven. The fire is then to be gently diminished till no more combustion remains than is convenient to give light for drawing out the salt. The latter is then to be drawn with an iron rake, or the bended part of the poker, to the mouth of the oven ; where it may be received in troughs of stone, or plate-iron, or cast-iron pots, of sufficient size to contain the whole. The fire may be suffered to decay, until the oven shall have acquired the proper temperature to begin the second calcination, if required ; which is to be managed as before, taking care only, that the
salt

salt be rather more frequently stirred at the commencement, because the floor of the oven is always somewhat hotter than at the commencement of the first calcination. The operator must also endeavour, as much as he can, to preserve his alkali from the small pieces of charcoal which fly in sparks from the wood, though these are not absolutely of much consequence, because they swim on the surface of the water in which the calcined salt is afterwards dissolved; in which situation they may be taken off with the scum which usually rises from this salt, though in less quantity than from the ordinary pot-ash; which last salt is exposed to a stronger heat, and is usually mixed and calcined with calcareous earth, or other earthy matter, either to increase its causticity, or to add to its weight. The coal and the scum obtained in this solution, are not to be thrown away, but may be disposed upon a cloth or sieve over the reservoirs containing the new lees. As these substances retain a small quantity of salt, it is advisable to pour water upon them several times; after which, they may be thrown into the oven at the next calcination.

If the calcination of this alkali be carefully managed, there will be no incrustation upon the pavement in the oven; but if that event should happen,

happen, the oven would not be less proper for baking bread. The only effect it will have upon this article of food, would be, that the bottoms of the loaves would be rendered more uneven. These incrustations may easily be removed by striking them with a hammer while they are still hot, or by raking them off after the oven is cold, and the alkali has began to attract the humidity of the air. In this state the slightest blow will detach all the saline incrustations, which may have fixed themselves to the pavement of the oven *.

The *salin* loses twelve or fifteen per cent when thus converted into pot-ash, accordingly as it is more or less humid at the time of calcination.

The process here described, is practicable by women as well as men. The whole was ex-

* In the second year of the French republic, I had occasion to direct my attention particularly to the inquiry after certain substances proper to afford alkali by incineration; that of the marc or stalks of grapes appeared to me, among others, to deserve the notice of those who are engaged in the manufacture of pot ash. I have, therefore, inserted at the end of this work, the two memoirs which I at that time addressed to the different committees of the national convention, which were specially charged to excite the zeal of the citizens towards the most proper means of supplying the saltpetre works with the requisite quantity of vegetable alkali.

ceedingly

ceedingly well managed by a woman, to whom I gave instructions. In an oven capable of baking two measures of flour, each weighing twenty-five Paris pounds (or twenty seven pounds avoirdupois), an hundred pounds of alkali may be easily calcined, in three or four hours, at a single heat, at no greater expence than twelve or fifteen sols, in such wood as is used by the bakers.

After this description of calcining the impure alkali, it may not be amiss to point out the method of obtaining the alkali from the old lees, which were formerly thrown away. For this purpose, I prefer the following method. Instead of covering with masonry, or brick-work, that space which remains above the flanch or horizontal part of the boiler for lixiviation, an additional piece is to be applied round the circumference, so as to form a circular cavity or external boiler. The heat which this channel undergoes from the continual action of the flame beneath, very speedily evaporates the old lees, with which it is for that purpose filled. When the lees are thus rendered very thick by evaporation, they are conveyed to a boiler, or pot of cast-iron, properly placed upon a calcining furnace; see Plate III. fig. 7, 8, 9, 10, and 11. The lees must not be suffered to become entirely

entirely dry in the circular cavity, which surrounds the great boiler, lest the copper should be burned or oxyded.

The old lees, when brought to a pellicle in the evaporatory apparatus first mentioned, are, as already observed, to be conveyed to the boiler of cast-iron, where they may be heated to dryness without any danger of breaking the vessel; particularly if it be made of soft grey iron. The residue must be stirred as frequently as possible, especially towards the end of the process, in order to prevent the salt from adhering; which, in that case, would render it necessary to dig it out with a chissel and mallet, unless there were time for it to soften by the humidity of the air; or the operator might choose to sprinkle it with water to produce the same effect.

In order to take the utmost advantage of the heat of the evaporating apparatus, it must be duly supplied with lixivium as soon as that which has been evaporated to a pellicle is taken out; and in case there should be no foul lees to evaporate, it will be proper to fill the external channel with water, to prevent the copper from burning. This hot water may be drawn off for use, by means of a syphon or cask, when required.

The heat which is carried up the chimney may also be converted to an useful purpose, by
placing

placing another small copper over the flue, into which the old lees may be put; where they will obtain a certain degree of concentration previous to conveying them into the circular channel. In this last vessel they will be still farther concentrated, previous to the last evaporation in the iron-pot, in which they are reduced to the state of pot-ash, or *salin*. This series of vessels may be used with great profit and advantage.

CHAP. VIII.

Respecting the Preparation to be given to the various kinds of Goods.

THE preparation necessary to be given to piece goods, before they are immersed in the oxygenated muriatic acid consists, first, in soaking them about twelve hours in water to dissolve, and clear off the dressing, which is usually either common starch, or thin paste of flour. If the piece be soaked in a trough, it must be disposed in very open folds, and covered with water. If the soaking be performed in a river, or stream, it must be exposed to the current, after having fastened it to a post fixed for this purpose. It would be much better to form a kind of reservoir, defended all round by planks, as well as at the bottom, in order that the pieces might swim therein, without being exposed to damage or dirt; and the water might pass in and out by two sluices. When the goods have soaked for a convenient time, they are taken out fold by fold, and then pressed or wrung by the wring, fig. 9, Pl. IX; or, if time permits, they are suffered to drain on the horse. With regard
to

to the goods soaked in troughs, as the water becomes very foul, it would not be amiss to soak them again in fresh water till the fluid comes off very clear. In fact, there cannot be too much attention paid to clear the goods perfectly of their dressing. This previous treatment disposes them for the subsequent operations, by rendering the extractive colouring matter more easily to be discharged. A fulling-mill would be very useful for these workings and rinsings.

The second operation to which the piece-goods are to be subjected, is that of maceration; which consists in soaking them in old lees which has been used, and is reserved for this purpose. In the macerating troughs the pieces are likewise to be disposed in folds; not only because they occupy less room, but likewise because they will be less pressed together, and the maceration will be more equally effected. The quantity of lees must be sufficient to cover the goods; and in order that these may not rise above the fluid, they may be pressed down by means of loaded planks, or which is still better, by pieces of wood capable of being fixed so as not to press the goods, but simply to prevent their rising above the surface. In this situation they must be left for at least forty-eight hours, even in summer, without any fear of inconvenience. For greater certainty

certainly, however, this process may be managed according to the heat of the atmosphere. It is known that the maceration operates in a proper manner when the lixivium is covered with an infinity of white bubbles, and begins to emit a fetid smell; and the piece-goods have assumed a clear yellowish ruddy colour, instead of the grey or dark colour they had before their immersion. This, at least, is the case with almost all the linens of Picardy, in consequence of the spreading of the linens in the field, where the impurities are so far from being detached, as when the clearing is performed in water, that they become fixed, and acquire more colour. This maceration is accelerated if the lixivium be used hot, as it is when rejected from the boilers. It would scarcely be imagined how much the maceration in the old lees, when thus managed, advances the bleaching of the goods. It answers the same purpose as two immersions in the copper; whence it is evident, how much it saves of time, labour, and expence.

Instead of macerating the goods in the old lees, I have sometimes used with advantage a cold bath of lime water, or milk of lime. The grey piece-goods when deprived of their dressing, or even without that previous preparation, were plunged in this liquid; and after having remained therein no longer than five or six hours,

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they

they were taken out, of a ruddy yellow colour, and in a proper state for the action of the lixivi-
viums.

In order that the pieces set to macerate may not be too closely pressed against the bottoms of the vessels, bundles of white osier twigs, or merely sticks deprived of their bark and laid across each other, may be disposed upon the bottom. The same remark is applicable to the first soaking, required to clear them of the dressing. This first operation is performed merely to save the lees, for when the operator is pressed for time, the foreign matter contained in piece-goods, that is to say, the saliva of the spinners, and the starch of the weavers, is cleared off as perfectly as in the old lees when the goods are submitted to maceration.

When the maceration is carried to the desired point, the lees are to be drawn off, the goods taken out, and wrung or pressed in the manner already described, and rinsed in the stream, or in a vessel where it may be worked until the water, which is repeatedly poured on, comes off clear; or, in preference to this last process, the goods may be passed through the fulling apparatus, if the manufacturer possesses one. See the plans and parts of this mill in the Plates IV. and V. After the fulling or rinsing, the goods are left to drain on a proper stage, or pressed or
wrung

wrung to such degree that they may remain only moist or humid. For too great a quantity of water if retained would weaken the action of the oxygenated muriatic acid.

If the operator do not possess the advantage of a fulling-stock, but simply that of a stream of water, the washing of these piece-goods may be hastened, by beating them on a stage, level with the surface of water, by means of dyers' sticks or poles, which are very well adapted for this operation.

Care must be taken that the troughs or other wooden vessels in which the goods are soaked or macerated, be clear of every crack or splinter, otherwise there would be danger of tearing them in taking out, because the fermentative process occasions them to expand and press against the sides of the vessels.

The observations we have made with respect to piece-goods of linen or hemp, are also applicable to those containing cotton, taking care to proportion the time of soaking and maceration to the coarseness or fineness of their texture.

Particular attention must be paid after the rinsing or clearing of the piece-goods, subsequent to the first soaking or maceration, and even after the first lixiviations or boilings, to rub

them well with black soap, and afterwards to clear them out, particularly along their selvages; for this part, being always closer than the rest, requires to be made very supple, in order to open it to the action of the lees and the acid. Without this precaution it might, probably, be necessary after the several operations to rub them separately by hand, and the bleaching would be retarded by requiring several extraordinary immersions to prevent these parts from being less perfectly white than the rest. If the rinsing and clearing be well performed at the commencement, the beauty and evenness of the white colour, and likewise its acceleration, will be much promoted. It is also highly advantageous, particularly to fine goods, that the whole piece should be soaped and cleared after the last lixiviation and rinsing, till the water flows off limpid. I do not hesitate to recommend this particular manipulation, as well after the maceration as after the last immersion in the lees, because the whiteness which it affords is proportionally more brilliant and solid.

It is proper to add, that it will be likewise very useful to proceed with the same attention and care in rinsing the goods after each lixiviation. This part of the work being well performed, has more effect than is usually supposed
on

on the solidity of the white colour in many piece-goods which are esteemed in the market. Out of the various kinds I shall only mention those called De Laval, which, after dressing, exhibit the most beautiful milk white; but which have the fault of not preserving it when they are brought into the usual wash, during the course of wear. This fault is particularly attributed to the exposure of the goods in the field, before they are properly cleared of the extractive matter detached by the lees.

I forgot to mention, that for numbering and marking the cloths, red ochre (*sanguine*) may be used as well as lamp-black ground with oil; but the mark traced with red-ochre upon a moistened place, is more expeditiously made, and equally tenacious.

Linen, thread, hose, mittens, and gloves, of the same material, must undergo the preparations of steeping in water, and in the old lees, with the same care. Sewing thread, hose, and gloves, only require more time to arrive at the desired point in the lees, on account of the firmness of their texture, which swells considerably, and acquires a degree of rigidity, that opposes the extraction of the impurities which this operation is designed to remove.

The first thing to be done in the management of thread, is to make good the fastenings of all the skeins, large or small; for there are many places in which the loops are either imperfectly or not at all fastened by the spinners. As thread swells up more than half its own bulk by wetting, it is necessary to loosen all the fastenings already made, in such a manner that the thread may lie very loose in the loop; for if it were otherwise, there would be reason to fear an inequality in the bleaching. One person may loosen, and tie up again, all the skeins of one hundred pounds of thread in a day. This is work for women rather than men.

When the skeins are made up, a string is passed through two or three skeins, according to their thickness; upon one end of which string, a certain number of knots may be made to denote the owner of the article, whose name is supposed to be entered in a book opposite the same number. This assemblage of skeins is called a hank, see Plate II. fig. 11. An account is likewise taken of the weight of the thread, and the number of hanks, together with its quality, as may be necessary. These different observations must be entered in the day-book as soon as the goods are received, for fear of omission or mistake. The same care must be taken to register the
quality,

quality, number, and weight, of the piece-goods under the name of the proprietor.

The strings for tying up the hanks ought to be previously boiled in water, as well for the purpose of clearing them of the dressing, which the manufacturer may have applied for the purpose of glazing them, as to render them supple, and prevent their curling up when acted upon by the hot lees. The same strings may be used for a long time.

The soaking in water requires a less time for thread than for piece-goods, because there is no dressing to be dissolved, but merely the impurity which it may have acquired during the spinning. The thread is to be disposed in layers in the steeping vessels, taking care to place the end of the string of each hank upon the hank itself, in order that there may be no difficulty in taking them out. It is likewise advisable, to place those articles together which belong to the same person. Attention must also be paid, to place a kind of basket-work, as was directed with regard to the piece-goods, in order that the lower parcels while pressed by the upper may continue to be surrounded with water. Fine goods ought always to be placed the last; and in order that no part may rise above the surface, they must be kept down either by a

cover perforated with holes, or boards properly disposed. Thread may likewise be soaked as well as piece-goods, by exposure to a current of water; but for this purpose it is necessary to pass the hanks over poles fixed beneath the water. When the thread has remained seven or eight hours in the water, it is easily taken out after the water is drawn off. It may then be wrung on the pin, or pressed, after having been rinsed, if convenient, in clear water.

It is then to be arranged in the same manner, one stratum cross-wise over the other in the troughs for maceration, as has been directed for the steeping; or, if the situation and convenience of the operator permit, it may be suspended upon sticks. But it will require more time to macerate or heat in this manner, though the goods will by that means acquire a more equal colour. When they are supposed to be well cleared, as we have observed respecting the piece-goods; they are then to be taken out, wrung or pressed, then rinsed or washed in clear water, and wrung a second time, or hung up to drain. When the thread is wrung on the pin, care must be taken to twist the hanks three times in three different parts of their circumference, drawing it out each time with as much straitness and equality as possible, to dispose and
arrange

arrange the threads. This operation is likewise necessary for the perfect wringing out of the skeins in every part. The precaution of extending the hanks upon the pin for the due arrangement of the threads, is particularly necessary for double thread, which is apt to curl up by the impression of the heat. If they be left in this situation, there would be reason to fear, that the bleaching would be less perfect in the curled parts.

Instead of wringing the thread on the pin, which requires much time, it would be still better to clear it of the water by the beetle, or by the press, as by this treatment the thread would be less subject to injury.

With regard to the time of maceration for thread, it requires in general less time than piece-goods, by reason of the close texture of the latter. The time, likewise, depends on the fineness or quality of the article, the temperature of the air, and the goodness of the lees.

With regard to stockings, gloves, and mittens, they require at least as much time, if not more, than cloths, to be properly macerated. This must be managed according to the closeness of their texture, and the other relative circumstances already mentioned.

Cotton, as well as linen thread, must be made
into

into hanks, then soaked in water, and disposed in cross-layers, if troughs be used. Cotton imbibes water with great difficulty, and is less disposed to adhere together than linen thread, which is not so soft and porous. It therefore always swims at the top of the fluid in spite of every precaution which can be taken, unless it be kept down by the methods before described. The cotton being disposed in cross-layers, and thus loaded, the troughs (which, as well as those for piece-goods, ought to be square, for the more convenient disposition of the several articles) are to be filled with water.

On account of the difficulty of imbibing water, which depends on a certain oil, gum, or resin, it is naturally impregnated with, cotton requires at least as much soaking as piece-goods. Though it may not appear foul, it never fails to render the water of a darkish colour by its impurities. The soaking, likewise, affords a saving of lees, for if the cotton were to be put into the lees, without this previous treatment, the copper would hold but a small quantity.

After twenty-four hours, or less time, of immersion, the cotton is to be taken out, and wrung or pressed, after rinsing in clear water, if thought necessary. It cannot be left to drain of itself, unless the process be conducted very leisurely

leisurely indeed, for it requires a long time to clear itself of water in this manner.

The cotton is not to be macerated. After steeping in water it is boiled in the lees. A good solution of black soap may on some occasions be used instead of the lees; but the lees are always more effectual, and need not be made stronger than three quarters of a degree below zero. But the solution of black soap must not be neglected for thread soiled by the oil of the jennies or spinning machines; for some of the girls who manage that process take so little care in greasing the spindles, that the bobbins of thread are spotted with a thick black oil, which it is advisable to rub, previous to lixiviation, with a good solution of black soap. If this be not done, it will be very difficult to discharge the spots: in spite of every care they are sometimes visible upon the hanks even after the bleaching. I must here remark, that I recommend black soap in preference to the white, because it is more active, and does not contain those small stones, or grains, which sometimes abound in the white soap, and may injure the goods, or the hands of the operator. Black soap, indeed, has a stronger smell, but this is dissipated in the course of the subsequent processes.

Night-

Night-caps, stockings, socks, mittens, and gloves of cotton, are to be tacked together as soon as received, and marked with threads passing through each pair; upon which a greater or less number of knots is to be tied, and an account taken in the day-book of every circumstance relating to their number, quality, &c. which may be necessary to prevent mistakes, or confusion, in the subsequent delivery to the respective proprietors.

These goods, when marked and tacked together, are not to be steeped in pure water; but, on the contrary, in a good solution of green or black soap as hot as possible, in order that the black and oily marks, and the impurities with which they always more or less abound, may be easily detached by rubbing them with the hands.

When the stockings, night caps, &c. are taken out of the suds, they must be rinsed and cleaned in clear water, and afterwards wrung by hand. They cannot be treated in any other manner, excepting by the press, without danger of breaking some of the stitches.

After this treatment the several pieces may be conveyed to the troughs for immersion in the bleaching liquor; but the work succeeds much better if they be previously boiled in the lees.

With

With regard to flax and hemp, which it may be required to bleach in the rough, it will be proper in the first place to give them a lixiviation, on account of the difficulty of macerating them in this state, though it is not absolutely impracticable to do it, by tying them up in small separate parcels. The different knots of flax, must, therefore, be disposed on the bottom of the boiler, first covered with a piece of wicker work, upon which a coarse cloth is spread. The different knots are to be mixed as little as possible, taking care to make a slight fold, or return, at the head of each knot. They are to be pressed by hand the same as the stockings. For rinsing and washing them, it is likewise necessary that this should be done by hand, holding each parcel by the head, and repeatedly plunging and moving it about in water. This, at least, is the management I have thought it best to adopt in my trials.

It is to be remarked, that the exhausted and unserviceable solutions of the oxygenated muriatic acid may be used instead of water for the lixivium, if it be sufficiently concentrated to mark one degree beneath zero on the areometer. I have sometimes used it to advantage for cotton goods, after the last, and even the second, boilings. This liquor was not less disposed to become

come coloured, by dissolving the extractive parts of thread and piece-goods, notwithstanding the acid with which the pot-ash appeared to be combined. It seems probable, that the acid is but slightly attached to the alkali, and may be driven off by a strong heat; as, in fact, I thought I perceived in separate evaporations*.

* This last observation seems to apply to such bleaching liquor only, as may have been deprived of its smell by pot-ash, and not to that in which chalk, or lime, may have been used;—*T.*

CHAP. IX.

Concerning the first Immersion.

THE first, as well as the last, immersions may be made with the acid without smell, composed with the proportion of pot-ash already pointed out; but in case this proportion should be exceeded, it must not be used but for the two first immersions. In every case these ought to be made with the acid without smell, because this liquid acts with more speed and equality. We shall presently mention the reason why, in case of a greater proportion of pot-ash, no more than the two first immersions ought to be made in this inodorous oxygenated muriatic acid.

When the immersions are to be made, if the apparatus is so placed, that the trough or back designed for that purpose is placed below the spigot of the pneumatic vessel (see Plate I. fig. 1, 2), the muriatic acid is to be drawn off to the necessary height, in order that the goods which are folded in equal folds may be covered at least two or three inches. But if the arrangement be not made in this manner, the liquor must be drawn

drawn off in pitchers, or conducted to the vessels of immersion by leaden or wooden tubes, provided those vessels be placed on the ground, or low enough for that purpose. With respect to what remains in the pneumatic vessel, which is shewn by the degrees on the external tube or gage, after the moveable vessel of immersion is conveyed away on castors, if the bleaching liquor be supposed to be sufficiently strong, and is not immediately wanted, it may be drawn off in stone-ware bottles of that kind which is used for nitrous acid; or, if requisite, the distillation may proceed to its entire termination. I must only remark, that when the liquor is thus partly drawn off, the distillation is renewed though there be no increase of the fire, because the gas which escapes from the distilling vessels undergoes less resistance from the diminished column of water. This is even a method, as I have already remarked, to render the liquor in the second partition equal in strength to that in the first; for otherwise there will always be a difference between them, which, nevertheless, speedily disappears when the whole of the fluid contained in the pneumatic vessel is drawn off at once, and poured into the same vessel for immersion.

I shall now proceed to describe the method
of

of submitting piece-goods to the action of the oxygenated muriatic acid.

1. Above the vessel for immersion is placed the winch, or reel, used by dyers. The piece-goods, if there be many pieces, are sewed together, or fastened with strings in such a manner, that they form a large loop, or endless web, which is passed over the reel, so that by turning one part rises as the other descends, and the whole length is subjected to the action of the acid. One workman turns the handle gently, while another standing in front of the cloth, takes it by each selvedge, and conducts it into the liquor. Two round smooth staves may be used for the same purpose. The person who manages the immersion takes care to prevent the piece from folding breadthwise, and guides the cloth in such a manner, that it may continue open and expanded as it descends into the vessel.

This process of turning must be continued for half an hour, in which time the liquor, almost in every case, has produced its whole effect in equalizing the colour. It is then taken off the reel, and left in the acid for another quarter of an hour; after which it is passed again over the reel, and left in the liquor till the time of taking it out, which may be done immediately, if the

fluid no longer acts on the goods, and should appear still of value to operate upon other pieces. This may be immediately ascertained, either by the appearance of the fluid, of which experience will render the operator a sufficient judge, or by the proof of indigo or cochineal, pointed out in the Annals of Chemistry, of which I shall hereafter speak.

If the liquor do not retain sufficient strength for new, or dyed pieces, but enough for such as are in a more advanced state (which circumstances, and qualities, will be soon learned by experience); or if it be proper for cotton stockings, or thread only, they may immediately be immersed after having wrung the cloths by the wring over the trough, in order to save the acid they have imbibed, and bring them to a state fit for boiling. Every time the piece-goods are wrung, it is necessary to arrange them in folds on a clean table, or board, whence they may be carried and arranged in the same manner upon the stage of the lixiviating boiler.

In case there be no particular haste required to boil the goods, after it has been ascertained that the acid exerts no further action upon them; and supposing, likewise, that no other goods are at hand to be immersed in the fluid, the pieces may be disengaged from the reel, and left
in

in the bleaching liquor until they are wanted for the boiling. This prolonged immersion can do no harm, and only exhausts the acid more completely. Lastly, when this liquor is entirely exhausted, it is either to be thrown away, or else reserved for the purposes hereafter to be mentioned. This first solution, it may be remarked, has usually a ruddy yellow colour.

The vessel, or back, for immersion ought to be square, or at least, long like a bathing tub, because the piece-goods are much better stowed in such a vessel. It ought to be somewhat more than five quarters long, and three quarters wide, these dimensions being best suited to our piece-goods (in France). The height may be proportioned to the quantity or length of the pieces intended to be deposited therein at the same time, and the mass of fluid which must, consequently, be poured in.

The mixed goods of cotton and thread, or cotton alone, being more susceptible of the speedy action of the acid than such as are entirely of linen; and among these the fine being more speedily affected than the coarse, they must accordingly be taken out as early as experience may have shown to be proper for their effectual bleaching. The other goods which lie beneath, and require to remain a longer time in

the fluid, will be more advantageously acted upon, because they will be less pressed, and will float in a greater volume of the bleaching liquor.

Instead of passing the goods over the reel or winch in the manner here described, which requires the time and attention of two persons, the goods might be previously disposed in a frame of one ell in breadth. This frame, see Plate VIII. fig. 1 and 2, is provided with a number of pins with heads, over which is passed the same number of loops attached to the selvedge of the cloth, at the distance of an ell asunder. By this means the pieces are suspended in a zig-zag form, and not only occupy a small space in the vessel, but likewise become of a very even colour, in consequence of the free access which the acid obtains to the whole of the surface when the apparatus is plunged therein. This operation may be performed by a pulley fastened to lines which suspend the frame. The latter may thus be easily taken out with its charge, and be left to drain above the vessel itself, or any other vessel appropriated to that purpose, in case the liquor should be found sufficiently strong to admit a second frame previously prepared. If this should not, however, be the case, the fluid is to be disposed as before directed.

With

With regard to linen and hempen thread, and knit or woven goods of the same materials, they may be managed as follows.

Over a trough for the immersion, see Plate IX. fig. 7 and 8, are placed clean poles or sticks cleared of the bark, upon which the skeins of thread, stockings, night-caps, or mittens in pairs, are to be hung. After the acid is introduced, each hank, or pair of stockings, &c. is to be successively turned, by immersing that part into the liquor which was before upon the pole. In this manner the operator proceeds from one pole to the other, and returns successively to those goods which were first turned. Care must be taken to open them well at the time of turning, in order that they may present a greater surface to the fluid. Instead of turning the poles singly in this manner, it might be so managed by a band, or other mechanical contrivance, that the whole might turn together upon turning one single piece of the set. This method would be less tedious and fatiguing for the workmen.

It is advisable, that the troughs for the immersion of threads should be as nearly as possible of a square figure, in order that they may hold a greater quantity of hanks; and the distance between each may be very nearly equal, for the purpose of exhausting the bath

with uniformity; excepting that the distance between the sides of the vessel, and the thread may be less considerable.

As the bleaching liquor is liable to lose its gas more speedily in proportion to the extent of its surface, it might, perhaps, be proper to have the troughs rather deep than broad, in order that the gas may be more effectually retained; and since it is essential, that the bleaching liquor should act with the utmost possible equality upon the threads, instead of pouring it into the troughs wherein these are disposed and arranged upon poles, it would be more advantageous to cause it to rise gradually to the height of the hanks or poles; a condition which may easily be obtained by means of one or more tubes of lead or wood; the bended parts of which might be laid under the middle of the bottom of the trough. These tubes being fixed along the internal sides of the trough, may be furnished at their upper extremity with a funnel of wood, or of lead, for the reception of the fluid. After the fluid has been poured in, great care must be taken to keep the funnels closed.

These are the methods which it is convenient to use, to subject threads to the action of the oxygenated muriatic acid, when the operator is in possession of a certain quantity; but when, on the contrary, the quantity he possesses is
small,

small, or his operations on a small scale, certain pieces of basket-work, with handles, for which see Plate II. fig. 2 and 3, may be used, several of which may be placed one above the other in a round or square trough of oak or fir, it being of no consequence which of the two kinds of wood be used; upon each bottom a single layer of hanks is to be disposed, taking care that it shall be covered with the bleaching liquor at least one inch or two in depth, and to turn them upside down, at first every quarter of an hour, and afterwards every half hour; lastly, after one hour's immersion the thread may be taken out, if its colour be equal, and other thread put in, if the bleaching liquor continues to possess strength. In a word, this process is to be managed like the other already described; it must, however, be remarked, that the bleaching liquor may appear to possess some strength by the test of cochineal or indigo, though it may not have sufficient for the bleaching process; these nearly exhausted solutions are to be reserved either for the kind of preparation hereafter to be prescribed, or thrown away if no immediate use presents itself; or otherwise they may be kept for uses which I shall describe when I speak of piece-goods. The colour of the bleaching liquor which has been used for the first immer-

sion of linen or hempen thread or stockings is of a ruddy yellow, the same as that which has been used for piece-goods.

Brown or white cotton threads are to be steeped and turned in the oxygenated muriatic acid, in the same manner as thread of flax or hemp; namely, upon poles, or in baskets; with this difference, nevertheless, that they require to be turned only half as often. A good half-hour is sufficient for the first immersion, after which time they are to be taken out, and other thread put in, if the bleaching liquor continues strong enough for use, for it very seldom happens that the new bleaching liquor is incapable of serving more than once for cotton. This liquor does not undergo any remarkable change of colour.

Stockings, night-caps, gloves, mittens, and socks of cotton, may be very well managed with regard to the immersion, in the same manner as linen or cotton thread; but as this sort of bulky articles occupy a considerable space, and cannot conveniently be laid on the other, it is advisable to arrange them separately in layers in the troughs, which may be of any form, either round or square, though the latter form is most convenient, and, upon the whole, to be preferred. These articles are to be disposed in layers upon platforms of clear osier work, provided, as has
already

already been observed, with four handles, upon which the other platforms are to be placed. No more than three can be put into one trough. As the articles placed upon the uppermost platform might rise to the surface, which would expose them to an inequality of colour, another platform, or piece of basket-work, with a rim, may be placed above them, which must be so managed as to press the goods in a small degree, and prevent their rising. Two or three ranges of night-caps, stockings, &c. are sufficient upon each platform.

It is easily known when the cotton stockings, or night-caps, have remained a sufficient time in the first bleaching liquor. Nothing more is necessary for this purpose than to hold them up to the light; in which position they ought not to shew those opaque spots, which are of a more or less ruddy colour, according to the nature of the goods, or at least very few of those spots should appear.

Cotton stockings, with clocks, are more difficult to bleach in that part, and must be carefully pulled open every time they are immersed in the liquor, because they are very subject to shrink up. It is advantageous to turn them inside-out previous to the second immersion.

The present remark with respect to cotton
stockings

stockings is still more strongly applicable to ribbed thread stockings. The fingers of gloves are likewise more difficult to bleach at their extremities, because the texture is closest at that part. It is even prudent to turn ribbed stockings inside-out several times during the course of the immersion, for which reason it will be most convenient to place them always near the top of the vessel. Common cotton stockings, and other goods, may remain in the fluid without being turned during their immersion, because they are more loose and spongy. They may be left in the liquor about half an hour. Cotton manufactured into goods is more difficult to be penetrated than the simple thread. By means of cords passing through the handles of the lower platform, upon which all the others rest, the whole system may be very easily raised by a pulley. In this situation they must be left to drain above the trough; after which, the pieces are to be pressed separately by the hand, or all at once by mechanical means, if the operator be provided with an apparatus.

If the acid be still good, other stockings are to be immersed in it, either in their first state, or in different stages of the process; the raw articles must be immersed in less quantity than those which are partly bleached: if the liquor be

be nearly exhausted, it is to be reserved pursuant to the recommendation already given.

The observation which we have made with regard to night-caps, stockings, &c. made of cotton, in which the greater or less effect may be seen by holding them up to the light, is also applicable to gloves and stockings of linen thread: but, as it has already been remarked, these goods are much more difficult to bring to an equal colour; for however loose the texture may be, the linen thread always swells considerably, so as to render stockings stiff and inflexible. The texture in this situation is so difficult to be penetrated, that the bleaching is as it were entirely superficial. It is better, therefore, when stockings are required to be well bleached, that the thread should have been cleansed at least before the knitting or weaving, by which means it becomes more disposed to open and imbibe the acid. Stockings, of linen thread entirely in the raw state, without having been cleared of their first impurities, are very unpleasant for the bleaching liquor to operate upon, and still more when they are ribbed or have clocks. These goods are liable to a very unequal colour.

In general, all kinds of looped or stocking work of flax or hemp, must be suffered to remain

main in the liquor at least half as much longer than other goods ; that is to say, from two to three hours, for the acid does not penetrate them and give them an equal colour, unless it be suffered to operate for a considerable time. They must not even be lixiviated until their colour is nearly equal. If it should happen that they do not acquire an uniform colour during the first immersion, they must have a second, which must, in both cases, be of considerable strength, and in which they must be kept a sufficient time to undergo the effect without the intermediate action of the lees. This observation is equally applicable to all other piece-goods of linen, or stockings of cotton.

With regard to knots of flax or hemp, they are to be bleached in the same manner as the stockings and night-caps, by disposing them as much as possible in thin strata ; because filaments are naturally much disposed to become entangled, and form a close mass. Knots of flax are bleached very speedily, that is to say, by one or two immersions less than are required for thread of middling fineness. It must, nevertheless, be observed, that they must not be bleached until after having been beaten and combed, because they must always be soaped after the bleaching, on account of their adher-

adhering together while drying, a circumstance which can hardly be prevented. If this be not attended to, there will be considerable loss. Knots of flax bleached in this manner, and afterwards combed, appear to the eye as beautiful and shining as white silk.

It must be remarked, that if the stoop of flax or hemp obtained from this bleaching, or bleached separately, be cut, in case the staple be too long, and afterwards carded, it has a singular resemblance to the cotton of Siam, which is very plentiful in the market, and known to have the shortest staple. When it is well carded, no difference can be perceived between the two articles; neither is it possible to distinguish them in spinning. I have had an opportunity to weave some of this thread at the end of a web of cloth, where it might have been taken for real cotton. I have likewise had an opportunity of using it in candle wicks, in which there was no perceptible difference between it and cotton, either with regard to the colour, or clearness of the light. It will, no doubt, be a very interesting object to ascertain all the advantages which the commercial world may derive from this application of the oxygenated muriatic acid.

CHAP. X.

Instructions with regard to the Quantity of Lixiviations and Immersions.

THE number of immersions for hempen or linen goods is commonly three for fine goods, such as hollands, cloths, lawns, &c. &c. five for common cloths, and seven for the coarsest. It may also happen, that an immersion extraordinary may be required for each of these kind of goods, according to the accidents they have met with, the greater or less degree of closeness in their texture, and the dark colour of threads here and there passing through the cloths, particularly in those known at Laval under the name of toiles brindellées. This name is given to them on account of threads passing through them, which are said to be dyed by the manufacturer for the express purpose of rendering it heavier, and on this account more advantageous in the sale. The dark threads of these cloths can never be bleached by the common method; whence a judgment may be formed of the advantage of the new method in bringing these goods

goods into the market, which, though fine and equal in beauty and general whiteness to those of Flanders, Ireland, and Silesia, are nevertheless greatly depressed in price, on account of the singularity in the colour, which renders them at least twenty per cent less valuable.

From the number of immersions here prescribed, it will follow that the lixiviations may be reduced to two for fine cloths, four for middling cloths, and six for the coarsest kind, supposing the most perfect white to be required; for if a commoner colour should be thought sufficient, one lixiviation, and one immersion, may be deducted from each kind of goods; whence it follows, that for a middling white no more will be required than to give one or two immersions to the fine goods, two or three for those of medium fineness, and three or four for goods of the most inferior quality.

With regard to piece-goods of cotton, the coarsest will not require more than four immersions, and three lixiviations. For such as consist of linen and cotton mixed, no regard must be paid to the cotton, but to the thread, which always, during the process, remains behind in its degree of perfection. Nevertheless these are bleached more speedily than if they were entirely of linen, because the cotton, which is intermixed,

termixed, renders the goods more penetrable by the acid. In general no more than five immersions and lixiviations are required for the coarsest goods of this kind. The same advantage of speed is also obtained in other open-worked goods, which admit the acid more readily into their texture.

Linen and hempen threads are affected nearly in the same manner as piece-goods; that is to say, the fine thread requires no more the three immersions, and two lixiviations, the middling four or five, and the double or sewing thread, or threads of coarse quality, six or seven immersions; whence it follows, that three or four lixiviations are sufficient for fine thread, five or six for close coarse thread, and six and a half for sewing thread of the same quality. The latter threads requiring more care and attention, are likewise more difficultly penetrated by the acid.

Gloves and stockings of hemp or linen follow nearly the same proportions, with the addition of half a lixiviation and one immersion more, according to their quality, the closeness of their texture, and the inequality of the thread. Ribbed stockings, or such as have woven clocks, will, likewise, in some cases require an additional immersion. The same proportion is to be observed in these goods when they are mixed, as
was

was shewn with regard to mixed cotton goods, excepting that an extraordinary immersion, or half immersion, is given on account of the linen thread, which swells up by moisture, and always becomes white somewhat more slowly. But, on the whole, single threads bleach more quickly than piece-goods, because the threads are more disengaged and separate from each other, and being less compressed admit the fluid into contact with greater facility, with the exception only of dyed or sewing thread. But this facility in the bleaching is fully counterbalanced by the care which thread requires to prevent its becoming entangled or broken.

Three immersions are sufficient to bleach the coarsest cotton thread, such as that which is intended for cotton wicks; and accordingly no more than two are required for common threads with the appropriate lixiviations, it being always understood that the finest white colour is here meant. It is of no consequence whether the cotton be of a dark colour, or inclined to white: the latter, which is naturally more foul or impure, might be expected to bleach more speedily, but it frequently acquires the proper degree of whiteness more slowly than the other.

Gloves, mittens, socks, night-caps, and stockings,

ings, of cotton, require no more than three immersions, and sometimes two are sufficient, according to the quality and closeness of their texture. Hence it may be observed, that the number of lixiviations cannot exceed two for the most common goods, and it is, therefore, easy to regulate the process for an imperfect white. This colour, however, is seldom required on cotton.

I must observe, that by the words half lixiviation, I understand that the lees possess no greater strength than one degree at most for thread and piece-goods, and half a degree, or three-fourths, for cotton, if the lees be new; but otherwise the operator may use such as have already been applied, and have not been restored to their original strength. When the same term is applied to immersions, I mean to speak of the bleaching liquor, diluted with one-fourth of its weight of water, or such as has already been used for the first white, and still retains strength enough for the immersion of pieces already advanced in their bleaching.

When the muriatic acid without smell is well made, the operator sees with pleasure that one quarter of an hour after the immersion of thread, a white, and, as it were, soapy lather comes up to the top. This is a good sign, for it very seldom

feldom happens, that pieces immersed in a bleaching liquor which produces such an effect, do not obtain an even colour. I must, moreover, remark, that it is not necessary to dry the goods before their immersion in the lees, or the bleaching liquor. It is sufficient that they be well wrung, or cleared of their water to such a degree, as only to remain moist. We might even plunge them into the bleaching liquor immediately after their rinsing, or wringing out of the lees, if it were not that this management diminishes its strength in some degree.

On the same principle we may plunge the goods, when taken out of the bleaching liquor, into the lees without rinsing, but merely after strong pressure, though the rinsing appears to deserve the preference. To save time and trouble, however, I would advise the operator to omit the rinsing when he is desirous of hastening his work; the only risk which this omission affords, is that of weakening or neutralizing the lixivium to a greater degree, which by this means will not serve for so many boilings. It is proper also to remark, that if a lixivium thus neutralized, but not loaded, with colouring matter (which may be productive of deception if the strength be not ascertained by the taste) be used, the goods will come out dyed of a

nankeen colour, and the operator will be astonished that they do not bleach though steeped in a new and strong bleaching liquor. This last, on the contrary, serves only to deepen the nankeen tinge; but, as I have before remarked, this accident does not happen, excepting when the lixivium is entirely exhausted, and neutralized by frequent immersions of goods therein. This effect does not usually happen, until after the lees having been used five or six times without being renewed. The remedy for this accident will be given hereafter.

I shall conclude the present chapter by observing how useful it is to rinse, and cleanse the goods as soon as they have undergone their lixiviation, that is to say, a few minutes after taking them out; they are at that time more open in their texture, and more disposed to part with the impurities which the lixivium may have detached.

In the rinsing of threads, they must not be held by the string of the hanks, but, on the contrary, the hand must be passed through all the skains, and thus held, they must be stirred round in the water. By this treatment the thread is better cleansed, because it remains less entangled, and more open. If the operator have the advantage of a river, or stream, the shortest

shortest method will be to loop them all on a pole, and hold them suspended in the water. The poles are to be fixed in an osier basket, in order that such hanks as may be accidentally detached, during the act of turning, or placing them, may not be carried away by the stream. This is much more expeditious, and less embarrassing.

CHAP. XI.

An Account of the Quantity of Linen, and Cotton Thread, bleached at each Immersion, and the Colours acquired by those Substances.

THE quantity of pounds of linen, or hempen thread, which may be passed into a bath composed of the whole contents of a pneumatic vessel of the acid without smell, obtained according to the doses and proportions before prescribed, may be estimated at sixty or sixty-two pounds for the first immersion, and eighty for the second and following immersions. In order to avail himself of this datum, for piece-goods which are to be plunged in the liquor, the operator must take care to weigh them beforehand, previous to steeping them to clear off their dressing. This quantity is also susceptible of variation, according to the quality of the thread. Thread of middling quality is here meant.

The quantity of cotton which may be passed through a similar dose of the fluid, is from eighty to ninety pounds, of middling quality, for the
first

first immersion, and one hundred for the second. According to this rate the operations must be regulated for other objects, such as stockings, night-caps, gloves, &c.

It is more adviseable to diminish than increase this quantity of goods, to have them more perfect, more equal, and of a better white. The succeeding immersions will produce a greater effect upon threads thus treated.

The bleaching liquor which has been used for cotton becomes slightly charged with colouring matter, and at the first immersions acquires a pale amber colour. The latter immersions do not change it, but leave it clear and limpid. The same observation is applicable to both the oxygenated acids; that is to say, the acid with smell, and that which is without.

As it is of essential consequence to be aware of certain events, or facts, by which the progress of the bleaching may be ascertained, I shall here point out the gradations of colour, which the pieces assume after each immersion in the oxygenated muriatic acid without smell, made according to the proportions here described. The first immersion gives the thread, or piece-goods, a reddish colour, slightly inclining to yellow; the second, a colour inclining to ruddy yellow;

the third, a whitish yellow ; the fourth, a white, slightly inclining to a ruddy tinge ; and by the fifth and sixth, the white becomes clearer and clearer. These are very nearly the shades which are assumed by coarse goods, for the fine goods frequently pass to the second or third gradation by one single immersion.

When the liquor is strongly concentrated in pot-ash, such as that which is denoted in the annals of chemistry by the name of Javelle, the goods immediately, and without previous lixiviation, assume the third colour ; but I have observed, that it is difficult to bleach them further without using the sulphuric acid, to remove the lees with which they are loaded. It must, moreover, be remarked, that in order to obtain this tone of colour, it is sufficient that the lixivium be diluted with water, so as to mark two or three degrees only on the aerometer instead of eighteen or twenty, which it may mark after it is prepared by distillation.

There are some who do not approve the colour which the thread acquires after the first immersion, but it may immediately be reduced by steeping the goods in cold or hot lees. The latter produces its effect more speedily ; and after subsequent rinsing and drying, the goods retain a
grey

grey white colour, more or less deep according to the shade it has received. Many venders prefer this grey, or reduced colour, on account of its preferable sale in certain markets.

With regard to the bright and perfect white, there are very few persons in the provinces who care for it, or appear to give it an exclusive preference. Two reasons may be given for this: first, because a prejudice is unfortunately established against the speed with which the new invented method of bleaching operates: and secondly, the consumer is constantly persuaded, whether the bleaching may have been performed in this manner, or in the field, that when the goods have attained an extreme degree of whiteness, they cannot be as durable as such as are less white. It is thought to be rotten, or burnt, and this opinion leads to a preference in favour of such linens, and even cottons, which preserve after bleaching a solid shade of grey, or dulness in the white.

From a prejudice of the same kind it is, that, in many countries, the women, particularly the peasants, prefer their linen, whether for clothing or household use, simply cleared without bleaching. The orders of proprietors, or purchasers, must therefore be attended to, and the
number

number of immersions and lixiviations regulated accordingly.

It may be considered as a rule, that when the goods no longer communicate a perceptible colour to new lees, they are entirely finished, and consequently, that every subsequent lixiviation, or immersion, will be attended with absolute loss, unless the immersion is necessary to clear off the last lees, on the supposition that simple rinsing in a large quantity of water may not be sufficient.

I must, nevertheless, remark, that thread bleached by the oxygenated muriatic acid, may be used by the sempstresses with much more speed and briskness than thread of the same quality bleached in the field; it is less brittle, and, on that account, is better for the weft, as well as the warp. It likewise may be struck much more effectually home to its place in weaving, and does not afterwards move. I received this valuable observation from impartial and unprejudiced manufacturers, for whom I bleached thread according to this method for making handkerchiefs.

Before I conclude the present chapter I must observe, that the conjunction of the old and new methods of bleaching may be of incalculable advantage.

advantage. For however great may be the speed of bleaching by the oxygenated muriatic acid, it is scarcely possible to adopt it in an extensive manufactory, to the exclusion of the method of exposure in the field, without very heavy charges in workshops, tools, and utensils; I would therefore advise, that the entire bleaching, without exposure in the field, should be confined to such goods as are intended to receive, what may be called, a half or three-quarters white; and that those which require a higher bleaching should be finished by exposure in the field. By this arrangement the production of each kind of white colour will be distributed, so as to be very speedy, and to acquire the requisite degree of perfection in a very economical manner for the manufacturer, under all the heads of time, expence, and labour. The high price which may be afforded by a piece of a perfect white, and fine quality, will be a compensation for the price of common goods intended for ordinary use.

CHAP. XII.

Of the First Dressings.

IN order to give more clearness to the white colour of bleached goods, it is usual to give them certain dressings. Fine piece-goods, sewing thread, stockings, gloves, and other articles of thread, or cotton, are more particularly subjected to this treatment. The following instructions may be sufficient to shew the management of these several articles, after they have been submitted to the last immersion. 1. The piece-goods are first to be pressed, or wrung, in the same manner as after taking them out of the muriatic acid, and in this state they are to be immersed in water, rendered sour by sulphuric acid, to such a degree that it may mark from two and a half to three degrees of the areometer of Mofsy. The Irish manufacturers, who use this acid in preference to sour milk, for the bleaching their piece-goods, compose their bath of one hundred parts of water to one of acid. This proportion communicates to the water a taste resembling that of strong lemonade.

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The French bleachers, particularly those of Mayenne and its environs, who are accustomed to pass their piece-goods through sulphuric acid, compose their bath of sixty pots of water to one pot of sulphuric acid, and they leave their goods immersed therein during the whole night. The bath may be used cold, but it is more effectual and speedy in its operation when heated, and appears besides to throw out the colour to more advantage. If it be thought proper to use the heated bath, it will not at all be necessary that it should exceed the heat which the hand can conveniently support. But it is adviseable in that case, to pour in the sulphuric acid at the time when the hot water is added, or else to mix it with one of the measures of cold water, which may be used to dilute the mixture, or to cool it. At the time the hot water is poured out of the boiler, the acid must be poured gently, and with care, because it is liable to fly about *; and the greatest attention must be paid to mix it well with the water, in order that the bath may be equally acid throughout.

The goods which are immersed in the bath

* This danger is obviated by actually plunging the neck of the bottle in the water. The sulphuric acid immediately quits the bottle, in consequence of its superior weight.—T.

may

may be left for half an hour, or an hour, without the least apprehension of any ill consequence: I have even left them for twelve or fifteen hours without the slightest accident. The bath must be left covered whether it be hot or cold, principally in order to prevent any accidental dirt, or other impurity, from falling into the fluid. The goods must not be too much pressed together: the less they are pressed, the sooner the acid will produce its effect, and consequently the less time will be required for them to remain in it.

When the goods are taken out of the bath they must be pressed or wrung, and then kept in a stream, or large mass of water; that is to say, until upon rinsing them out in various parts, and applying the tongue to the part that is cleared, no acid taste shall be perceived. If any such taste remain, the goods must be immersed again, if in a running stream, or the water must be changed if they be steeped in troughs.

When the goods are ready for taking out, they are to be wrung with the winch, or hook, before described, and pressed, and then passed through the blue liquor if necessary. The bluish cast may be given in two ways, either by passing them through a hot or cold solution of
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the soap, in which a small quantity of fine indigo has been diffused in the usual manner by means of a bag; or otherwise the piece may merely be plunged in a solution of white soap, without any kind of blue, while it still contains a small portion of acid. In the latter case, the acid contained in the cloth immediately develops in the bath a slight tinge of Prussian blue, arising from the particles of iron combined with the alkali of the soap, which tinge is distributed very equally on the whole piece. I must remark, that I have always used white veined, or mottled soap, to produce this last kind of blue. As a certain degree of experience is necessary in the use of this second method, which, nevertheless, possesses the recommendation of economy, I would advise the operator to make use of the former, until, by trials, he is so far accustomed to the second as to have no fear of mistake.

The piece-goods being then well pressed are always dried upon lines of hemp, or, which is still better, of hair stretched on poles properly disposed under cover; the pieces are held on the lines by the usual wooden peg or clamp of the laundresses, or they may be hung over poles cleared of the bark, and covered with coarse cloth, in order that the goods may not receive
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any stain from the wood. It seems, upon the whole, a matter of indifference, whether the drying be performed in the shade, or in the sun-shine.

With regard to common or coarse cloths, which require no very extraordinary bleaching, they are never blued unless it be required. In every case, as it is essential that the blue should be given with as much evenness as possible, care must be taken to pass the pieces over a reel placed above the vessel expressly appropriated to this purpose.

Linen or cotton thread, &c. is dressed in the same manner as has been directed for piece-goods. These may be plunged in a bath of sulphuric acid upon poles, or in the same manner as has been directed for the bath of blue. It is not necessary to turn them, because the poles are fixed in the vessel beneath the surface of the liquor; or, instead of this method, they may be disposed in layers in baskets of white willow. The bath of sulphuric acid may be used for all kinds of goods, though in process of time it assumes a slight amber colour; it is possible, nevertheless, to use it without danger until it is entirely exhausted, taking care only to restore it from time to time, by the addition of that quantity of acid which may be necessary to keep up
its

its strength ; when, however, the bath of acid has at last acquired too deep a colour, it must be entirely renewed.

Linen and cotton threads are likewise plunged in the bath of blue, after having immersed them in the acid upon the poles ; but in order that this part of the preparation may be distributed equally, the skeins must be turned once or twice half round ; they may likewise be pressed by the hand, provided the quantity be so small as to render the economy of time an object of no consequence.

Every kind of wood may be employed with nearly the same advantage, for the baths of sulphuric acid or blue, without fear of spotting the goods. I have used oak, chestnut, white-wood, and deal. The latter, however, is preferable, if at hand. Great care should be taken, that there should be no nails in it ; and before the pieces are plunged in either of the baths, the acidulated water must be well stirred, in order that the acid, or the blue, may be equally distributed. Stockings, night-caps, gloves, &c. of thread or cotton, require particular management. After the bath of sulphuric acid, and before they are passed through the blue, it is always advantageous to give them a good solution of white soap, in which they must be well

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rubbed,

rubbed, for the purpose of completely removing the spots of oil or grease of the manufacturer, which may have resisted the black or green soap, or the lees, to which they have been subjected during the process of bleaching; for it very seldom happens, that they are entirely clear of such spots, because the dirt of the hands with which almost all this kind of goods are covered, frequently prevent their being seen. The oxygenated muriatic acid having likewise little or no action on fat or oily bodies, the different objects so spotted might be plunged to little purpose in that fluid.

Stockings, gloves, &c. when taken out of the solution of soap, are to be cleared in clean water, after which they are to be subjected to the press, or wrung, previous to passing them through a slight infusion of blue. The second method of communicating the blue tinge, as before described, may here be used, that is to say, they may be plunged in the solution of soap immediately upon taking them out of the acid, and rinsing them, if the goods have no spot upon them, which it is essential previously to discharge. After they have received the blue, they are to be pressed, or wrung, and dried upon cords, first turning them inside-out, for fear of soiling the place of contact. This precaution

caution ought to be taken before they are passed through the blue, and at the time of taking them out of the solution of soap.

Linen or cotton thread requires its hanks to be opened and separated, in order that it may dry more speedily. This is the most certain method of preventing the entangling of the thread, and their consequent breaking, which would not fail to happen sooner or later, especially with single thread, if the operator were to suffer them to dry before they were separated from each other. This separation is to be made after they have been pressed, or wrung out of the last fluid. It is time enough, nevertheless, to do it when they are half dry, and in this state it is, in fact, rather more convenient.

The following method is very convenient to untangle the thread, particularly such as is fine, and restore it to its original state, when, in consequence of the operations of bleaching, the skeins may have been mixed in such a manner as to endanger their breaking, if an attempt were made to clear them by any other means. It consists simply in extending each skein separately, and slightly, under water. By turning and returning them, and afterwards extending them with the hand, the threads will very soon arrange themselves, and obtain their original

situation gently, without obstacle, and without giving any cause to apprehend their breaking.

If by accident the thread should become dry, while too much intermixed to be cleared and wound off in this state for wefts, warps, or other uses, nothing is more effectual to clear the skeins, than slightly rubbing them with linseed oil, here and there. This method is used for entangled filk; and I have found it succeed perfectly well with thread.

The operator must be aware not to soap cleared objects (such as callicoes, or other linen, or cotton goods, dyed or printed) in the soapy solution, which has been used upon pieces taken out of a strong oxygenated muriatic acid, even though they may have first passed through a bath of sulphuric acid. For this solution of soap does not fail to acquire the property of bleaching and discolouring other goods, unless the goods which were soaped have, after being taken out from the muriatic acid, been immersed in clear water for a long time. I have several times beheld this effect with surprize; I have frequently remarked, even that pieces, which after being taken out of the bleaching liquor, have undergone an immersion in the sulphuric acid bath, still retained a sufficient quantity of muriatic acid to assume a yellowish tinge after

after they had passed through an infusion of indigo. This last sometimes assumes the same tinge after an interval of twenty-four or thirty hours.

To avoid this inconvenience, it is necessary not only to cleanse the piece by rinsing after its last immersion, but likewise to give it a slight immersion in a soapy or alkaline water, from which it must be afterwards well cleared.

The bath of indigo must be composed in such a manner, that it may not be necessary to restore it during the immersion of the same article; otherwise there would be a danger of its receiving different shades of blue.

There is much less danger of this in using the azure blue (powder blue of the market), the different shades of which are all previously prepared, and sold in this separate distinct state. In either case it is necessary to plunge the goods in the bath, at the moment when the colour is suspended, and to leave them in it no longer time than is necessary for them to imbibe it.

I have before recommended, that the waters of the immersions, or bleaching liquor, should be preserved, even though too weak to act sensibly upon the pieces already in part bleached. They are useful in this part of the process; that is, after the dressing with soap, for such articles as

are not to be passed through the blue: for this last dressing is not agreeable to every one, because it gives a greyish tinge to such parts as are not of a very firm white. After the immersion in soap-water, and the subsequent rinsing, the goods, being first well pressed, are thrown into this exhausted bleaching liquor, where they soon acquire a clearness, which has a very good effect. After they have remained in this fluid for half an hour, they are to be pressed and dried as before directed. It may also be remarked, that the same reserved bleaching liquor, though exhausted, is excellent for clearing and rinsing thread and stockings from their lixivium when they are already bleached. If it were applied to no other use, it is preferable for this use to common water. The several articles are much more speedily cleansed, and acquire a certain degree of improvement in the general appearance of their colour.

Some persons require in their goods a certain dressing, as it may properly be called, which affords, particularly to such as are of open texture, an appearance of firmness, which they lose when folded. The dressing may be given in a more or less durable manner. The first method consists in drying the goods, with scarcely any wringing, and hastening the drying

as much as possible. This dressing is, as may easily be imagined, one of the most innocent; but its effect disappears by handling, or carriage, or by one single time of wear. The second dressing, which is permanent till after washing, consists, as all the world knows, in incorporating starch with the powder-blue for such objects as require it, or using it without blue for those which do not. The dose must be varied according to the quality and kind of the goods, and the choice of the proprietors.

There are likewise certain articles, to which a greater or less appearance of firmness is given, by a dressing of glue or gum-arabic, which is mixed with the starch after both have been boiled separately.

There are also certain articles, such as linens, which are frequently dressed with a decoction of rice.

These different goods are always hot-pressed by means of a cylinder; which operation gives them the proper degree of firmness.

As every object which can be of use to accelerate the work, and diminish labour, is of great importance, I shall here describe the machine with which the English, who are the inventors, wash their fine linens.

It consists in a kind of churning instrument

(see Plate II. fig. 15 and 16), the circular part of which has four holes bored in it, into which are fixed pins of white-wood, rounded at their extremities. They are more or less long, according to the depths of the troughs in which they are used. The handle of this instrument is a cross, or T, with which the pins at the other end may be moved in different directions, and used to agitate the stockings, and other small articles deposited in the troughs, containing the solution of soap. This instrument being moved in various directions, is very convenient in causing the fuds to lather, and to impregnate the linen with great expedition. It appears to me, that such an instrument may be useful to cleanse stockings, gloves, and other articles of cotton or linen thread, which may be required to be bleached or discoloured, as I shall hereafter more fully explain.

I have been informed by an English woman, whom I saw make use of this machine, that they have others of the same kind in England, of a size adapted to common washing; and even some of such large dimensions as to be moved by horses. If this be practicable, it might, at least, be worth trying. And for this reason it is, that I have thought proper merely to describe the small instrument I have myself seen.

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The same recommendation may be offered in favour of another machine, which is used in England to rub coarse linen. It consists simply in two strong planks with grooves, the uppermost of which is moveable; the motion which it gives to the cloth passed between them causes the soap, or lees, in which it is plunged, to lather, and contributes to clear it of its impurities.

The English likewise use, with advantage, for washing clothes, two grooved cylinders, running one upon the other, by means of a handle above the vessel of water, between which cylinders a number of pieces of cloth are passed at a time, their extremities being sewed together, so as to form a long loop, or endless web. A few turns of the cloth between the cylinders (the lower of which is absolutely covered with water) are sufficient to cleanse it from all the impurities which the lees have opened and detached. I have not thought it necessary to give a design of these two machines, which are executed and used with success at St. Denis, as well as at Beauvais.

CHAP. XIII.

Of the last Dressings.

PIECE-goods, bleached by the oxygenated muriatic acid, if left to themselves during the course of bleaching, are subject, from the nature of their thread and texture, to swell and contract; and, consequently, to lose, in their dimensions, particularly in length. It is essential, therefore, not only in order to recover this measure, but likewise to render the piece more uniform, softer, and more equal in its grain, that it should receive a proper dressing, to restore its original state. The necessary treatment for producing this effect, is by means of an apparatus described in Plate VI. fig. 1 and 2. It consists of a light frame of wood-work, on the upper part of which there are several light bars fixed across, very near one another; and on each side is a grooved piece. The piece-goods are drawn between these bars and the stretcher; after which they are rolled on a wooden cylinder, moved by wheel-work, turned by one or two men, according to the degree of tension required

quired to be communicated. This dressing on the roller may be performed either with or without the application of heat; the piece being either humid or dry.

It must be dressed in a dry state, without heat, when nothing more is required than to soften the grain, and to restore its original dimensions. On the contrary, the operation is performed with the assistance of heat on the humid piece, where it is required not only to be stretched but dried at the same time. Independent of the force of tension to which the piece is subjected in the direction of its length, the person employed to roll it upon the cylinder must be careful to pull it out by the selvages, to the same width as that part which is fixed upon the cylinder already. The piece must then remain at least twenty-four hours upon the cylinder, that the folds, or wrinkles, may be totally effaced, and its original dimensions permanently restored. The rollers, or cylinders, should be covered with cloth, to prevent the bleached goods from being soiled, and iron plates must be placed beneath for the purpose of drying them, when it is required that this operation should be performed at the same time as they are stretched and rolled.

When the object of the manufacturer is
simply

simply to take out the folds or wrinkles of the piece, without altering its grain, it is to be successively passed over seven wooden rollers, disposed one over the other in such a manner, that by turning one, the six others, over which the piece is rolled, must likewise turn. The handle of this apparatus is fixed to the lower roller, and requires one person to turn it. I have not thought it necessary to make a drawing of this machine, as it is now used in many manufactories and workshops.

When it is required to compress the grain of the piece, or to glaze it, it must then be passed through a hot calendar, see Plate VII. fig. 1, 2, 3, which consists in a solid frame of wood-work, in which moves a brass cylinder, kept at a certain degree of heat, by means of balls or bars of iron heated in a furnace, prepared for the purpose. This cylinder is placed between two others of walnut-tree, and of twice the diameter. Before its arrival at these cylinders the piece is passed over and under several bars, as well as through a stretching frame. This machine is usually moved by a horse, though there are some which are worked by hand, but, of course, with less expedition. In either case, that is to say, whether they may be intended to act with or without heat, although the former is preferable,

able, the machine is always set in motion by a train of wheel-work, to procure a somewhat greater degree of tension, and more perfectly to efface the folds. When the piece passes under the heated cylinder, it is to be slightly sprinkled with water, by means of a small broom or rod. In some bleaching works they use the mangle, more or less loaded; a well-known engine, consisting of a square heavy box, which is made to run backward and forward upon cylinders of wood. This machine, which is commonly moved by water, or by a horse, does not glaze the goods, but lengthens the measure. It necessarily implies the use of an engine, like that described in Plate VI. to dispose the pieces upon the cylinders. The mangle is also necessary when the goods are required to be damasked, that is to say, when the effect of a wave is desired upon their surface. This last dressing is easily obtained, by rolling the folds a slight degree in zig-zag.

The following method is likewise very much used for drying piece-goods by the dealers of those articles. It is extremely simple, and consists simply in a plate of copper or brass placed on an iron stand, under which is placed a basin of charcoal, or burning embers. The piece being passed over this heated plate, dries gradually,

ally, and very speedily. This method is equivalent to a second passing through the stretching engine, and serves well for drying, but does not restore the original measure. It is, however, perfectly well suited to stockings night-caps, &c. The heated plate should be kept perfectly clean, lest it should soil the goods.

The method of drying, and giving uniformity to piece-goods, being described, it now remains to be shewn, how thread is to be arranged and dressed after drying on the pole. The preparation given to this article tends to clear the thread from that roughness which it acquires from handling, and never fails to exhibit when dry. This is easily removed by shaking each hank, either upon the pin or the hand, after having rubbed it between the hands, or beaten it with a mallet. The operation is particularly necessary for skeins of sewing silk, which, as I have before remarked, are disposed to curl up and shrink from their original measure; to which they may, however, be very speedily and conveniently restored by means of a kind of frame, see Plate VIII. fig. 3 and 4, across which the skeins are to be passed and stretched. One of the moveable cross-pieces is to be raised and fixed, by means of the pins which enter into holes disposed in a zig-zag direction, at a small distance

distance from each other, on the apparatus of the frame. It may easily be understood, that each skein being moistened and wrung, and afterwards passed over these cross-pieces, must remain thus stretched for a certain time, that is to say, until it is dry, and by that means forced to preserve the length, which it has received from this tension. But this last preparation is not usually given, except to double or sewing thread, which must be spread out as much as possible upon the cross-piece, in order to hasten the drying.

The skeins of single thread are afterwards to be tied up in the middle, and put together by scores, or quarters of the hundred, in a bundle, tied together with a skein of the same thread. At least the finished thread, in some provinces of France, is thus made up for delivery from the bleacher to the merchant or manufacturer. With regard to sewing or double threads, they are turned up in a spiral or twist, and, in order that they may lie close, this operation is made on the pin. See Plate II. fig. 12. This, in France, is called folding up in carrots.

Stockings, night-caps, &c. of thread or cotton, as soon as dry must be examined, to take up the stitches, or repair them, for it very seldom happens, particularly in slight goods, such as stockings,

stockings, that they pass through the various operations here described without some stitch falling ; there is, indeed, little to be feared if the cotton be knitted by hand, but most goods which are wove in the stocking engine, which is employed in preference for articles intended for sale, are very unequally knit ; and many articles are made, like the English goods of the same kind, with two or three threads, which diminishes their strength still more. Stockings, gloves, &c. after examination, turning, and repairing, if necessary, are disposed in the prefs, folded in three folds according to their length, then sorted according to their quality, fashion, and dimension, in sixes or half dozens. After dressing, if required, they are then put into the prefs ; and lastly, wrapped in blue or white paper, and properly marked.

These last dressings are not commonly given, unless the employer requires them ; otherwise these kind of goods are returned as soon as dry, even without turning them, for fear they should be soiled in the carriage. In many places stockings are dried on the leg, in order that they may recover the contraction they have undergone in the bleaching, for it is the property of frame-work knitting to shrink and draw up a little when wetted. No more than one pair of
stockings

stockings is put on each leg; and to prevent their shrinking, as they dry, the upper part of the leg is fixed with pins after the stretching has been carried to the required extent. The forms, or legs, ought to be made of ash-wood, and, if possible, of a single piece, because the stockings may be torn at the place where the two pieces that form the foot and leg are joined together, as is frequently the case with these implements. The corners ought to be very carefully taken off, to prevent the same accident from taking place.

Stockings, whether of thread or of cotton, are likewise singed with a hot iron, which is passed over the article, properly stretched on the leg. This preparation is not to be given but just before the last bathe in the lixivium, or immersion in the acid, on account of the reddish brown colour, which is the consequence of this process, and requires to be cleared off.

Instead of this process with the hot iron, the goods are sometimes passed over a lamp of burning spirit of wine. These particular dressings are only given to such goods as are required to have a very uniform appearance, and the most exquisite white, in imitation of goods of the same kind which we import from England.

Having thus shewn the method of dressing, squaring, and drying the pieces, I shall now proceed to give directions for folding them. This operation is usually performed on the stick, because it is very expeditious, and the goods are in this way very properly folded.

Most piece-goods are folded in two, across their length (see Plate II. fig. 7); for this purpose, one of the ends of the piece is passed over a moveable roller, previously suspended at each extremity in the loop of a cord, fixed to the cieling of the work-shop: this length of the cloth is thrown on the other side of the roller, and the workman continues to make the fold he has began, by drawing what he has folded equally over the roller. In this manner the piece becomes completely folded up. Attention must be paid, that it should fall upon a stage, or board, in order that it may not be exposed to injury, or dirt.

The cloth, thus folded in two, is carried to a table (see the same Plate, fig. 8 and 9) to be folded in this state, in equal and regular folds. The length of the intended fold is taken with the piece itself, which is applied to two flat iron bars, fixed on each side of the table, and pierced with different holes, to fix the supports which determine the length of the folds; after which,

which, with a first rod resting on the two first supports, the cloth is thrown over the rod, and thence carried to the second, which is to form the opposite fold. In this place a rod is laid to form the fold, and the cloth is again carried to the opposite extremity, where a second fold is made over another rod. Hence the workman proceeds, as before, to the other extremity, and the same process is thus repeated to the end of the piece, drawing out those rods, as he proceeds, which were first laid. It is not necessary to use more than four or five rods at each side. They are of polished iron, of the thickness of a little finger; the pins, or supports, placed in the holes of the flat bars of iron, ought to be sufficiently long to contain all the folds which the cloth may require. The length of these folds are proportioned to the extent, or volume, which the piece is expected to occupy after the folding. Experience will soon direct the operator in this matter.

To this operation succeeds that of the press, if the pieces are thought capable of it, with regard to their bulk, and the facility in disposing them for that purpose. On taking the piece out of the press, when it is folded in equal folds, whether single or double, it is turned inwards, so as to form one general fold, as may be seen in

Plate II. fig 10; in which situation it is secured by strings of different size, according to the quality of the piece. The piece thus packed together is ornamented with tassels of gold thread for fine goods, such as cloths, cambrics, muslins, or of silk of different colours for more common goods. With regard to coarse goods, it is usual to knot the strings together in the front part of the fold.

I must here observe, that piece goods lose in their length by bleaching about one ell, or an ell and a quarter in twenty-five, according to their quality; and this loss is restored to them again by the last dressings here described.

With regard to the loss of weight which threads undergo, it depends much on the rotting of the flax, according as it has been more or less perfect. The linen threads of Flanders and Artois, for example, which are rotted in water, do not lose more than 20 per cent; whereas those of Picardy, of which the rotting in water is so far from sufficiently washing the thread, that it acquires, on the contrary, a degree of impurity from the earth on which it reposes, in addition to that which is detached in the course of time by the maceration, which its external part has undergone, lose more than one fourth of their weight, generally speaking. Coarse threads naturally

turally lose more than others. In general the loss may be estimated at twenty-five or thirty per cent, and eighteen or twenty-five for those of middling quality. With regard to cotton threads, the loss is scarcely three or four per cent. Cotton piece-goods may lose more in proportion, on account of the dressing which was added to their weight, and which must first be dissolved, and taken out of the cloth, before it can be prepared for the discolouring or bleaching process.

Having treated of the ordinary dressings used in France, I think that the reader will receive, with pleasure, some account of the singeing, particularly used by the English for light cotton goods. Every one knows that muslinets are striped, plain, and spotted: muslins are more beautiful in proportion as they are less downy, or covered with fibres of the cotton wool. On this account the English, who are likewise attentive to use cotton of long staple for these goods, take the greatest care to render them as smooth as possible; this may be observed, particularly in their frame-work, and other cotton goods, of which the beauty of the bleaching is the more conspicuous, in proportion as the surface of the article is smoother, or less covered with the light down, which is observable on

all the articles of cotton when first manufactured.

I have, therefore, presumed, that my countrymen will learn with pleasure how the English manufacturers contrive to take off all this down, which on a beautiful and fine piece of cloth is singularly hurtful to the reflection and brightness of the white colour it has received. With this view I have given a drawing of the machine used for this dressing. See Plate VIII. figs. 5 to 10, and the description. It will be sufficient to observe in this place, that after having sewed the mullins to the coarse cloths, which are nailed upon two rollers, with handles to stretch them, they are rubbed with a brush to raise the down. The brush is passed once or twice over the face of the piece, after which a bended bar of iron, more or less ignited, is speedily and lightly passed over the upper surface. This bar, according to its degree of heat, is passed two or three times over the same place, and after it has been repeatedly moved along one border, it is insensibly moved towards the other. When the down of this first length is well cleared off, which is observed by looking astant upon the surface of the piece, a new portion is stretched, by rolling another part of the piece, which is to be treated as before.

Piece-

Piece-goods which are intended to produce an effect on both sides, are singed on the back as well as the face, but more slightly on the former than the latter. It is necessary to have at least two or three irons, one of which is to be heated, while the other is in use; and the greatest precaution must be had to make them very clean previous to each time of using; this is done upon a rag, or a fine grained sand-stone, when they are taken out of the furnace in which they were heated. This attention is necessary, for fear some greasy substance, or tallow, might attach itself to the face of the iron, and burn, or penetrate the piece. The irons may be heated indifferently with turf or pit-coal, as well as with wood.

Cotton cloths, or muslin, which are rendered even and smooth by this method, immediately acquire by this treatment, which is always performed at the commencement of the bleaching, a brown tinge similar to that exhibited by linen burned in ironing, but this colour mostly disappears at the first or second immersion, without any intermediate lixiviation.

This management with regard to cotton goods, or muslins, is equally applicable to linens, though these are less subject to the downy covering,

covering, on account of the length of the staple of which they are composed.

It is very possible to use the same process with stockings, night-caps, and other fine knit works in cotton, capable of being rendered more valuable by their clear white colour, which always seduce the consumer, who is, for the most part, less attentive to the quality of the merchandize than its external appearance. But I have already remarked, that the mechanism to dispose knit, or frame-worked goods, to receive the singeing, ought to be different from that of piece-goods, and appropriated to the form of the object.

There is another method also of singeing cotton goods and muslins, namely, by spirit of wine; but this method never operates with the same smoothness and equality as the red-hot iron, and is also much less expeditious. Nevertheless, as it may be useful and applicable to certain goods, the reader may consult Plate VI. fig. 1 and 2, where I have described the machine which may be used for this purpose. I need only remark, that instead of the box which contains the hot embers, another must be placed, containing a row of wicks for burning spirit of wine. One man is sufficient to attend

tend and direct this method, as well as the former; and the spirit of wine made use of may be mixed with a certain proportion of brandy, or otherwise it may be lowered in its strength, as the operator may find best suited to his purpose.

CHAP. XIV.

Concerning Proof Liquors.

BY proof liquors, I understand all those coloured fluids, which are extracted from vegetables by decoction or fermentation, and which, when mixed with the oxygenated muriatic acid, are more or less changed, according as the one or the other liquors is more or less concentrated: these vegetable fluids, according to the degree of alteration which they undergo, are of use to ascertain the strength, and more particularly to afford a judgment of the use to which the muriatic acid may be applied, when after having been prepared according to the directions already pointed out, it has been applied to one or more immersions. It is true, indeed, that this acid might be more concentrated by putting less water into the pneumatic vessel, or by increasing the doses of the ingredients; but this would afford no advantage excepting for the purpose of carrying it from place to place, or for the more speedy bleaching of coarse goods, or other objects of the same quality; such as towel pieces, coarse thread,

thread, twists, and the like, of which there is no reason to fear an alteration in their texture. For every other merchandize of a fine quality, it is always prudent to dilute the acid in a certain proportion for its most advantageous application.

A solution of one part of indigo in eight parts of sulphuric acid, is particularly pointed out by Berthollet as having been used by De Croisille at Rouen. This preparation differs from a solution of Saxon blue in no other respect than that this last is made with one part of indigo to four parts of the sulphuric acid. Either of these compositions may be digested in a matras, or simply in an apothecary's phial, placed on a water or sand bath, or in hot ashes: at the expiration of several hours part of the indigo, previously pounded and sifted through silk, becomes dissolved. This solution, which is of a very deep and dense blue, is to be gently poured by inclination into an appropriate vessel, after which it is to be diluted with water, until it marks one degree below zero on the areometer of Mossy. In this state it forms a proof liquor, of which three parts will be rendered colourless by one seventh or eighth part of oxygenated muriatic acid, composed in the manner before described. This liquor may be measured

in

in the cap of the case of the areometer, and then poured into a glass cylinder, which is graduated and stands upon a foot. See Plate IX. fig. 10 and 11.

I have thought proper in this place to mention the kind of measure which is made use of in this proof, because the degree of strength indicated by the fluid is very frequently different when the oxygenated muriatic acid is poured into a vessel of a different diameter. It is therefore essential to use the same measure constantly.

It must be observed, that the oxygenated acid may be used to advantage, as a second bath for linen goods, already in the progress of bleaching, or as a first bath for cotton goods, from the time its strength is such, that one single half part of the acid is required to render three parts of the blue fluid colourless, until that state in which it requires one entire part of the latter to discolour three of the blue. When the bath is weakened to this degree, it is no longer applicable but to the preparation.

Nevertheless, if there be a certain quantity on hand, it may be used for steeping and preparation, in case there is time for such goods as are either cleared or uncleared; for though the acid be so weak that it does not seem capable of bleaching, nevertheless it will act in process
of

of time, as long as it is capable of discolouring the proof liquor. For I have many times remarked, that however weak the preparation may be in which the piece is thus immersed, the white colour of this last does not fail to be very perceptibly forwarded, when it comes to be again subjected to the action of a newly-prepared and strong bleaching liquor. This exhausted fluid must not, therefore, be rejected, even though one whole measure should be required to discolour one measure of the blue solution of indigo, with which it may be mixed. In this manner trials may be made to ascertain its strength, as soon as it is weakened to that degree that three parts of the blue liquor are discoloured by one of the acid. The operator cannot pay too much attention to the total exhausting of the power of the bleaching liquor, since, upon the whole, those weak solutions may be very profitably applied in a well-regulated manufactory. When the liquor of the bath no longer acts upon the proof liquor, it is entirely exhausted of the oxygenated muriatic acid, though it still preserves a peculiar odour, which is not disagreeable; it then consists of the common muriatic acid diluted with water, if it be the residue of a bath of the odorant muriatic acid; but, if, on the contrary, the fluid be the
residue

residue of the oxygenated muriatic acid without smell, it contains likewise a combination of that acid with pot-ash. In either case the fluid may be thrown away, if the operator is not aware of any peculiar purpose to which it may be applied; if he has such a purpose in view, he may reserve it either for that object, or for rinsing such goods as are already bleached, and have passed through the last lees, as has before been remarked, for which last purpose it appears preferable to common water.

The tincture of cochineal may be used as a proof liquor, according to the information given in the annals of chemistry. It is equally valuable with the Saxon blue, and even made with less trouble; nothing more being required than to boil a small quantity of the cochineal, first crushed in a marble or glass mortar, or strongly rubbed between the fingers; the decoction must then be filtered through cloth, or blotting-paper, upon which it must be poured slightly by inclining the vessel, in order that the remains of the insect may be separated from the fluid.

Two parts of the tincture of cochineal diluted with water to half a degree below zero, require two parts of the muriatic acid without smell, at the same degree as that which is necessary to render the blue proof liquor colourless. The
tincture

tincture of cochineal becomes converted to a yellow colour.

It may here be remarked, that the violet liquor of Javelle concentrated to four degrees of pot-ash below zero, requires no more parts to discolour three parts of the blue before described, than are required of oxygenated muriatic acid to discolour the same quantity of blue; but the liquor of Javelle bleaches more speedily and uniformly.

The tincture of turnsole may also be used with no less advantage than cochineal, and is prepared in the same manner; and, lastly, the tincture of beet-root, and even wine itself, may be used with equal convenience, if other vegetable tinctures and decoctions be not at hand. The juice of acacia and currants are also susceptible of affording the same indications.

With regard to the colours which the different tinctures assume, they are as follows:

The Saxon blue, or solution of indigo in the sulphuric acid, becomes a yellow, more or less inclining to fawn colour, whether it be mixed with the oxygenated muriatic acid with smell or without. Its tint becomes deeper in proportion as the blue is more intense.

The tincture of cochineal assumes an orange colour.

Red

Red wine of Macon acquires an opal colour; the infusion of turnsole becomes of a light amber colour with either of the acids, prepared in the manner recommended in this treatise; I have, nevertheless, observed, that it does not change with the fluid called the lixivium of Javelle (*lessive de Javelle*), which nevertheless causes a slight effervescence with vinegar.

It is very easy for the operator to regulate his process with regard to every kind of tincture or infusion, which he may find it most convenient to use, whether of woods or roots, according to the preparations I have laid down for cochineal and indigo. The latter solution may be prepared without the assistance of heat, as follows. After having poured the proper quantity of sulphuric acid into an earthen or stone ware bottle, the pounded and sifted indigo is poured in, and strongly agitated by the hand for an hour, which is a sufficient time for the clots of indigo, which are formed either at the surface of the acid, or on the sides of the bottle, entirely to disappear: during this agitation a strong effervescence takes place in the fluid. The indigo, when well shaken, and penetrated by the acid, is soon dissolved, but it usually requires half an hour for that purpose. This portion of time is applicable to two ounces of indigo in
one

pound of the fulphuric acid. To this quantity of acid half a glass of water may be added. I am convinced by experience, that this addition renders the action of the acid upon the blue more speedy.

CHAP. XV.

The Methods of remedying such Accidents as happen during the Course of Bleaching.

THE accidents likely to happen in the course of bleaching, may be distinguished into accidents *of the distillation*, accidents *of the immersion* in the alkaline or acid liquor, and accidents *of the dressing*. I shall give a short account of these three clauses of accidents, and at the same time point out their remedies.

Accidents in the distillation. The principal accident which is capable of interrupting the distillation, is when the lutes of the adapter suffer the gas to escape. The most speedy remedy, in this case, to prevent the exhalation of the acid, which cannot be retained but with great difficulty, seldom for any length of time, and then very imperfectly, in consequence of its great expansion; the shortest method, I say, at least if the distillation be not near its conclusion, is to remove the fire immediately from beneath the capsule of the retort, and to suffer this last to cool for a certain time, by raising it a little in
its

its sand-bath. If it be not possible to take it out of the furnace, together with its capsule, on account of the heat, or its sticking too fast, the adopter must be unluted from the funnel of the leaden tube, and the aperture of this tube closed with a cork, or lute, to prevent the gas of the pneumatic vessel from evaporating; after which the retort must be raised, and placed gently upon a bag of straw, or on coarse cloths folded together; and then holding the retort by its neck, near the flexure, the adopter must be entirely unluted, by twisting it round and drawing it off. The orifice of the neck of the retort is then to be closed with a cork stopper, but not so closely but that a very small portion of gas may be suffered to escape, for fear of an explosion. The stopper of the neck may, for greater safety, be slightly raised. This precaution is necessary, on account of the great expansion of the muriatic acid gas. The old lute must then be taken off, as well from the adopter as the retort, and the places to which they were applied must be well cleaned, in order to receive fresh lute, after having carefully wiped off the moisture with a cloth or a sponge. If the lute which comes off be still good, it may be kneaded again, adding, if required, a small

quantity of boiled oil, or it may be mixed with new lute, if it be burned or decomposed. This decomposition in the fat lute may be known by the white or reddish colour which it acquires, and the facility with which it breaks, on account of its having lost the gluten which afforded it that toughness and tenacity, on which its goodness chiefly depends.

With regard to the lute of linseed cake, it must, in almost every case, be totally renewed, particularly when internally applied, because the heat hardens it too much to admit of its being kneaded again, with any moderate degree of facility; the decomposition of this lute is known by the yellow colour it acquires, and the contraction it undergoes from the effect of the heat. The lutes being kneaded to a proper consistence, and duly placed according to the directions laid down in Chap. IV. the adopter is to be fixed, previously removing the stopper from the mouth of the retort, and placing another in that of the small end of the adopter, to prevent any inconvenience from the vapour which might issue out during the time of fixing it. This vapour is likewise condensed within the adopter, in consequence of its coldness. The retort is then to be placed, as before, on the
furnace,

furnace, the adopter uncorked, and its beak luted into the tube of lead; after which, the fire is to be replaced beneath the capsule, and the distillation very speedily recommences, and proceeds as usual. This operation is a work of some delicacy; it requires to be performed with speed, and great care must be taken while placing the lutes and the adopter in their proper situations, to stand always in such a position, that the current of the external air may drive the vapour from the operator himself.

If the accident here described should take place towards the end of the distillation, as it may sometimes happen, in consequence of the strong heat which, at that time, may soften the lutes, it will be sufficient if the fire be taken from beneath the capsule. The distillation soon ceases when this is done, particularly if care be taken to condense the gas, by the prudent application of wet cloths on the neck of the retort, as well as the adopter.

This inconvenience would not take place, if the workmen in those glass-houses which are principally employed in the fabrication of chymical vessels could make retorts with necks recurved in the form of the adopter. These kind of vessels may be assiduously supplied by making

use of a tube of lead, so formed as to serve instead of the adopter, as I have already observed, with regard to the tubulated bottles or bodies *. If, by accident, the lute which is adapted should fail, or suffer the gas to pass through, it may easily be stopped, by applying new lute to the place of junction. Instead of the leaden tube, we may substitute, with still greater convenience (the danger of breaking excepted), a tube of glass, of which the end nearest the bottle, or tubulated body, should be ground with emery. By these means there would be no application of lute, and consequently no danger to be feared with regard to the filtration of the gas, the escape of which is easily perceived by the smell which diffuses itself through the workshop, and is more particularly perceived when the nose is applied near the vessels, or the lute. But as this last method of discovering the place where the lute has failed may be attended with the most serious consequences, if the greatest precaution be not used, it is more prudent to apply an open bottle of ammoniac near the

* This last method appears to me preferable to every other; because it requires only a slight attention to the lute, and can never produce those dangers which arise from the use of retorts.—C.

suspected place; at the instant that it is presented, a white fume is formed, which immediately points out the defective spot. The bottle must be presented above the current of air, which takes place near the lute, or in the workshop. If this precaution be not attended to, the operator might be induced to remove a good lute, instead of one which was really defective.

On the other hand, if in the course of the distillation, and for want of keeping up the heat, the fluid in the pneumatic vessel should be absorbed and rise into the distilling apparatus, it is necessary the instant it is perceived to withdraw for a moment the stopper out of the neck of the retort, where, as I have already had occasion to observe, the absorption instantly ceases. Nevertheless, if, for want of being observed in time, the water should rise so far as partly to fill the retort, or body (for it never entirely fills it), the distillation will be stopped, from the coldness of the water, and its too great quantity. The shortest remedy is to draw out the excess of water, which is thus introduced into the distilling vessel, by the assistance of a glass pump, or syphon, and afterwards to heat the same vessel, first returning the water into the pneumatic vessel, if thought expedient; but if the distillation be properly attended to, this accident can never happen.

Accidents in the lixiviations and immersions. I place the accidents arising from these two operations in the same class, because they can scarcely take place, but by the joint operation of both.

Any article which is badly cleared of the lixivium, and afterwards immersed in the oxygenated muriatic acid, becomes almost immediately of a nankeen colour, particularly in the folds, either in spots where certain parts have not been sufficiently rinsed, or else the colour is general, if the whole has not been well rinsed.

The same accident happens if soot has fallen on the linen or thread. The difference is simply in the colour, which approaches more to brown. These colours are capable of becoming more and more deep if the mismanagement be not remedied as soon as perceived, and that before the goods are subjected to other immersions in the alkaline lees, or of the oxygenated muriatic acid. The same accident is to be expected, if the goods, though white at the time of their immersion, are suffered to remain too long in the bleaching liquor. This does not fail to happen, particularly if the articles which are suffered to remain even in a weak solution, are kept in that state the whole night. The next day they are found to be yellow, or charged with lixivium.

The

The remark which has here been made, concerning the nankeen colour, takes place also with regard to those articles which, though white, have been immersed in an exhausted lixivium, or lees which have been used several successive times for the immersion of goods taken out of a strong muriatic acid, without previous rinsing. These articles, when taken out of such exhausted lees, and plunged into a new acid solution, undergo a change even though they may have been properly rinsed. I must in this place remark, that a lixivium may be exhausted in consequence of its combination with the muriatic acid from the goods which are plunged in it, though they may have been pressed or wrung at the time of taking them out of the acid. Such exhausted lees may, nevertheless, indicate a certain degree of strength by the areometer, though in fact they do not possess it.

The only method of remedying these accidents consists in the use of water, slightly acidulated with sulphuric acid, no matter whether cold or hot, but the hot solution operates more speedily. The spotted or tinged goods are to be soaked in this water for a few minutes, or a quarter of an hour, accordingly as the colour may be more or less deep, in consequence of a series of
lixiviations

lixiviations or immerfions, more or lefs repeated. In this fituation the offensive colour is feen almoft immediately to difappear.

Inftead of making a fulphuric folution exprefsly for that purpofe, that which has ferved for the drefling may anfwer very well: neither of thefe need be ftronger than has been there directed, unlefs the goods be confiderably charged with colour, and there be a great quantity to immerfe at once. The acidulated water is tried by the areometer, and if, in confequence of having been ufed, it fhould not be fufficiently ftrong, it may be reftored by adding the requifite quantity of acid for that purpofe. It is neceffary when any new acid is poured in, to mix it well with the water before any goods are immerfed therein.

It muft, in this place, be obferved, that though the thread and piece-goods may become charged with a foreign colour, in confequence of the accidents here pointed out, both thefe articles are frequently very well bleached at the under furface. It is even a proof that the muriatic acid has operated effectually, in caufing the lixivium to produce fuch an effect: but thefe accidents are difficult to be obferved on objects fimplly cleared, or in the crude ftate. In the
latter

latter case, a permanency of the original colour may alone shew the necessity of using the sulphuric acid, particularly when the lees and the muriatic acid which have been used are not at all exhausted.

Accidents attending the preparation or dressing. When the piece-goods are immersed in a solution of soap, after having been taken out of the sulphuric acid, while they are still too strongly acidulated, or if instead of rinsing them they be immediately conveyed from the acid into the solution of soap, this last solution is subject to curdle, or become immediately decomposed; whence the operator has the mortification to observe the whole surface of the goods covered with an infinite number of small spots of oil, in the form of clots, of a yellowish colour, and very tenacious, particularly on stockings or cotton goods, because they incorporate as it were with the nap or texture of the goods: they disappear in consequence of much washing or rinsing. I must particularly mention an accident which may happen to any one, namely, that of placing by mistake stockings or other bleached objects, which have received their first treatment in the solution of soap, upon articles which have been exposed to the vapour of sulphur. I have placed stockings upon gauze, which had been whitened
by

by sulphur, and found that after they had remained in this situation for the course of a night, they became entirely of a brown-red at the place of contact. They appeared as if burnt or marked with an hot iron. This colour, which, no doubt, was produced by the combination of the volatile sulphuric acid, with the alkali of the soap, with which the stockings were still impregnated to a certain degree, immediately disappeared upon exposing them, first, to the action of a bath of the odorant oxygenated muriatic acid, and afterwards to another of water, slightly acidulated with the sulphuric acid.

Every salt with excess of acid, such as the salt of sorrel, removes the ruddy spots here mentioned with equal ease. It is true, that this salt cannot with convenience be used, on account of its dearth, but the residue of the distilling vessels, that is to say, the water which holds in solution the residue of the distillation of the oxygenated muriatic acid, is very serviceable in this process, and may be advantageously used either hot or cold, to remove those very tenacious spots, which are not at all capable of being removed by soap or alkaline lees.

CHAP. XVI.

*The Method of taking out Spot's of Rust or Ironmould,
Tar, Fruit, Wine, &c.*

WHEN the spots of oxyde of iron, commonly distinguished by the name of ironmould, are small, they may easily be taken out with salt of forrel in powder, laid upon the spot itself, which is afterwards to be moistened with a small quantity of water; or the part which is spotted may be steeped in a solution of the same salt. It soon becomes fainter, and at length disappears, after which the place must be very well rinsed. The sulphuric acid may be usefully applied instead of the salt of forrel, as Bertholet seems to affirm in his memoir; and I have proved with success, that, though the spots may penetrate quite through the cloth, and be very broad, yet if they be soaked in a bath of sulphuric acid, either warm or cold, when the goods are taken out of the bath of muriatic acid,

the

the effect will be that the spots insensibly disappear. If the goods be of close texture, the operation of the acid is slower *.

With regard to the spots of rust which are frequently seen on thread or cotton stockings, they are produced by the needles of the engine, and commonly disappear during the dressing, that is to say, in the bath of sulphuric acid. The same observation is true of the spots of rust which sometimes appear on the piece-goods, in consequence of their having been in contact with iron. In general, the older any ironmould may be, the more tenacious it is, and the more difficult to be effaced; but every spot may be made to disappear in time.

It frequently happens that piece-goods are spotted with tar, during their carriage by water, in boats, where they are liable to be placed upon the pitchy parts of the vessels, or in contact with tarred ropes. These spots may be soon taken out, by rubbing them with oil of olive, which dissolves the tar; or still better, by holding the part in spirit of wine, if this process should be thought more convenient. The latter

* The salt of sorrel is sold in London, in small bottles, by the perfumers and apothecaries, under the name of salt of lemon. The sulphuric acid, as prescribed above, must, of course, be diluted.—T.

method operates by the complete solution of the tar.

With regard to spots of wine, cyder, or any kind of fruit, they may be effaced by dropping a few drops of the oxygenated muriatic acid upon them, which causes them almost instantly to disappear. But there are certain fruits, such as plumbs, of which the spots are more difficult to efface; they requiring one or two lixiviations. Those that are grey, or reddish, at first, assume a fine yellow colour in the muriatic acid, which does not disappear during a subsequent lixiviation, but requires a second immersion in the bleaching liquor.

I must not omit a second very simple and economical method to take out every kind of spot occasioned by fruits, such as strawberries, gooseberries, &c. It consists in causing the spotted part to imbibe water, and afterwards to burn one or two common brimstone matches over the place: the sulphureous gas which is discharged soon causes the spot to disappear.

There is a kind of indelible spot which is produced from red ochre and the charcoal black, with which the weavers mark the turns of the beam, in order to ascertain the length of the chain of piece goods. This kind of mark, which

which is impressed on the goods at equal distances, is so far from being effaced, that it seems, in some measure, to receive strength from the oxygenated muriatic acid, notwithstanding the intermediate action of the lees.

CHAP. XVII.

The Expence of Bleaching different Kinds of Goods, of Linen, Hemp, or Cotton, by the oxygenated muriatic Acid, at per Ell, or per Pound.

BEFORE I proceed to give an account of the expence of bleaching any quantity of ells or pounds of goods, by the muriatic acid, I shall, in the first place, mention the prices of the materials required to make the liquor, either with or without smell, of which I have before described the composition. The prices are calculated according to those of the articles to be delivered at Abbeville, in 1791 *.

The sulphuric acid of Rouen, rectified for

* I have not reduced the numbers in this chapter to their values in English money, because the difference of locality would, even in that case, have rendered them of little immediate utility.

As translator, I am obviously not at liberty to omit the chapter, even if I were so disposed. The English prices of the materials are given in the Appendix.—T.

the market to 66 degrees, delivered at Abbeville, will cost 11 fols the pound, wholesale.

Manganese, crySTALLIZED in needles, ready sorted, from Pelletier, apothecary, rue Jacob, at Paris, 8 fols, retail.

Grey muriate of soda, in the market of Abbeville, 2 fols, retail.

Charcoal, weighing five or six pounds to the bushel, according to the quality of the wood, 3 fols, retail, per bushel.

Blue potash, of Dantzick, or the yellow potash, in hard lumps, of York, 12 fols, wholesale.

Green or black soap, of Abbeville, 8 fols, retail.

White marble soap, of Marseilles, bought at Abbeville, 12 fols, retail.

The sack of turf, containing four mannes, 8 fols, wholesale.

I shall now shew the expence of charging two pneumatic vessels, by two successive distillations with the simple apparatus, or by one distillation, when the apparatus has two of these vessels, as well with muriatic acid which emits no smell, as with that in which the odorante gas is not detained.

Expence

Expence of two pneumatic vessels of the muriatic acid, without smell, made according to the proportions prescribed in this Work.

	<i>Liv.</i>	<i>s.</i>	<i>d.</i>
Sulphuric acid, five pounds and a half - - -	3	0	6
Manganese, two pounds and a half - - -	1	0	0
Grey muriate of soda, eight pounds - - -	0	8	0
One bushel of charcoal of wood - - -	0	3	0
Workman, one day - - -	1	0	0
Potash, two pounds and a half - - -	1	10	0
Total	7	1	6

Expence of two pneumatic vessels of the odorant muriatic acid, made according to the proportions prescribed in this work.

	<i>Liv.</i>	<i>s.</i>	<i>d.</i>
Sulphuric acid, five pounds and a half - - -	3	0	6
Manganese, two pounds and a half - - -	1	0	0
Grey muriate of soda, eight pounds - - -	0	8	0
One bushel of charcoal of wood - - -	0	3	0
Workman, one day - - -	1	0	0
Potash - - -	0	0	0
Total	5	11	6

I shall, in the next place, shew the expence of lixiviating, or rather of boiling, two pieces of cloth, each seventy-two ells long, of such a degree of fineness, that two ells in length, on a breadth of two-thirds, may weigh one French pound; or of seventy-two pounds of thread,

0 2

such

such as is commonly spun in Picardy. I choose this kind of cloth in preference, as an example, because it seldom happens that coarser goods are required to be bleached even to the ordinary white, which I must be understood to mean in the present instance.

The proportion of ingredients for the lees required to steep the seventy-two ells of cloth, beforementioned, or the seventy-two pounds of thread, are ten vessels of water, of eighteen pints each, with about five pounds of potash, which gives a degree of strength, marking rather more than one and a half, composed according to the directions in chap. VII. separately, and in a small covered portable boiler.

Expence of new lees, proper for one boiling of seventy-two ells of cloth, or seventy-two pounds of thread, of middling quality.

		<i>Liv. s.</i>	
Potash, five pounds, 3 livres	- -	}	- - 3 4
Turf, two mannes, or half a sack, 4 sols			

It remains to be shewn, what may be the expence of bleaching the above seventy-two pounds of single thread, or seventy-two ells of cloth. I have before observed, that cloth of middling fineness requires nearly four immersions, two of which may be made in the muriatic acid without smell, and two, if it be thought

thought better, in the odorant acid, besides four lixiviations; and again, that one pneumatic vessel is sufficient for sixty pounds of thread, at the first immersion, and from seventy-two to eighty at the second. I shall take seventy-two pounds as the middle term, between the first and the last immersions, which, as well as the lixiviations, I will suppose to be made with fresh solutions.

	<i>Liv. s.</i>
Two pneumatic vessels, for the two first new immersions in muriatic acid without smell -	14 3
Two pneumatic vessels, for the two other immersions, in the odorant muriatic acid - -	11 3
Four new lixiviations, or the quantity of potash necessary for that purpose - - -	12 0
Two sacks of turf - - - -	0 16
One day's work - - - -	1 0
Total	39 2

Hence, the pound of thread of Picardy, containing sixteen ounces, will cost 10 sols 10 deniers. With regard to Flanders thread, which is cleared in water, the price will not, at most, exceed 8 sols, because this article requires only one immersion, and a lixiviation less. Flanders thread, likewise, as has been remarked, is subject to a loss of no more than twenty per cent.

If this calculation be, therefore, applied to the bleaching of common coarse cloth, two ells

of which weigh a pound, the ell will not exceed 5 sols 5 deniers for the bleaching.

If it be, therefore, settled to charge for the thread of Picardy, or any other which is cleared on the grafs, 12 sous the pound, or livre de Marc; for Flanders thread, or any other, which is rotted or cleared in water, at 10 sols, upon an average; and for linen piece-goods, 8 sols the ell, of fine or middling quality, the manufacturer will find himself reasonably paid for his trouble. These are the usual prices at the most celebrated bleaching works of Lille, Beauvais, Saint Quentin, Senlis, Rouen, Rheims, &c. I must, however, take notice, that the dressings are not reckoned in these charges, which, with regard to the piece-goods, amount to about 2 liards per ell for cold calendering, and 1 sol for hot calendering, including the folding, &c. There are some articles of which the price of the dressing amounts to half that of the bleaching: these are such as require a degree of firmness, by means of starch, gum, or other similar material, with blue, which, in certain markets, and with regard to goods of a certain description, is favourable to the sale.

The proper dressing for thread amounts to about 1 sol the pound, but is the object of a particular agreement between the bleacher and the
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the owner. With respect to the price of bleaching double, or sewing, threads, my advice is to charge 2 fols extra per pound, on account of the greater difficulties they present, and the attentions they require, as may be gathered from what has been before said on this subject.

Piece-goods, in general, require more care, and are attended with more difficulty, than threads, on account of their volume, their weight, their texture, and the even white colour required to be given, on both sides, as well as towards the selvages. It must also be remarked, that the selvages having their texture closed by the action of the temple, when the cloth is in the loom, sometimes require, in the middle of the bleaching process, to be rubbed with soap, by hand, for which purpose black soap is to be used in preference. If they be not opened to the action of the acid by this treatment, there will be danger of the white being less advanced towards the edge than on the rest of the surface. This management may, however, be avoided, if, at the time of steeping and macerating the cloth, as well as in the first lixiviation, the operator is careful to rub or clear these parts, on account of the firmness of their texture.

From these several data, it will be easy to

estimate the expence of bleaching finer thread, for linens and lawns, as well as that of the ell of these articles respectively. For nothing more will be necessary, for that purpose, than to consider the account of the number of immersions and lixiviations which I have stated to be necessary for those goods. The thread of lawns, of the ordinary fineness, will run six ells in the piece to the pound, on a breadth of one ell.

Having thus shewn the cost of bleaching thread or linen goods, by the pound or ell, I shall proceed to examine that of the same articles in cotton; for which purpose I shall choose the thread proper to make the commonest wrappers, which run two ells to the pound, on a width of one ell. I have before stated, that each pneumatic vessel is sufficient for the immersion of eighty or ninety pounds of thread, for the first working, and 100 for the second. I will, therefore, take only ninety for the middle term. I have also stated, that no more than three immersions, at most, were required to bleach cotton, one of which should be in the muriatic acid without smell, and the others in the odorant acid, besides three lixiviations. I will suppose that neither the acid nor the lees have been used before. My piece of cloth shall be assumed at 180 ells, or two pieces of ninety ells

ells each, and the quantity of thread equivalent to this shall be stated at 90 pounds; whence it will follow:

	<i>Liv. s. d.</i>		
First immersion in new muriatic acid, without smell - - - - -	7	1	6
Two other new immersions in the odorant muriatic acid - - - - -	11	3	0
Three new lixiviations in one of double proportion with regard to the mass to be lixiviated -	12	0	0
Three sacks of turf, on account of the double lixiviations - - - - -	1	4	0
One day's work - - - - -	1	0	0
Total	32	8	6

This computation settles the pound of cotton thread at about 7 sols 6 deniers, and consequently the cloth at 3 sols 9 deniers the ell. It is to be observed, that cotton, being more loose and spongy, and more subject to rise up in the boiler by the action of heat, requires near double the quantity of lees than for thread, and consequently more fire in the same proportion to heat it, supposing the same boiler to be used. The same remark is, in part, applicable to the muriatic acid; but as this may be used rather weaker for cotton than for thread, the liberty of diluting it with water may be taken.

If the bleacher, according to this new method

thod, shall therefore fix the price of bleaching cotton thread at 8 sols 6 deniers the pound, and of cloth entirely of cotton at 6 sols the square ell, of every kind coarse or fine, he may derive considerable advantage, and the public will have no reason to complain, since cotton threads in general, and likewise muslins, require much care and attention, on account of the delicacy of their texture and the slight tenacity of the fibres, the short staple of which, as is very well known, will scarcely permit it to be turned on the reel without great care.

It now remains to be shewn what price ought to be fixed for the bleaching of stockings of linen or cotton per pair. I shall begin with plain thread stockings of men's size, from which an estimate may be made for smaller articles of the same kind, as well as all other knit or stocking-wove goods. I shall likewise assume that one pair of men's stockings contains half a pound of thread, and consequently 6 pounds will be contained in one dozen pair. My calculation will be for 12 dozen or 72 pounds of thread. I shall likewise assume that one pound of green soap will be required for the first washing of six dozen pair of men's stockings, and one pound of white soap for the second and last washing of the same six dozen. And accordingly I shall add to the sum
before

before deduced, for the mere and simple bleaching of 72 pounds of linen, of which the detail has been given, the surplus in lixiviations, immersions, and washing with soap, which stockings require. This amounts to two lixiviations, and the same number of immersions as I have shewn at chapter X.

	<i>Liv.</i>	<i>s.</i>	<i>d.</i>
Therefore first set down the simple price of bleaching 70 pounds of thread, namely	-	-	39 2 0
To which add two additional lixiviations	-	-	6 8 0
Two immersions in the odorant muriatic acid	11	3	0
Two pounds of green soap for the first washing	0	16	0
Two pounds of white soap for the second washing	1	4	0
Half a sack of turf to heat the solutions of soap	0	4	0
A woman one day for the washing	-	-	0 15 0
Total	59	12	0

This account gives 8 fols 3 deniers for each pair of men's stockings; and if 12 fols be taken for this article, I am of opinion that there will not be many bleachers envious of the advantage of rendering them milk-white at this price, on account of the difficulties they present, which require them to be turned from time to time to open the texture, which would otherwise become close and impenetrable to the muriatic acid: and if the stockings be ribbed, or have clocks, it will not be too much to charge 14 fols the pair, on account

account of the particular care required for these kind of goods, the ribs of which being disposed to shrink up, are very apt to prevent the intire action of the acid.

With regard to women's and boys' stockings, 10 sols per pair may be charged, and for smaller articles 8 sols; at which last price gloves ought to be charged, because the fingers being closer than the other parts, require to be turned from time to time to produce an even colour. Mittens may be charged at 5 sols the pair. Articles of the same kind of thread and cotton, mixed, deserve nearly the same price on account of the thread which retards the bleaching.

We must now inquire the price of bleaching the same articles in cotton. Here likewise I shall ground my comparifon on plain stockings for men, admitting that 6 ounces of cotton will make one pair of this fize, which will amount to $4\frac{1}{2}$ pounds the dozen pair, or 90 pounds of thread for 22 dozen pair. To this last quantity we shall direct our inquiries, in which I shall confine myself to add to the former determination with regard to 90 pounds of cotton thread of like quality, the extraordinary lixiviations and immersions which knit or stocking-wove articles require. This excess, as shown at chapter X. is
half

half a lixiviation and one immersion in the odorant muriatic acid.

	<i>Liv.</i>	<i>s.</i>	<i>d.</i>
I shall therefore reckon for the mere bleaching of			
90 pounds of cotton thread as before stated -	32	8	6
To which add half a lixiviation in a double dose	3	4	0
One immersion in the odorant muriatic acid -	5	11	6
One sack of turf for heating the double quantity			
of lees - - - - -	0	8	0
Four pounds of green soap for the first washing	1	12	0
Four pounds of white soap for the second and			
last washing - - - - -	2	8	0
One sack of turf for heating the solutions of soap	0	8	0
Two days' work of a woman to wash -	1	10	0
	<hr/>		
Total	47	10	0
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Whence we see that the cost for 1 pair of men's plain cotton stockings is about 4 fols, and if the charge be settled at 5 fols for men and 4 for women, or 4 fols 6 deniers one with another, there can be no cause of complaint. Ribbed stockings must, however, be excepted. These deserve at least an addition of 1 fol per pair for the extra attentions, which have been before mentioned.

Nightcaps may be charged, one with another, at 2 fols 6 deniers: gloves, on account of the fingers, must be charged at 3 fols the pair, and mittens, and children's stockings, at 2 fols.

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The foregoing are, in general, the articles which are usually bleached at the proper works for that purpose. With regard to the prices I have assigned for bleaching each article without any kind of dressing, they are such as I have, from my own experience, thought fit to advise to those persons to whom I have had the pleasure of teaching this new and important art of bleaching. They are capable of being considerably diminished by turning to advantage the lees and acid which have been used as I have advised in the proper place. But I have chosen in my estimates to consider them as new, in order that I might be subject to no reproach for diminishing the charges which I have, on the contrary, stated at the highest, as every operator may convince himself. If to these first savings of lees of muriatic acid, and of the other collateral and dependent objects, we add the advantage which may be derived from the old lees, as I have shewn, as well as from the exhausted bleaching liquor, the residues of the retorts, &c. there can be no doubt but that all these different prices may be considerably abated; even though we might not venture to affirm that the expence would be entirely compensated by the profit arising from an intelligent application of these matters, which have heretofore been thrown away as useless.

CHAP.

CHAP. XVIII.

The Method of bleaching yellow Wax, Nankeen Stockings, and other Articles which have acquired a dark Colour by keeping; Linen stained by Dampness, and the Madder Grounds of printed Goods.

THE bleaching of yellow wax may be effected by means of the bleaching liquor, with smell, as well as with that which has no smell. For which purpose a single immersion, or, at most, two, with the same number of intermediate fusions, are necessary. The operation, nevertheless, succeeds more speedily with the odorant muriatic acid, because the wax bleaches as well above as below; which facility it acquires by its property of swimming, and presenting a greater surface, as well to the gas which rises in the liquor, and bleaches in its passage, as to that which escapes above the ribbons of wax, which, being retained by the covers of the vessels, is forced to act upon the surface exposed to its action by falling in a kind of dew. These ribbons of wax must be very thin.

It is more convenient, however, to use only the vapour of the oxygenated muriatic acid,

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as Berthollet informs us from the experiment of Landriani. This last method is, as I likewise find by experiment, much more effectual. To prove this truth, nothing more is necessary to be done than to expose wax rasped or scraped into very thin leaves, under the cover of a pneumatic vessel, above the surface of the liquor. I am even disposed to think that this experiment may point out the invention of a bleaching process in appropriate vessels furnished with different stages of frame-work covered with coarse cloths. The goods being suspended through the whole height of the vessel thus constructed, or else in a chamber disposed and appropriated to the same effect, that is to say, that it shall be provided with shelves, or poles, so disposed all round within its capacity, upon which the acid vapour, directly conveyed from the neck of the retort, or admitted through the sides of the chamber, may thus act with great freedom and promptness, in the same manner as the volatile sulphureous acid acts upon goods which are required to be bleached by its means. I have also remarked, that the mass of wax, with which the ends of the leaden tubes, plunged in the intermediate vessel when I used this apparatus, was rendered of a beautiful white through its whole thickness, which was nearly half a line, and

and this by no more than two hours exposure to the action of the vapour.

The true nankeen is bleached or deprived of its colour with some difficulty. It is first to be wetted and wrung; after which it is subjected to a first immersion in the bleaching liquor, which deprives it of a large portion of its colour. It is then to be properly rinsed, and agitated in a good solution of soap, which is preferable to lees, because it causes the colour, which had merely disappeared, to shew itself again more effectually. The piece of nankeen is then to be well rinsed, and subjected to a new immersion. The number of immersions varies according to the shade of the colour; but this article seldom requires more than three immersions, with intermediate washings with soap. The finish is given in a bath of sulphuric acid, after which it is to be rinsed in a large quantity of water, and then wrung and dried. This process may be performed indifferently with either of the two acids, the odorant, or that without smell; nevertheless the latter ought always to be preferred, particularly for the first immersion, because it more speedily and equally destroys that kind of flesh colour which is peculiar to the true nankeen. Nevertheless, though the oxygenated muriatic acid acts so strongly on this
P colour,

colour, I never have been able to bring nankeens to a white of the same beauty as is acquired by cotton, thread, and piece goods bleached by this process.

Stockings and other goods bleached by the old process, but which have acquired a ruddy colour, at the extremity of the folds, by remaining in the shop or warehouse, partly uncovered either from want of care or for shew, require only a single immersion without preliminary soaping or lixiviation. The ink marks which retailers are in the habit of making to ascertain either the number, price, or quality of their goods, partly disappear in this immersion, and totally in the bath of sulphuric acid, in which they are afterwards plunged. These goods are to have all the subsequent dressings, of which I have given an account, if the proprietor expects or requires it.

It is a peculiar property of the oxygenated muriatic acid, to discharge those black spots which are seen on foul linen, particularly when they rise from perspiration or moisture. The places most subject to these stains, are where the linen is applied to the back or beneath the arm pits. This process is to be commenced with a lixiviation or boiling, which is to be succeeded by an immersion, and afterwards by a
bath

bath of sulphuric acid. However strong the spots may be, they never resist these several operations.

Spots of brandy likewise disappear by the same process.

With regard to the madder ground of painted or printed goods, it is easily discharged by either of the oxygenated muriatic acids, a single bath usually being sufficient for that purpose.

For greater convenience, it is adviseable to use the acid without smell, because the operator may, with more ease, follow and conclude at a proper time the immersion of the piece as soon as, while passing it over the reel, he observes that the ground is sufficiently white and clear. The bleaching liquor, which is partly exhausted, may be used to advantage in this process. Before the immersion is made, care must be taken to plunge the piece in water and wring it out so far as to leave it merely humid or moist. After the immersion it must be well rinsed and dried either in the sun or in the shade, turning the coloured surface from the sun.

It may be remarked that the deep reds are capable of being again brought out, or rendered slightly red, by the sun's light, and the other shades advanced in proportion; this would happen in the common method of bleaching, if the printed

part were not always turned to the grass. I shall proceed to mention some circumstances with respect to this method of discolouring or bleaching, which may be of use to those who are interested in applying it to practice.

Goods printed in fast colours (*bon teint*), for those with chemical colours (*petit teint*) are too difficult to be treated by this method, intended to be bleached by the oxygenated muriatic acid, instead of the usual exposure in the field, ought to have their designs much more charged with colour, than such as are intended simply to be subjected to the action of the air; in order that while the acid exercises its action on that part of the ground which is maddered without mordant, the same action which is also exerted on the part where the madder is combined with the mordant, may not destroy in the last part any more of the colour than that quantity in excess, beyond what the piece ought to preserve to produce the intended effect, and, consequently, that it should not, after the process, appear more sensibly altered than it would have been after the usual exposure in the field: this precaution ought to be attended to more particularly with regard to the ordinary violets, blacks, and browns. They are much more easily degraded than the red, or rose-colours, and the deep browns.

One leading object, which is essential to the preservation of the colour, and contributes infinitely to the unmaddering, is to give the pieces one or two boilings in bran and water, which may follow a boiling in a solution of soap. If these three boilings are properly managed, the ground of the piece goods will be brightened at least three quarters. One or two immersions in the bleaching liquor will remove the small portion of colour which remains. Between the two immersions attention must be paid to plunge the goods in bran and water. This ought to be done after the last immersion, for it raises and relieves the tone of the colours which may have been slightly weakened.

I have several times found, that when the preparatory baths have been well proportioned to the grounds intended to be coloured, it is unnecessary to apply the bleaching liquor. A few days exposure in the field are sufficient afterwards to complete the bleaching.

The proportions which I followed for the bath of bran and water, were three ounces and an half of wheat bran, and three pounds and an half of river water. Those for the solution of soap were two ounces of soap to four or five pounds of water; the weight of the goods to which these doses were adopted were 10 grs.

Moreover, it is practicable, according to the depth of the tints, and the experience the operator may have acquired, to diminish the force of the oxygenated liquor to that point which may insure him against a too perceptible destruction of those parts which ought to preserve their brightness. But, in this practice, the process is too slow, and the great advantage of using this method with regard to such kind of goods would thus be lost.

In a considerable manufactory, where the operations of printing and bleaching succeed each other with rapidity, it might, perhaps, be more advantageous to clear off no more than three-fourths of the ground of the cloth which has received the madder without mordant, by subjecting it to the boilings with bran, water, soap, and a slight immersion in the liquor, as has been prescribed, and afterwards to expose it to the action of the air in the field. This method of operating seems preferable, and would be no less expeditious, whether in summer or in winter. And in the case only of the goods being in great haste, the complete bleaching with the oxygenated acid might be adviseable, taking care to use all the precautions which have already been pointed out.

In order to avoid exposing the goods to too

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considerable alteration, it is more convenient to pass only one or two pieces through at a time, with the attention that they should be of the same degree of intensity in their colours, in order that if it should be necessary to stop suddenly the effect of the liquor, it may, in some measure, be done instantly. This could not be easily accomplished, if eight or ten pieces were sewed together as soon as soaped. For it is easy to imagine, that while one piece was drawn out, the others remaining in the liquor too long a time, would be exposed to have their colours weakened, at least in the proportion of the longer time they remained in the liquor. If it were thought an object of sufficient importance, this last inconvenience, however, might be removed, by placing at the bottom of the vessel for immersion a platform of strong basket work, which might be speedily raised by means of a pulley, or other mechanism, to remove the goods out of the bath at the instant it might be found necessary, and they might afterwards be thrown into a reservoir of water, or conveyed to the river.

It would be a very desirable object, if the oxygenated muriatic acid could act only upon the surface opposite to the printed side of the piece. In this way it would operate like the

atmospheric air, without giving cause to fear the destruction or perceptible alteration of the shades, whatever might be their depth. The difficulty of succeeding, and the length of time required for bleaching, may, perhaps, sooner or later, give rise to a method of fixing the colour by particular mordants, without the assistance of madder.

It would also be a desirable object to discover a process to prevent too much degradation of the transversal red or blue stripes, and other ornaments of coloured thread, which are usually made at each extremity or angle of cotton coverlids. This process might also be applicable to the defence of those transversal blue or red stripes which are made in pieces intended for napkins, between one napkin and another, and at the ends of pieces of muslins and the like. The best method, no doubt, would consist in manufacturing these goods entirely of one colour, and afterwards making the terminations with coloured thread. As these kind of goods are capable of being soiled, either by the dressing given to their chain, or by the different operations which succeed or are previous to the weaving, they may be easily cleansed by a proper washing or soaping.

The following is the expedient which I have
thought

thought proper to use to preserve the stripes in question from every action which might be too perceptible. After two good baths in the lixivium, each of the stripes was covered, on both sides, with one or more coatings of chalk and oil, which was left to dry until the pieces could be handled without fear of spotting the neighbouring parts. I then subjected them to the bleaching liquor, afterwards to a slight lixiviation, and a solution of soap, &c. and so on, successively, till the ground was as clear as required. After each lixiviation I took care to repair or renew the covering, if necessary. I afterwards cleared off this covering of chalk and oil, either with a good soaping, or with a slight bath of sulphuric acid, according to the nature of the colour of the bar, and the degree of tenacity of the paint. If by accident the colour of the bar was somewhat weakened, it did not fail to be raised again, by passing it through bran-water at the conclusion of the process. I apprehend that this expedient, which I have always used with a certain degree of success, will be acceptable to the manufacturer.

CHAP. XIX.

The Method of discharging the Colour of painted or printed Coltons, or Linens, and every Kind of Dye on Cloth or Thread, before or after it is wrought up.

ALL the colours of callicoes, or printed goods in fast colours, are destroyed by either of the oxygenated muriatic acids, without having recourse to the lixiviations or other previous or intermediate operations before described. The blues, yellows, and blacks, afford an exception with respect to the bath of sulphuric acid, which must be substituted instead of the lixiviation. A single immersion in the muriatic acid is sufficient to destroy all other colours, such as reds, yellows, auroras, green, &c.; but the yellows, properly so called, and the lemon colour, with which greens are produced, and the blues and blacks, sometimes require, according to their shade, three immersions, and two or three intermediate baths of sulphuric acid.

It

It must not, however, be supposed, that the Adrianople reds, when discharged by the oxygenated muriatic acid, become perfectly white. There always remains a slight ruddy appearance, which arises from the oily matter which enters into the preparation for this dye. This tinge of redness does not disappear, however numerous the lixiviations and immersions and baths of sulphuric acid may be.

There is another thing no less worthy of remark with regard to the black colour, which forms the outline or border of designs, namely, that if the muslin, or cleared fine piece, upon which the different flowers were designed which have been discharged, be folded together in several folds, or placed upon a dark-coloured ground, the effaced outline becomes visible according to the exposure of the piece under a certain obliquity of the light exhibiting the appearance of a slight trace. The kind of outline which, under these circumstances, becomes visible, cannot be compared to any thing better than the embroidery of muslins placed on a coloured ground. This trace seen at a certain distance has the same effect, and even when closely observed, it is impossible to determine what it is, because it is not visible, except under a certain reflection of the light; nevertheless

theless the whole piece appears white, and of a very superior quality. I have remarked that this effect does not take place excepting with regard to the old prints of flowered designs of the true India calicoes imported from that part of the globe. For in the printed goods of our manufactures, such as those of Paris, Joly, St. Denis, and Beauvais, all the traces of the designs completely disappeared, to my great surprize. It must, therefore, necessarily be admitted, that the difference in these results depend on the qualities of the mordants, which are more or less oily, or the manner of striking the blocks in the act of printing.

If this effect were produced by the mordant with the outlines of the designs in the pieces of printed goods, it might, perhaps, be of advantage to take the same method of obtaining a substitute, instead of the rich expensive embroideries with which the fine muslins of India and Switzerland are covered. These designs likewise do not appear in their full effect, but when they are placed upon a transparent stuff of a deep colour, which exhibits all the outline. This method of producing so rich an effect would be extremely simple, singularly permanent, and highly economical. I think, however, that I may add, that, after many trials,
I have

I have at last succeeded in discharging this mordant, sometimes by a bath of sulphuric acid, rather stronger than usual, and at other times by soaping the goods before and after the bath. This management is very essential to be known, in order that the operator may not be exposed to the mortification of seeing the same designs return again by the second action of the madder applied to the same bleached piece in a subsequent printing process. To obviate every accident of this kind, it will be proper to inform the owner which of the methods have been used to bleach their goods, and in case the new method may have been used, it would then be prudent to pass them previously through a good bath of sulphuric acid.

With regard to chemical colours, as they are called, which are applied on calicoes or other goods, they disappear immediately, and much more speedily, than fast colours. A single immersion in the weakest oxygenated muriatic acid, without any other preparation, is sufficient to destroy them, excepting only the outline of the flowers, which, as has already been remarked, requires particular precautions.

Among the yellow colours of this description there is one, however, in the composition of which sulphate of copper, sulphate of iron, and

and acetate of lead, are used, which is so far from being destroyed by the oxygenated muriatic acid, that, on the contrary, it is fixed by that means. This colour cannot be discharged, unless the piece be previously well rubbed in a good bath of soap, which disposes it so far to detach itself from the goods, that the immersion it afterwards undergoes in the muriatic acid completes its discharge.

It is very remarkable, that, after the discolouring of the printed goods, particularly brown or black, and when the oxygenated muriatic acid has combined with the merchandize, there arises from the trough a certain gas, which acts upon and irritates the organ of sight only, to such a degree, that it is very difficult to support its action for any considerable time without a discharge of tears *. This effect, however, is not very perceptible in a trough over which the workman has operated for the whole day, until towards the evening, whence it fol-

* The effect of this gas upon the human body is very similar to that which was produced on the 22d Brumaire in the evening, the present year, 6th of the republic, by a thick mist, of which the influence was felt, more or less, throughout Paris. This action was exerted principally by an irritation of the throat, a pricking sensation in the eyes and nose, and a discharge from the head. The oxygenated muriatic gas produces the same effects when it is breathed for any length of time, on which subject see chap. vi. of the present work.

lows that the acid does not act till after a considerable time upon the mordants, so as to produce this peculiar gaseous combination, which is then capable, by its quantity, of irritating the organs of sight. These inconveniences may be avoided, by taking care to work these pieces under a glass cover, expressly disposed for that purpose, nearly as is represented in fig. 1 and 2. in plate 1; or by making use of the covered vessel represented in fig. 1 and 2. plate 9. It would be an important acquisition to know the nature of the gas here spoken of.

With regard to piece goods dyed before or after the weaving, whether of thread or cotton, all the false dyes, such as red, blue, green, flesh-color, orange, grey, black, &c. disappear in an instant, and almost constantly, by a single immersion, and certainly by one immersion and one lixiviation; but it is most usual to omit the lixiviation.

The same remark does not apply to the true dyes, or fast colors, such as blues, Indian red, strawberry colour, deep brown, &c. the yellow colour and lemon colour either applied to linen or cotton: these are much more difficultly effaced. They sometimes require one lixiviation between two immersions, according to the force of the shade. The blue in particular is the most tenacious

cious colour ; it must be observed, that a bath of sulphuric acid must always be given at the conclusion, particularly with respect to the yellows, of the colour of rust of iron, which does not totally disappear but in this last fluid.

With regard to goods which have not been maddered, and of which the designs have been printed in oil, the first preparation is that of the lees, in which they must be heated, without rinsing or clearing off. After this, while they are yet hot from the lees, they must be strongly rubbed in a good solution of soap. Most of the colours are, by this means, partly discharged, and their destruction may be completed, either by the oxygenated muriatic acid, or by the sulphuric acid. It is seldom necessary to repeat this course of operations, many of these colours being usually discharged by the soap.

It is certainly proper to remark, in this place, that the effect of the oxygenated muriatic acid in destroying all colours whatever, as well on printed goods, as in such as have undergone the process of dying, whether in the thread, or in the web, must afford many persons the advantage of multiplying, in some measure, the changes of their clothes, without going to the expence of new : for if the old or unfashionable colours of a garment be discharged, and it be afterwards sent

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to the printer's to receive a new design, this simple process would enable the wearers to change the fashion every season, if they thought proper. The only expence would be that of discharging the old colours and printing new, at so much an ell, for the several colours, according to their respective value. It is equally obvious, that dealers in printed goods * might, by this means, vary or enlarge their speculations. I must likewise add, it might be possible to take advantage of the said property of the oxygenated muriatic acid, to destroy the colours of dyed goods, or to trace any required design with the pencil, the pen, simply in the way of outline, and in the manner of goods printed *à la reserve*. I have several times attempted to sketch different slight designs on such goods, principally in the muriatic acid without smell, and I succeeded perfectly in obtaining very neat and fine traces. It might be, perhaps, an object of still greater interest, to give a rose or other colour to piece-goods dyed *à la reserve*, because this method has not hitherto been applied but with respect to blues, and

* It seems probable that the wholesale method of operating in England, and the effect of the excise laws, would render the practice here described not very convenient in the English market.—T.

sometimes to orange or olive colour, or a few other light colours of this kind.

The same thing might be done with regard to the particular designs or things which might be imitated on striped goods, the threads of which were dyed before the weaving; from which it might be possible, either to take away part of the colour, or to add at pleasure a stripe of another kind. I have sometimes accomplished this purpose on blue and white stockings, as well as striped and chequed piece-goods, by lightly sprinkling the oxygenated muriatic acid upon them: the different drops of the acid produced a singular effect by spotting those stockings and striped goods. All the goods thus treated may be washed with soap or lees, without danger of effacing the different singular marks or designs which have been traced upon them. The observation I have made, with respect to dyed goods, is likewise applicable with regard to certain patterns of one uniform colour; it is probable that the prints might be made from a block impregnated with the muriatic acid, combined or amalgamated in such a manner as to work with the same accuracy as in the common practice of callico printing. I shall hereafter relate an experiment

periment which I have made in support of this observation.

I must not omit the remark, that the oxygenated acid is very useful to brighten up the white designs reserved in piece-goods printed *à la reserve*.

It is well known that these white spaces are seldom clear; either because the composition being ill applied, or ill made, suffers a small quantity of the colour to pass through; or from the effect of the sulphuric acid in which they are steeped to clear off the composition, when it is made of tobacco-pipe clay, &c. If the piece, when taken out of the boiler, is not well cleared of its colour, this last will slightly extend itself towards the blue, which is uncovered; consequently, by steeping the piece in a bath of oxygenated muriatic acid, after its immersion in the sulphuric acid, the colour is not only brightened, but the reserved white, in consequence of the neat finish in its outline, is rendered much more striking in its effect.

CHAP. XX.

The Methods of taking out the Dye from Silk and Wool.

SILKS dyed in a simple colour, such as indigo-blue, lilac, crimson, and grey, are capable of losing their colour, and acquiring a yellow chamois colour, by steeping in a bath of oxygenated muriatic acid, without any previous or intermediate lixiviation or preparation. White silk receives the same yellow colour, if exposed to this acid. But it is possible to convert this yellow colour to white, by exposing the silk to the vapour of sulphur or the sulphureous volatile acid. For this purpose, it is necessary that they should be yet in a moist state, to facilitate the equal action of the sulphureous gas. It must be observed also, that the goods ought not be exposed too near the flame of the sulphur, because the heat dries them, and retards the action of
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the volatile acid, and may likewise give them a scorched or brown colour.

Compound colours, such as browns, violets, greens, and blacks, likewise lose their colour, and acquire a similar tinge of chamois yellow; but this discolouring commonly requires two immersions. The blue of brown violet and puce colours commonly disappears first, leaving the shade of red more or less weakened. The same gradation takes place with regard to the green and orange colours, of which the yellow gives way first. The blue of the former, and the red of the latter, only remains. It is necessary that the oxygenated muriatic acid should be weak (*légère*) otherwise it would acquire an aurora colour instead of a rose colour, when it afterwards came to be steeped in sulphuric acid; for it is to be noted, that it is proper to use a bath of sulphuric acid, and rinse off with much water previous to each of the said immersions. With regard to black silks, the brown disappears first, and leaves the blue ground, if this may have been used; or the root ground, supposing this last to have been the basis of the black.

These observations, respecting silk, hold good also with regard to wool dyed grey, orange, green,

Saxon blue, apple green, root or fawn colour, brown lemon, and dipped blue. All these colours disappear more or less readily, and become of a chamois yellow, like the silk; but this last tint is easily brought to the original white, by exposure to the volatile sulphureous acid. Two immersions in the oxygenated muriatic acid are sometimes required, according to the depth of the colour; and the exposures to sulphuric acid will likewise require to be occasionally repeated. For if the chamois colour does not totally disappear at the first exposure, it will at the second.

If we attend, for a moment, to the alterations which woollen and silken goods undergo by exposure to the air, we shall immediately see, that the oxygen of the atmosphere is the principle which acts on the colouring matters with which the goods are impregnated, particularly the false dyes; and that the change is of the same nature as that which is produced by immersing these goods in a liquid which is, in some measure, saturated with that principle. The difference consists only in the speed with which this effect is brought about in the latter case.

The yellowish colour produced by the oxygen of the air is particularly observable in grey woollen with a raised nap, and loose hosiery of
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the same colour. This mode of fabrication and openness of texture probably affords a stronger hold to the oxygen, from the more extended surface it presents.

With regard to dyed silks, those of a rose colour, and Saxon blue, as well as the false blacks, are most subject to alteration by simple exposure to the air.

CHAP. XXI.

Dying by the oxygenated muriatic Acid.

I HAVE little to say, with regard to the dyes, in which the concurrence of the oxygenated muriatic acid is of advantage, after those of the nankeen and lemon yellow, of which I had occasion to speak in the fifteenth chapter. I shall here speak only of the different tinges of grey, which are obtained by plunging white wool or silk in a solution of sulphate of copper, and afterwards taking them out and immersing them in a bath of the oxygenated muriatic acid, either with or without smell. By this treatment the operator will observe the gradual appearance of a fine grey colour, more or less dark, and varying in its tinge, accordingly as the solution of the sulphate, or of the oxygenated acid, may have been concentrated. This dye appeared to me to be solid; for I perceived no alteration in its shade after exposing it for several days to the sun, and to a strong solution of soap.

It may be proper, in this place, to speak of a black or grey dye varying in its shade, which I have several times seen successfully made, in
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those glass-houses where the mineral alkali, with the crude soda, or the purified salt, is used. I here speak only of the Spanish soda, which is well known to contain a certain quantity of the muriate of soda, the presence of which is indicated at the moment of the fusion of the glass: for at this period more especially, as well as during the whitening of the frit, there exhales from the pots, for about half an hour, a thick white fume of muriatic acid, which acts on the noses and mouths of the workmen, and causes them to cough and sneeze: its presence is likewise manifested by the rust which immediately covers the pipes and other iron implements, placed within its reach, which the workmen are obliged to brighten, whenever they use them. I have concluded that the dye, of which I shall here give a concise account, was the more evidently produced by the action of the oxygenated muriatic acid, because a considerable quantity of manganese is used in the glass-works in which it is practised. The quantity used is such that the *cadmia fornicorum* of these works are of a perfect violet colour.

The following is the process I have seen in practice, at the glass-works of St. Gobin, in the department of Aisne, as well as in that of Tour-la-ville, in the department of la Manche. The former

former of these establishments use wood for fuel, and the purified salt of the soda of Alicant; the other burns pit-coal, and uses the same soda in the crude state.

The skeins of thread being previously washed in lees, or cleaned and afterwards rinsed and dried, are steeped in a solution of alum, in river-water. When they are well soaked in this solution, they are dashed strongly upon a kind of blackish foot, which is fixed along with the saline vapours by the internal projection of the furnace above the glass pot or crucible. After having repeated this a number of times, in order that the thread may become more or less loaded with the foot, it is agitated or rinsed in the same alum water, and again dashed against the foot, until it is thought to have acquired a colour sufficiently equal and deep. Last of all, they are rinsed in the same water, in which they become deprived of the excess of saline and colouring matter; after which they are slightly rung out, and dried, either in the sun, or in the shade. This black or grey colour, which the thread has thus acquired, is singularly tenacious. I have stockings of thread, thus dyed ten or twelve years ago, which have been washed in lees upwards of forty times, and have lost not the least portion of the intensity of their colour. It is to be remarked,
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that linen and cotton piece-goods are dyed by the same process. There is no doubt but it would be possible to imitate this dye, with profit and advantage, by some direct manufacturing process. I have made some trials which have succeeded, to a certain degree, by putting the foot of pit-coal into alum-water, in which I steeped thread, which acquired a shade, and was afterwards put into a bath of oxygenated muriatic acid. I repeated this alternation several times, which appeared to communicate an equal dye, and this dye was very slightly altered by soap.

We may likewise give the same grey or black shade to cotton, by boiling it for some time in a certain quantity of the saline foot of the glass-works, usually diffused in water, in which mixture the thread is simply turned and worked for a number of times, without any previous or subsequent operation, excepting that of washing or rinsing, which is always indispensable. I have, in this manner, dyed white thread stockings of a violet grey colour (*grisdelin*). This shade became somewhat pale after repeated washings.

CHAP. XXII.

Various Properties of the oxygenated muriatic Acid.

THE power of discharging every kind of colour from painted or printed goods, must render the discovery of the oxygenated muriatic acid of the highest value to manufacturers of paper, who may very profitably avail themselves of the acid to form white paper out of coloured rags. It, in some measure, affords them an additional resource to supply their manufactories with raw materials, and to avoid any particular sorting. They may, even in this respect, extend their speculations to cordage, oakum, old sails, and other articles, which they may bleach as speedily, and in as large a quantity, as they please, without giving themselves any concern about the scarcity of rags. It may also be questioned, why the bleaching property of the oxygenated muriatic acid should not be used to whiten paper which has been
written

written upon, and is become waste. This paper may afterwards be sized again, like any other sort, by which means the product and activity of this manufactory may be instantaneously augmented. This last object is so much the more easy to be attained, because the leaves of paper, containing writing, require to be steeped only one single time in the oxygenated muriatic acid without smell. The work is, therefore, of the greatest facility. This first operation may be made on a number of leaves together, disposed in such a manner that the oxygenated muriatic acid may surround and penetrate each leaf suspended in the fluid. It must be followed by a bath of sulphuric acid, of the same strength as has already been prescribed for the dressings. This bath is essentially necessary, however clearly the ink may appear to have been discharged when the paper comes out of the muriatic acid. The sulphuric acid is required to take up the iron, which, as is well known, composes a great part of every writing ink. Care must be taken to wash the paper, when it comes out of this last bath, in clean and limpid water, in order to carry off the sulphuric acid, after which the paper may be sized, if necessary, and then left to dry. Such paper as has been sized before it has undergone this operation,

ration, will not require fizing again, or at least this is very seldom the case, unless it has remained too long in the rinsing water. The paper, when dried, must be afterwards treated exactly in the same manner as if it had been newly manufactured. This method of bleaching written paper may also be of the greatest use to men of business of every description, merchants, and others, who use many books. When these have become useless, and out of date, they may, by the method here directed, be easily cleared of their writing, and rendered useful a second time*. When we reflect on the property of the oxygenated muriatic acid to discharge ink from paper, we observe, in the action of this liquor, a kind of analogy with that action which takes place, in the course of time, with respect to ancient writings. There is reason to think, that, in this last case, the air, by virtue of the oxygen which it contains, is acted upon in the same manner as the oxygenated muriatic acid; for old writings

* Since these experiments I have had occasion to make others, as well on the bleaching of the paste of paper, as on discharging the colour of written or printed papers. I have, therefore, thought it useful to insert, at the end of this work, the series of particular processes which I have made use of, and which I addressed to the different committees of the National Convention, in the year II. of the republic.

are so considerably altered, that a single slight bath of sulphuric acid is often sufficient to discharge them entirely, and in case this bath should not have been sufficient, they do not resist a very slight immersion in the muriatic acid.

The same observation may be made with regard to snow and dew; both these substances discolour and soon render the soles of shoes yellow when exposed to their action. This observation may very easily be made after walking out on the snow or grass imbued with dew.

On the same principle it is in the mountainous country, in the department of La Somme, the country people clear their linens simply by exposing them in the winter to the action of the snow, the dew, and the mists, without giving them any other preparation, except that they are careful to turn them from time to time on the ground, for about fifteen or twenty days, during which time this vegetable substance is exposed to the influence of the air and the atmosphere.

A solution of sulphate of soda, and the residue of the distilling vessels, is sometimes sufficient to discharge these ancient writings, which are already in part effaced by the oxygen of the atmospheric air in the course of time.

I must here mention an observation I have had

had occasion to make in the course of my operations on the bleaching of threads and cloths. The waters which had served to rinse the single, double, and twisted threads, when taken out of the lees, were very soon covered in the vessels, where this rinsing was then performed with a kind of lather, more or less white, accordingly as the thread was more or less advanced in its bleaching. This froth, which rose to the top of the water, was sometimes more than an inch in thickness, according to the quantity of thread or cloth which was rinsed or cleared, and forms an excellent paste for the immediate manufacture of paper. It may, in fact, be easily understood that this substance is of the same nature to that which is usually formed by the decomposed rags in the paper-mills, and is, in the present case, formed of an assemblage of the filaments of thread or cloth detached by the lees or the acid, but more particularly by the former, and more speedily and effectually separated by the rinsing. I can also assert, that the samples of paper which I have attempted to make with this material, were very beautiful and fine. The bleachers may, therefore, reserve this produce, and sell it to the paper manufacturer at a price which must necessarily vary according to its colour and quality.

The same remark is applicable to the inner
part

part of the sides of the vessels or tubes which is directly bleached by the action of the oxygenated acid, which, in process of time, renders it of a very fine white colour. This ligneous substance, when collected, is also very proper to form paper, after it has undergone the previous action of the mallets or cylinders of the paper-mill, and is afterwards properly diluted with water, according to the practice of the paper-makers; a very considerable quantity of this paste may even be collected in a short time. Nothing is more necessary for this object than to dispose the wood in the vessels destined for this purpose in such a manner, that it may present alternately to the acid and the salt of the intermediate lees the greatest quantity of surface possible. Two lixiviations, and two immersions, are sufficient to alter the wood so far that it may be rasped off with advantage. This very economical method may, with much profit, be used to supply certain pastes, which will afford very fine and good paper, according to its beauty, its whiteness, and the proportionate mixture of other pastes formed from rags. I have in this manner fabricated small samples of paper, which I shewed, at the beginning of 1789, to the administration of commerce, announcing this particular method, as well as that of mak-

ing a kind of grey paper with the tufts of the *typha palustris*. These pastes are not to be rejected, even supposing they could only be used for the white-brown or common paper, or for pasteboard ; as they would always contribute to render the fine rags more abundant for the manufacture of white papers, to which use they might be entirely reserved, if it should not be found advantageous to mix them with the other materials to produce the intermediate kinds of paper.

Olive oil, exposed in the uppermost false bottom of the pneumatic vessel to the gas or vapour of the oxygenated muriatic acid, passed through water loaded with potash in the proportion I have pointed out, became changed to the consistence of soft soap, or very white grease, without taste, nearly miscible with water, not soluble in the spirit of wine, nor subject to any perceptible change by the ordinary muriatic or nitric acids. Rectified sulphuric acid alone decomposes it almost as soon as poured on. The muriatic acid, with which the oil was combined, flies off, and the sulphuric acid changes the white and soapy colour of the oil into a brown mass, which very soon afterwards became blackish. Does not this experiment lead to a presumption that it might be possible

possible to form a kind of muriatic soap in the soft or hard form, which should have the property of bleaching? Thus much is certain, that from this notion I have attempted to combine olive oil with potash, partly neutralized by the oxygenated acid; and a sample of thread, which I bleached and soaped with this kind of soap, appeared to me to become white to a higher degree, and much more speedily, than by the method above described. This new method would be of infinite utility in every respect.

Copper or brass exposed in the same manner as the oil above mentioned to the action of the oxygenated acid gas, became, at first, blackish, after which it was covered with a firm, dry, pellicle of verdigrease, as well above as beneath: this verdigrease was of a very fine colour. When washed and ground, it is absolutely equal in colour to that fine English green so highly esteemed, with which the fashionable paper-hangings are printed. It might be possible to obtain this matter, in great quantities of it, at a low price, by constructing an apparatus for this purpose. I have obtained this kind of verdigrease by putting copperplates into the waters obtained from the residue of the distilling vessels. I have had occasion to remark on this subject,

that the fluid was, in the course of time, covered with a pellicle similar to that which rises upon milk when set to boil, but of a green colour.

Water, impregnated with the gas, has no action upon the copper, except in the course of a long time; but the gas itself acts instantly either upon copper or brass.

This kind of verdigrease may also be usefully employed in dying, and, in many instances, supply the place of that which is made with the refuse of grapes in the southern provinces.

Tin vessels (pewter) are totally dissolved or corroded by the oxygenated muriatic gas, and assume a grey colour.

Malacca tin is corroded in like manner, but it assumes a whitish colour. From this experiment it is that we have thought proper to conclude, that the solder of leaden tubes cannot long resist the action of the gas or liquor which is impregnated with our acid, and that it is particularly necessary, when tubes of this metal are to be used, that they should be cast entire, or without solder*.

* As the muriatic acid, whether oxygenated or not, when in the expanded or vapourous state, attacks, and speedily rusts copper, iron, and tin, it is improper to have in the place of distillation, any vessel or instrument made of those metals, because they would speedily be destroyed.

Sheet lead did not all, or scarcely at all, change its colour or properties by this exposure. It merely acquired a slight brown tinge. It was in consequence of this experiment that I determined to substitute tubes and adopters of lead instead of those of glass, and to recommend that the pneumatic vessels to be made of common wood, and that these, as well as the vessels for immersion, should be defended with sheet lead.

Litharge of gold, or yellow litharge, remains dry, and undergoes no other effect than to acquire a violet colour.

The directions or address on the outside of letters disappear entirely, without leaving any trace or alteration in the paper. This experiment, added to that of taking out the ink-marks made by the proprietors of stockings, gave me the first hint to apply this method of bleaching to written paper, which I have mentioned in this chapter.

Red sealing-wax became of a pale rose-colour, and was reduced into a kind of moist or soft wax.

Indigo, in small fragments exposed in the same manner to the oxygenated muriatic acid gas, changed its colour from a deep blue to the yellow colour of dead leaves. Black pitch merely became red at its surface. Hair, and feathers

of a black colour, were changed, the first grey, and the latter to an aurora colour. Green oil-cloth (*toile cirée*), spotted with black, became very white, and spotted with brown spots.

Fluid vegetable alkali, being the solution of blue potash exposed to the simple contact of the oxygenated muriatic acid, acquired the property of bleaching like the true water of Javelle, but, instead of the clear yellow colour it at first possessed, it became white and limpid. The bottom of the saucer made use of was lined with an infinite variety of very white crystals, in thin brilliant plates, of a dry appearance, like talc or mica; having the appearance of so many sections of the crystals of sulphate of potash, through the whole length of the prisms, terminating in their pyramids. These crystals might be one line and an half in length, one in breadth, and near a quarter of a line thick. This experiment, and another mentioned in the following chapter, seemed to prove that the violet colour of the lees, distinguished by the name of javelle, is, as Berthollet has observed, more particularly owing to manganese, of which the colouring matter is carried off with the gas that escapes.

The solution of mineral alkali, extracted from the soda of Alicant, and of an amber colour,
being

being exposed in the same manner as that of the vegetable alkali, acquired the same property of bleaching, without, however, entirely losing its own colour, or presenting any crystalization.

Pure water, exposed in the same manner, obtained the same property of bleaching, preserving its natural colour, without exhibiting any observable peculiarity.

These three different fluids, by becoming thus impregnated by the muriatic acid gas, seem to prove that it is not absolutely necessary to agitate the water of the vessels to concentrate the gas. An experiment with the intermediate tubulated vessels of the old apparatus, in which I have obtained pure solutions of this gas, coloured yellow or greenish, and marked from ten to twelve degrees of concentration, appear likewise to shew that agitation of the water is not, in strictness, absolutely necessary.

Thread, which had been subjected to the lees, and was merely moist, or slightly humid, with the lixivial solution, being simply exposed to the vapour or oxygenated acid gas, acquired a ruddy white colour similar to that of the third immersion, and without any kind of alteration.

Coarse thread, macerated several days in a weak solution of sulphate of potash, became

three fourths bleached, and with much uniformity or evenness of colour.

Flax macerated in the same manner likewise obtained a very fine white.

Flax, macerated for several days in the solution of potash, one degree below zero, and exposed, like the objects above mentioned, to the oxygenated muriatic acid gas, became of the most beautiful white.

All these different articles were subject to no alteration. It is true, that, being apprehensive lest the gas, with which they were impregnated, should alter their texture in consequence of its concentration when they should become dry, I was careful to wash them out in a large quantity of water.

May we not infer from these various trials, which were all made during the winter of 1790, that it is highly probable that threads and piece-goods might be advantageously bleached by simple exposure to the vapour of the oxygenated muriatic acid. For this purpose it appears to me, that the various articles, slightly moistened with water or with lees, would require to be hung up in a very close chamber, like that which is used for exposing goods to the vapour of sulphur, into which room the extremity of the distilling vessels must be introduced,
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to convey the gas in proportion as it should be disengaged. An experiment of this nature would require peculiar management, and its success would be of the greatest importance to the manufacturer.

CHAP. XXIII.

On the Possibility of applying the Residues to Profit.

THE residues to which the attention of the operator may be directed, in order to derive advantage, are: 1. Those of the retorts, bottles, or other distilling vessels: 2. Those of the immersions, or bleaching liquors: 3. Those of the alkaline lees, or soap: and, 4. Those of the baths of sulphuric acid.

The residues of the retorts, bottles, or other distilling vessels, are reducible to the following: 1. Manganese not discoloured, and the common muriatic acid coloured by manganese, if the muriatic acid has been used instead of the muriate of soda: 2. Sulphate of soda, and a small portion of muriate of soda not decomposed, if this last has been made use of: 3. Sulphate of potash, if lees have been used to extinguish the suffocating odour of the residue of the solution, which is always more or less impregnated with oxygenated muriatic acid.

Though

Though I have reduced the proportions of manganese to one-sixth less than directed by Berthollet, it is not, nevertheless, discoloured after the operation, or rather, it is only discoloured very slightly, and in few places. In this state it still preserves sufficient virtue, that is to say, enough of vital air to be mixed with about one-third of new manganese of the same quality. This property, or strength, cannot, however, be ascribed to manganese in lumps, or interspersed with quartz, though well cleared of foreign matter. The manganese crystallised in needles, such as is sold by Lapelletier, has alone afforded me this very perceptible difference *. Every other manganese, on the contrary, that is to say, the specimens in lumps, afford a much less quantity of gas, and render the bleaching liquor less strong. This last kind of manganese is also harder and more troublesome to pulverise.

The manganese taken out of the retort, after the first distillation, preserves almost the whole of its metallic brilliancy, and soils the hands as before, and may be used to purify glass. It is true, that in this state it seems to have increased in bulk. Manganese entirely decomposed is known by the whitish or pale

* This manganese is brought from Hambourg, in the duchy of Deuxponts.

purple colour, which the strong impression of the fire has given it.

The solution of the residue of the distilling vessels diluted with water, the evening after the distillation, is found on the following day, if the vessels have been closed, to be of a fine red, inclining to violet or purple, accordingly as the solution has been more or less diluted; but this colour does not fail to disappear by exposure to the open air, or by the heat employed to evaporate it. In either case, the violet colour of the solution is changed for a shade inclining to apple-green.

It seldom happens that the water which holds the residue of the retort or bottle in solution, is not sufficiently concentrated to afford, after remaining for a day or two in the receiving vessels, crystals of the sulphate of soda; but these crystals, which are of different sizes, are covered with manganese, from which it is necessary to clear them. This is easily done, by putting a small quantity of these residues into a vessel, and pouring a little clean water upon them, which, after brisk agitation, must be immediately poured off, before the manganese subsides, into a proper vessel intended to receive this last substance. This manœuvre is to be repeated

peated four or five times as quick^{ly} as possible, in order that less of the salt may be dissolved.

This trouble of washing may be avoided, if the violet-coloured water, which covers the residue of the distilling vessels, be carefully decanted off into wooden or leaden receptacles appropriated to this purpose. The crystals, which are soon afterwards formed in this water, are neat and clear as they ought to be. But it is necessary, after having decanted this violet-coloured fluid, that common water should be poured into the retorts or bottles, for the purpose of facilitating the extraction of what remains. This, together with the water, must be reserved by itself. If it be proposed to separate the manganese, for the purpose of using it again, as I have before mentioned, the following method must be recurred to. The residue must be washed repeatedly with a large quantity of water till it gives no perceptible saline or acid indication. The residue must then be dried, and afterwards mixed with new manganese, in the proportions before directed. If the waters of the washing be sufficiently impregnated to render it proper to mix them with the violet water, in order to increase the product of crystals, whether by insensible evaporation, or by the assistance of heat, this must be done, taking

taking care only, that in the latter process leaden vessels must be used, because copper, iron, and most other metals would be speedily corroded and destroyed.

The sulphates of soda and of potash, which are obtained from the washings of the residue of the distilling vessels, have not hitherto been applied to any use in the arts. It is possible, as I have before remarked, to employ them for discolouring certain ribbands, and effacing writing from paper or parchment, as well as for scouring copper and iron for braziers, &c. Both these salts are likewise used in medicine when purified; but it may be doubted whether the apothecaries would purchase them, because the very small quantity they consume is afforded very cheap from the salt-works of Lorraine and other places.

It would, therefore, be much more interesting to decompose these salts, and obtain the alkalis, in a disengaged state, which might, in that case, be used, to make the lees in the subsequent operations. Berthollet, in the first volume of the *Annales de Chimie*, informs us, that several persons have communicated different recipes to him for effecting this purpose; it were much to be wished that the authors would benefit the public by a more liberal communication.

cation. In the mean time I shall here remark, that it is very possible to decompose these neutral salts by means of liberal sulphur and the muriate of soda, by the sulphuric acid, and more especially by certain metallic oxydes, particularly that of lead. I have successfully tried this last method in 1784, which was indicated by Scheele. The alkali which is obtained by these different processes is of the purest kind, and I have had reason to be assured, that, with proper treatment, it affords glass equal in beauty to flint or crystal glass *.

The second residue, which may be applied to use, is that of the exhausted liquor of immersion. After the vital air, or oxygen, has been exhausted, the odorant liquor contains nothing but muriatic acid and water; the liquor without smell likewise contains muriate of potash. This salt, as well as the neutral salts, with

* The Committee of Public Safety published, in the second republican year, the various processes for decomposing muriate of soda, which it had received from the different authors or inventors. Establishments may, therefore, be made for supplying the national commerce with the alkaline salt of soda, the use of which is indispensable in different works, such as those of glass, soap, dyeing, bleaching, &c. for the supply of which several millions are annually expended among foreigners. *Note of the Author.*

A copy of this report may be seen in the *Annales de Chimie*.—T.

a fixed

a fixed alkaline base, is of some use in medicine, but it is not worth while to extract any thing but the sulphate of soda. This may be decomposed for the sake of the alkali, if the result should be attended with sufficient profit. I shall simply remark in this place, that these exhausted bleaching liquors may be effectually used in making sal ammoniac. The different trials I have made on this subject, by combining them with the volatile alkali of putrified urine or rotten vegetables, have constantly tended to confirm my opinion. Lastly, if it should be found advantageous to reduce the pure bleaching liquor without potash to the merchantable strength, it may be used for the subsequent distillations, in the same manner as other muriatic acid, instead of the muriate of soda and sulphuric acid; unless, indeed, it should be thought more advantageous to use it for making white lead or verdigris, both which combinations I have made and used in painting with success. The verdigris might also be used in dyeing.

I have also occasionally used these waters of immersion of the muriatic acid without smell, to make the second lees for piece-goods and threads. This fluid becomes as highly charged as if the lees had been pure. The exhausted
bleach-

bleaching liquor may likewise be usefully employed in the first maceration of goods; for which purpose, when it is not highly charged with colouring matter, it is no less valuable than the new liquor from the pneumatic vessels.

There is another property of the exhausted bleaching liquor, which is, perhaps, of considerable importance, namely, that of accelerating the vegetation of plants; from repeated trials I can affirm that it possesses peculiar properties in this respect. I have at different times used it, instead of common water, on cauliflowers, chervil, peas, cabbages, leeks, &c.: and these various plants have not only grown more quickly than others of the same kind planted in the same bed, and watered with river water, but have likewise acquired double the size.

Besides the property of accelerating vegetation, these waters have likewise the property to drive away, at the instant of pouring on the ground, the spiders, ants, worms, snails, and other reptiles of this kind, which are noxious to plants and feeds. A gardener, near the laboratory where I made the muriatic acid for bleaching, was so fully convinced of the advantage of these waters, from his own experience, that he requested, as a favour, that I would reserve them for his use; and was continually
s speak-

speaking in praise of the good effects it produced on the plants in his garden.

But in proportion as the small quantity of oxygenated muriatic acid, diffused through the exhausted water, is of advantage to vegetation, so much more noxious it is to plants when in the form of gas or vapour. Plants exposed to this elastic fluid instantly fade and perish. I have frequently seen this effect on the plant monk's-hood, and even on vines, the leaves of which soon became yellow, and the stems, after having languished for a certain time, partly died.

With regard to the third residue, of which the waters of lixiviation form a part, I think I have said all that is necessary in the chapter upon lixiviums. I shall here only add, that if there were an opportunity of disposing of them to advantage to a saltpetre-work, it would probably be more advantageous than to reduce them by evaporation. There is, however, reason to think, that the old lees might be restored to a certain point by boiling them a long time with lime; this earth, having the property of destroying the vegetable parts which cover and weaken the alkalis, might, perhaps, produce the same effect as reducing the solution to the solid consistence.

The following is likewise an economical method

thod of constantly applying the same lees to use, which I have often employed with the greatest success. It consists simply in throwing the ashes, from which they have been extracted, into the fires used for domestic purposes in the house, suffering them to dry, and afterwards wetting them with the exhausted lees from time to time, which are to be reserved for this purpose. The flame of the wood, burned in the chimney (for these observations are only applicable to a wood fire), and the heat of the hearth, soon burn the impurities, which coloured the alkali, and the ashes speedily become proper for lixiviation as before. This operation, which demands very little care, may be of great use, even in the domestic concerns of a house where alkaline lees are used.

The soap-waters likewise are not to be neglected. It would be possible to decompose them, either by means of the waters which have served for the baths of sulphuric acid, or with those of the exhausted bleaching liquor; but the best use would be for the manufacture of saltpetre, for which purpose the alkali must be extracted by calcination. In the last case the process is nearly the same as with the lees; that is to say, when the soap-water is reduced to the consistence of extract, and nearly dry, the oil must

be burned off in an open fire, which will leave the alkali soluble in water, and ready for use, in the distillations and lixiviations, in the same manner as new potash. I have practised this method, and must here remark, that new soap-water rises in froth above the vessel when it boils, whereas that which has been used does not exhibit the same property.

With regard to the baths of sulphuric acid, which compose the fourth residue, when they are too much diluted with water, from the immersion of wet articles, the shortest method is to add more acid, or else to concentrate the fluid in the same manner as I have observed with regard to the sulphate of soda, and other salts. For this purpose it may be concentrated to such a degree as to be used again instead of common sulphuric acid, or it may be used for making alum or sulphate of ammoniac, by combination with the alkali of urine or putrefying vegetables.

CHAP. XXIV.

The Method of bleaching Hemp and Flax in the unmanufactured State, as well as Thread and Piece-goods, by the Assistance of Water only.

I HAVE long remarked, that the rags or pieces of unbleached cloth, which have been set to ferment in order to make blotting-paper, became white to a certain point, in consequence of being washed or soaked, either in heaps or under the mallets, for the purpose of destroying their texture. The washing, in these circumstances, becomes more easy on account of the fermentation, which opens the threads of the cloth, and the mechanical process of the cylinder, or mallet, which renders the colouring parts more easily detached, and in a certain degree dissolved. I attempted to imitate this fermentation, and solution of the colouring part of the thread, by washing in a large quantity of water. I made my experiment in preference upon flax. I first macerated it in pure river water, in a vessel, where I suffered it to

remain till the surface of the fluid was covered with numerous bubbles. In this stage I turned it, and saw, with pleasure, that its grey colour was changed to a light yellow. I then changed the water, first washing out the flax, and left it till other bubbles appeared, when I washed it again. At the second washing, I observed several parts which were whiter than the rest, and at the same time observed a considerable quantity of small portions of grey and yellowish impurities, which detached themselves from the filaments of the flax. I then washed it with rubbing, and was not a little surprised to observe the quantity of impurity increase, and the flax become whiter in proportion. Encouraged by the success of this washing, I then plunged the same flax into warm water, to hasten the solution of the other colouring parts, which had immediately fixed themselves on the flax, as soon as it had dried, after taking out of the vessel. I then pressed it in the water, which disengaged an additional quantity of colouring parts, and the flax appeared much more beautiful. I did not carry this experiment further, because the flax appeared clear and white, to as great a degree as I supposed it would arrive at by this method, for no more impurities were detached. Though it appeared to be white, when in the state of division,

sion, yet in the mass it still preserved a slight shade of yellow, which with a simple bath of oxygenated muriatic acid totally disappeared, without the use of lees, or any other particular preparation.

This experiment perfectly agrees with an observation which may be daily made upon pieces of cloth which are subjected to the fulling-stock. Some of these pieces have holes in them; and in order that these damaged parts may not be enlarged by the process of fulling, it is usual to secure them by sewing on a piece of brown linen cloth. I have remarked, not without astonishment, that these pieces of unbleached linen, after having remained in the water for two or three days, with the cloths to which they were fixed, and which were thus exposed in order to clear them, either from the solution of soap, the urine, or the fullers' earth, became as white as if they had been passed through the lees, and exposed alternately in the field for several months, or the usual time employed in bleaching.

This result likewise agrees with the method in use in India, where, according to the relation of travellers, the natives bleach their fine cottons, which we receive from them, in no other way than by wetting and evaporation by

the sun, and exposure to the dew, without the use of lees, or any other preparation.

All these experiments prove, therefore, that it would be very possible to bleach with water alone, if not piece-goods, at least flax, in as expeditious a manner as can be desired. This has, to a certain extent, been put in practice by a certain industrious individual in the town of Amiens, named Basse. Without any knowledge of this man, or his method, but from the simple recital of his discovery, that he had bleached hemp in the stalk by water alone, I was tempted to make the trial. In consequence I set to macerate in water, during for about a fortnight, a certain quantity of hemp stalks, which had been gathered about five or six months, and afterwards dried in a barn, without undergoing the process of rotting. At the end of fifteen days the hemp had recovered its original verdure, that is to say, the appearance it had when first gathered. I rubbed them much under water, which dispersed the green matter which appeared on the bark, and discovered the fibrous part, which had a pretty good appearance. I separated this, and left it to steep for several successive days in fresh water, after which I gave it another rubbing, and immersed it for a second time. It then appeared of a very beautiful white,

white, nearly the same as thread acquires by the old method of bleaching in the field, or the new process with the oxygenated muriatic acid. This flax retained only a very slight tinge of a pale ruddy colour.

These various experiments evince how important it would be to bring the steeping of hemp and flax to perfection, particularly of the latter article, which in the department of La Somme, whence it is watered only on the grass; but the desire of gain, which attends to the weight only, and not the quality, will scarcely permit the old method to be laid aside. On the other hand, the bleacher, who is accustomed to use lime in solution, and even in substance—an ingredient which is, in some respects, rendered necessary by his interest, and the black tenacious colour of flax thus watered—might also, perhaps, be unwilling to abandon this practice. For the cheap price, which the use of this method enables him to offer, namely, 3 sols an ell, without regard to the breadth, may secure employ, which would, perhaps, leave him, if he were to use another method, somewhat more costly, though at the same time in every respect beneficial for the merchandize and the proprietor.

CHAP. XXV.

*The Method of Bleaching written or printed Papers
and Rags, whether unbleached, dyed, or coloured.*

THE following processes are extracted from different memoirs addressed to the Committee of Commerce of the French National Convention; also to the Commission of Subsistences and Provisions, on the 24th Frimaire, the 15th Pluviose, and the 9th, 14th, and 21st of Germinal, in the second year of the French republic.

*Bleaching of old printed Papers, to be worked up
again.*

1. Boil your printed paper for an instant in solution of soda rendered caustic by potash. The soda of varech is good.

2. Steep them in soap-water, and then wash them, after which the material may be decomposed, or reduced to apulp, by the machinery of the paper-mill. The washing with soap may be omitted without any great inconvenience.

Bleaching

Bleaching of old written Papers, to be worked up again.

Steep your paper in a cold solution of sulphuric acid in water, after which wash them before they are taken to the mill. If the acidulated water be heated, it will be so much the more effectual,

Bleaching of printed Papers without destroying the Texture of the Leaves.

1. Steep the leaves in a caustic solution of soda, either hot or cold. 2. And in a solution of soap. 3. Arrange the sheets alternately between cloths, in the same manner as the paper-makers dispose thin sheets of paper when delivered from the form. 4. Subject the leaves to the press, and they will become whiter, unless they were originally loaded with size and printers' ink. If the leaves should not be entirely white by this first operation, repeat the process a second, and, if necessary, a third time. The bleached leaves, when dried and pressed, may be used again for the same purposes as before.

*Bleaching of old written Papers without destroying
the Texture of the Leaves.*

1. Steep the paper in water acidulated with sulphuric acid, either hot or cold. 2. And in the solution of oxygenated muriatic acid. These papers, when pressed and dyed, will be fit for use as before.

*The Method of bleaching Rags of the natural brown
Colour for the Manufactory of white Paper.*

1. Let the rags be opened or separated from each other, after previous soaking or maceration for a longer or a shorter time, according to their texture and quantity. 2. Give a lixiviation in caustic, vegetable, or muriatic alkali. 3. Pass them through the oxygenated muriatic acid, more or less concentrated with alkali. 4. Let the mass be then worked for a sufficient time in the apparatus of the paper-mill, and it may be advantageously substituted instead of that which is afforded by white rags.

The white colour will be still better, if, after the maceration, the rags be opened and subjected, as usual, to the action of the mill; after which the paste itself must be subjected to one lixiviation, one immersion, and a bath of sulphuric acid. The mass being then well washed
and

and pressed out, may be thrown into a trough to be manufactured.

Method of bleaching Rags, of all Colours whatever, in order to make white Paper.

1. Let the rags be opened, as before. 2. Steep them in the oxygenated muriatic acid. 3. If, as it commonly happens, the colour is discharged by this first immersion, let these bleached and decomposed rags be immersed in water acidulated with sulphuric acid. 4. Complete the disorganization by the mallets or cylinders of the mill, after having previously well washed them.

If the colour should not be sufficiently discharged by the first immersion in the oxygenated muriatic acid, which is very seldom the case, give them another alkaline lixiviation, and after that a second immersion in the oxygenated muriatic acid; after which steep them in water acidulated with sulphuric acid, either hot or cold, the latter of which is the most active and effectual; and, lastly, let them be subjected to the action of the mallets or cylinders.

Red and blue colours are most tenacious. With regard to black, it will be sufficient if they be steeped after opening their texture,
1. In a diluted solution of sulphuric acid; and,
2. In a solution of the oxygenated muriatic acid.

If

If the operator could know that these rags had been dyed in the raw state, a still more brilliant white might be obtained by following the second method described in the preceding article. But it very seldom happens that coloured rags have not been bleached before they were dyed. The manipulations may be performed with sufficient speed to bleach at least three thousand pounds weight in the course of the day, without appropriating any extraordinary edifice or workshop to this purpose.

These new methods, if adopted in the present circumstances (of France), will greatly contribute to prevent the want or dearness of paper or rags. The quantities of the respective materials cannot be precisely directed on account of the difference of the vessels, the papers, and the colours; but practice and attention have soon regulated these matters. In the applications of these principles, the republic of France have obtained two valuable advantages. On the one hand, a greater quantity of linen has been saved for the use of the hospitals; and, on the other hand, it has been more easy to reserve the rags of superior quality for paper-money and the purposes of trade, which require peculiar strength to undergo the circulation.

CHAP. XXVI.

THE valuable product of vegetable alkali, which may be expected from the incineration of the marc or residue of grapes*, in order to shew the considerable magnitude of the advantage which this hitherto neglected material may afford, which in some vineyards is used as fuel, and in others as manure, I shall simply remark, that, after direct experiments, I find that five hundred pounds of the residue of this marc, dried after distillation (a purpose to which they are in some provinces applied to obtain brandy), and afterwards burned, have constantly afforded me one hundred pounds, or thereabouts, of ashes, which produced ten pounds of fixed vegetable alkali or potash, reduced to the consistence of saline of a blackish brown colour.

It is easy to perceive what an immense provision of this article one might annually obtain in countries where the marc is used only as

* The following account is extracted from a memoir on the same subject, which was addressed on the 18th Thermidor to the Commission for Provisions and Ammunition to the armies of France.

manure. Nothing more would be required than to collect the ashes of this marc, burned after it is taken from the press, or subsequent to the time of attaining the small vines, or, lastly, after distillation in those places where they are used to make brandy.

The residue of grapes is not easily burned, because the seeds become disengaged. It may, nevertheless, be burned with a certain degree of speed, by means of a grate, having intervals of one inch, or half an inch wide, raised above an ash-hole or hearth to the height of 12 or 15 inches. The husks intended to be burned are to be disposed all round, because the previous drying is of advantage to hasten the combustion. The seeds which fall through must be thrown up, from time to time, with a shovel, until they are entirely red hot, in which state they are to be taken out and thrown in a heap in some convenient place near the furnace, where the combustion may be completed by turning them over from time to time, and exposing them to a current of air. The larger this heap is made, the more speedy and perfect will be the combustion, and the more abundant will be the alkaline produce. The heat remains a long time. I have seen instances in which the mass remained very red after having burned for a month

month with frequent stirring and exposure to the air. It is proper to remark, that whatever care is taken to burn the seeds, there will, nevertheless, remain near one-tenth part not entirely consumed, which may be easily separated from the rest with a sieve. These may afterwards be burned with the husks, or separately, as may be most convenient. The rain does not perceptibly injure the ashes of these heaps, if they be covered with other husks, either dry or slightly moist. If the marc be burned in this last state, it produces a cinder, which is disposed to agglutinate together in a stony form.

When the fire is once kindled upon the grate, it is afterwards kept up without intermission, by charging it with dry husks in proportion as the combustion proceeds. These may be put on to the depth of six inches. When the fire is well lighted, and urged by a strong wind, the moist husks and stalks burn almost as speedily as those which are dry.

It is of essential consequence, that the grates should be fixed in a spacious airy place, where there is no danger from fire. The residue of grapes emits during its combustion a white and very thick smoke, which would incommode the neighbourhood.

Two grates of iron wire, about three quarters of an inch in the meshes, or holes, twelve feet in length, and four and an half or five feet wide, properly attended by one man, will burn in a day, by a fresh wind, five thousand pounds of this dry residue, which afford nearly one thousand pounds of ashes, and from the lixiviation of these ashes a product of one hundred or one hundred and ten pounds of well dried salin or vegetable alkali is attained.

The residue of grapes may also be made up in the form of peat, and dried in the open air, or under a shed. These are moulded in the same manner as the residue of the tanners. After drying for three days, they are sufficiently firm to be burned on a grate of bars one inch square, and an inch asunder, which form a kind of furnace either in the open air, or beneath a chimney. A furnace 8 feet long, 20 inches wide, and 18 inches deep, may consume four thousand of these dry pieces, each weighing about one pound and a half, and measuring in diameter five inches, and from an inch and a half to two inches thick. A woman, or a boy of fifteen years old, can make fifteen hundred of these cakes in a day with ease. This was the process I used in Messidor, in the year two, in order to afford

afford a speedy supply of vegetable alkali to a manufactory of saltpetre, which I directed that year in the department of La Côte d'Or.

It may also be remarked, that advantage may very easily be derived from the heat of the fire, necessarily made of this process, whether for the purpose of lixiviation of the ashes, or drying the alkali.

The most essential fact, however, which requires to be known, is, that a very speedy and abundant product of vegetable alkali, for the manufactory of saltpetre, or for other arts and manufactories, may be obtained by the simple means here pointed out.

CHAP. XXVII.

*Fabrication of crude Alkali (cendres Gravelées), with
the Lees of Wine*.*

UNDER the mantle of a kitchen, or a bake-house chimney, from one wall to the other, at the distance of 18 or 20 inches from the back, according to the opening of the flue, let a grate be fixed of bars of one inch square, at the distance of about one inch and a half asunder. This grate is to be raised at least 18 inches above the hearth, and defended in front with a wall one brick thick, having perforations nearly resembling those of a pigeon-house. Or, instead of the wall, a grate may be substituted similar to that of the bottom. This wall, or grate, may be 24 inches high. The interior space of this kind of furnace, is then to be filled with the lees of wine pressed dry or green. The latter are to

* The following is extracted from a memoir presented on the 22d Vendemiaire, in the year two, to the Committees of Commerce and Provisions, and to the Commission of Agriculture and of Arts.

be preferred, because the alkali they afford is much finer. The whole is to be set on fire by means of straw or small wood, previously disposed under the lees. The fire soon penetrates the whole mass, and in less than a quarter of an hour the flame speedily reaches the upper strata, which must be regularly supplied with new lees, in proportion as the mass sinks down by the combustion. That portion which falls through the grate, and may appear from its brown or blackish fracture to be not entirely consumed, must be returned again to the fire. The grate must be cleared from time to time with a hook, in order to facilitate the combustion.

Instead of burning the lees in a furnace of this kind, another furnace may be used with equal advantage, entirely of brick, in the form of a hollow tower, at the bottom of which some faggots of wood are to be placed, which are to be lighted after having filled part of the capacity of the furnace with fresh lees, mixed with dry, or with fresh lees only; for those which are too dry must be steeped a day beforehand, in order that they may be perceptibly moist. Those lees are then successively thrown in at the top of the furnace, in which manner the process is to be continued until the whole of the lees are consumed. After continuing this process for several days, the

furnace is suffered to cool, and the ashes taken out through a door at the bottom.

It is proper again to remark, that these furnaces ought to be constructed in a spacious place, on account of the dangers of fire, and the inconvenience of the smoke, which is very considerable.

The lees, thus burned, emit a light very long flame tinged with different colours. It may be advantageously used in furnaces instead of wood, either alone, or mixed with that combustible.

One barrel or piece and a half of *cendres gravelées*, weighing about 260 Paris pounds, is the product per day by one man's work of the combustion of 6 or 7 barrels or pieces of wine lees, well dried in a furnace constructed under a chimney 20 or 24 inches deep, 18 inches wide, and 8 feet in length. This was filled four times during the day, taking care each time in the first place to stir the lees at top and in front with an iron fork, and to clear the grate beneath with a hook, which is absolutely necessary to be done, in order to prevent the mass from coagulating, and to favour the action of the air. With proper attention 50 or 60 barrels may be burned in six days, without being obliged to employ the night; the same quantity may
be

be burned in three days and two nights in the round furnace above described, if constructed of a diameter of 5 feet.

The good *cendres gravelées*, or that which is afforded by the red lees, contains at least 70 or 80 pounds of vegetable alkali in the hundred, when it has been carefully burned. That which is made with white lees, though well pounded and dissolved in hot water, does not afford more than 45 or 50 pounds of alkali. In general, when the cinders have acquired a green or blue colour in the fire, and are light and sonorous, the quality is good; but it seldom happens that the whole product is of the same colour. That which is too much burned and resembles the scoria of iron, must be rejected, not only because it is very difficult to pound, but likewise insoluble and earthy. The saltpetre-makers, dyers, bleachers, potters, leather-stainers, glass-makers, and others who use this saline substance, are particular in their choice of that which is light, spongy, and of a greenish or bluish colour, which shews no sign of vitrification in its fracture, the undoubted sign of too strong a fire.

CHAP. XXVIII.

The Method of Bleaching Wool.

PIECE-goods formed of thread and wool, or wool and cotton, being at present very much in fashion (in France), it may probably be an interesting object to manufacturers in this branch, to see an account of the method of bleaching wool in this place by the ordinary process, though well known. I shall in the first place speak of carded wool, which is used for broad-cloths, and wool proper for combing, which is used for the manufacture of stuffs*.

Wool for carding for the manufacture of broad-cloths, &c.—This kind of wool, as it is usually found in the market, has already been subjected in the hands of the grower or dealer to a cleansing, which has deprived it of 50 or 60 per cent. But the wools forwarded to the manufactories are still loaded with a portion of the unctuous or

* The following is, in great part, extracted from different memoirs of Roland Laplatiere, and Allard, formerly inspectors of manufactures.

greasy matter, which it is necessary to clear them of. Experience has shewn, that this small quantity of natural grease is necessary to preserve them from worms, during the carriage, as well as the time of keeping, before they are applied to use.

The manufacturer's method of cleansing his wool, is usually performed as follows:—To a given quantity of water poured into a boiler, for example, five-and-twenty pails, an addition is made of five of old putrified urine, which is boiled for a short time. The mixture is then proper to dissolve the grease of the wool. Three or four pails of this liquid are then poured into a vessel at the heat which will admit the workman to hold his hand in it. About 20 pounds of wool are then thrown in, which, after steeping a very short time, are continually stirred with a stick for a quarter of an hour, after which it is taken out and drained for a few moments in a basket over the vessel, into which the drainage liquor returns. The wool is then carried to the river and repeatedly washed in large open baskets, by stirring it about with long poles or rakes, till the water comes off very clear. In the mean time another workman puts a like quantity of wool into the vessel, and the same operation is repeated, &c.

Several

Several essential matters are required to be observed during this operation. 1. The bath in the boiler, as well as in the other vessel, must be refreshed * from time to time, when its force is found to be diminished, for it loses much of its strength, in consequence of the various changes of the wool, as well as from evaporation. 2. If he should think the addition of urine unnecessary, by way of restoring the bath, he must raise its temperature, in order to give it the requisite power for the washing. 3. But the heat must be carefully prevented from increasing beyond the proper degree, as determined by experience, for it is found that too much heat hardens the unctuous matter, instead of dissolving it, and that too great a quantity of urine changes the wool, and renders it harsh. 4. When the bath has become too foul for the washing, it must be entirely changed: it may easily be imagined, that this work requires a very intelligent workman; but practice renders the business very easy.

The success of this operation is ascertained from the appearance of the wool, which becomes

* It is more advisable to refresh than to renew the bath, because the greasy impurity of the wool, which is disengaged by washing, becomes a leaven which disengages the grease from the other wool, plunged in the bath.

white, soft, elastic, and open, dilating or swelling when touched, instead of being hard, greasy, and close, as it was at first. The qualities it acquires in the bath do, therefore, sufficiently shew the necessity and utility of this second cleansing, by which it loses 10 or 12 per cent more. This last loss, added to the former, gives a total of about 60 or 70 per cent; that is to say, 100 pounds of raw wool produce scarcely more than 30 or 40 pounds in a very clear state, fit for the manufacturer.

Wool for combing for the manufacture of Stuffs.

— This wool, in the market, is broken or sorted by the clothier, and sent before or after the dying (if this be intended) to the combers in parcels of about six pounds and a half each. The quantity is first washed in a vessel filled with hot water, taken out of a small boiler in which two or two and a half pounds of green or black soap has been dissolved, for the said quantity of wool, which accordingly as it is thought to be more or less foul, is well pressed and afterwards wrung on the hook, and then dried in the sun, or in the open air. Before it is combed, it is again subjected to a second bath of the same kind. These two clearings are sufficient to deprive it of all the natural grease which remains,

and

and of such impurities as might be an impediment to the combing process.

It must be remarked, that these six pounds and a half of wool are washed in successive small portions at a time. The water of the washing-tub is renewed as the work goes on, in order to detach the grease and other impurities from the wool; there are two hooks fixed within the vessel, one at each end, one of which can be turned round by a handle. The workman, after having well washed and pressed with his hands the several parts of the wool, wraps them round the two hooks, and by wringing it out, he expresses the dirty water, which carries with it all the grease detached by virtue of this strong pressure. After this second washing, the wool is dried carefully to prevent its being accidentally soiled.

In this state it is, that the wool is combed. It must be rather moist for this operation, in order to facilitate the prolongation of its filaments, of which, when the wool is well cleansed, the comber ought always to form lengths of three or four feet each. It is, therefore, essentially necessary, that this operation should be well managed, not only for the good effect it produces in the opening, but, likewise, because the
colour

so our and clearness of the stuff depends much more upon this first operation, than it is generally imagined.

In many manufactories, after the wools are combed, and according to the kind of stuff intended to be made, it is usual, in order to dispose them to spin well, to give them a third washing in the same vessel with hot water and soap. The wool is afterwards carefully dried, and in this state delivered to the spinner, if it be intended for the chain or weft; but that which is intended for weft is returned to the comber, and after coming out of his hands it is washed a fourth time as before. But this fourth and last washing is not given except to wools of the first quality, manufactured of a white colour, or intended to receive any clear and brilliant dyes.

Wool, which is well cleared of the grease, ought to have its filaments slender, long, even, and not connected with each other, besides which it ought to be tenacious, white, and disengaged from every foreign substance. The wool from Holland is remarkable for this last quality. That of England, is harsher and much fouler. The German wool is still harsher, but equal to this in length. It approaches the French wool,
which

which is the worst kind of any, with regard to its length and fitness for combing.

The loss sustained by cleansing, is somewhat less than one-fourth in the Dutch wools, and about a fourth in those of England. The German wools, and those of France, undergo a still more considerable loss, on account of their inferior quality. Some of the latter lose more than one-third.

Sulphuring. Wool, stuffs, stockings, and other articles of the same nature which are soiled by dressing or use, are exposed to the vapours of sulphur. By this process these goods receive a clearer white than that which is natural to the wool after the usual washing and cleansing.

This operation is usually commenced by washing or fulling the piece. For this purpose it is requisite that the fulling rammers should be made lighter than usual. When the convenience of a stream is not to be had for moving them, it will be sufficient if a frame of 15 or 20 inches wide be made with two beams three or four inches thick, supported by cross-pieces, and terminating below in a cross-piece somewhat longer, stronger, and vertically suspended to a plank or poles placed between the timbers of the roof, and forming a spring. A wooden trough

is placed underneath, in which a workman may move the springing pestle up and down with his hand with great facility, and by inclining the trough the same effect of turning the stuff may be produced as in the common fulling apparatus.

Instead of a machine of this kind, the manufacturer may use the mallet, or which is still better, the goods may be worked with the feet, in a place properly disposed for this effect, as has been recommended for piece-goods and stockings.

When the piece is well cleansed and rinsed in a stream, it is dried and singed, or sent to the dye-house; if, on the contrary, it is intended for a clear white, it must be singed before the scouring*. For the fine white, a second slight washing is given in a solution of soap, in which the stuff is left for a certain time, then washed well, rinsed in running water, and left to drain for an hour on the horse, after which it is exposed to the vapours of sulphur for five or six hours, or longer, as far as 24 hours, according to the bulk of the piece.

After this operation, it is again washed, and

* The method of singeing muslins, is equally applicable to woollen goods which require this treatment.

its colour heightened with fine whiting and blue, which are diffused in clear water; it is then sulphured a second time, washed in a slight solution of soap, dried, passed through the stretching machine, callendered, or pressed, according to its nature.

The following is the method of treating a piece of cloth of 40 or 42 ells, with the whiting and blue. Seven or eight pounds of fine whiting (*blanc d'Espagne*) are pounded and mixed up with water in a pail. This mixture, except the coarse particles at the bottom, is poured into a small trough of clear water. The bath being well mixed, the piece is passed rapidly through it upon the reel for a quarter of an hour, after which it is raised out of the bath upon the reel, and a pail of water is added, in which an ounce and a half of the finest indigo, or Prussian blue, has been diffused by the usual method of pounding, sifting, and wrapping it in a bag. The bath being again well stirred, the piece is immediately returned through the fluid again by means of the reel. After this treatment, it is laid on a packing-cloth, and carried to the workshop, where the nap is laid by the fullers' thistle, during which the surface is wetted with the fluid of the bath, and when the piece is dry,
it

it is beaten with twigs to clear it of the white powder it received in the foregoing process.

It is proper to observe, that bad smells, and even the offensive breath of individuals, will sometimes produce a change in the bath of blue and white, in which woollen goods are steeped; or, at least, this is what very respectable manufacturers affirm to be the case. When this happens, the operator is obliged to plunge his piece in a bath of hot water, to wash out the white and the blue, which have fixed themselves irregularly in a kind of vegetation, after which the operation must be repeated. With regard to woollen shirts, flannels, and other articles intended to be worn next the skin, neither sulphur nor soap are in any respect suitable to them. It is sufficient if these be well scoured in bran and water, and afterwards well washed in clear water. The colour is of no particular consequence, as the main object is to render it as absorbent as possible, to which quality the soap itself is a great impediment.

The preference is often given to leave stockings on the leg with washing or sulphuring them.

The place in which the operation of sulphuring is performed, is merely a very close chamber, in which the goods are suspended on poles of

white deal, so as to hang down in folds, which neither touch each other, nor the floor or wall. It is still more particularly necessary, that they should not touch any iron, which becomes oxyded by the muriatic and the volatile sulphureous acid afforded by the sulphur which burns in a vessel on the floor, and would certainly spot it. Instead of passing these pieces over the poles, it might, perhaps, be more adviseable to fasten them beneath the same poles, by means of hooks passing either through the lifts themselves, or through loops of twine attached to the lifts.

It is necessary to be aware, that a cloth which has undergone the operation of sulphuring, should not be immediately laid upon wood before it is purged of the sulphureous acid, which would dissolve the resinous or gummy parts, and spot the goods.

The sulphuring not only communicates a disagreeable smell to the cloth, but likewise gives it a harsh feel. A bath of soap which is given after this operation restores its softness, and that in a degree which is more effectual the longer the cloth is worked in it.

CHAP. XXIX.

The Bleaching of Silk.

THE same reasons which have led me to insert the process of bleaching wool in the foregoing chapter, with the account of the goods which are wholly or in part made of that material, induced me likewise to insert the processes for bleaching silk.

There are two methods of performing this, either by ungumming it, or leaving the gum in its texture. I shall treat of both, beginning with that in which the silk is ungummed and boiled*.

This process is managed as follows: Dissolve, in a sufficient quantity of water, in a boiler over the fire, 30 pounds of white soap of Marseilles for every 100 pounds of silk. After the solution has boiled, lower its heat by an addition of cold water. Extinguish or slacken the fire, but take

* Here, as in the foregoing chapter, I recur to the Memoirs of Roland Laplatiere.

care, nevertheless, to keep the bath at a considerable heat. Steep therein the silks, hung on rods, in which state leave them till their whiteness and flexibility shews that the gum is dissolved and separated. Spread out the silk on the rods, and turn them, in order that the parts out of the bath may be steeped in their turn, and when each hank is perfectly ungummed, wring them on the pin to express the soap; shake them, and put them in bags of coarse cloth, containing 20 or 30 pounds each.

Make a new bath in the same proportion, and in the same manner, as the former. Throw the bags therein, and boil them for an hour and a half, stirring them from time to time in the boiler. The ungumming and boiling of silk deprives it of 25 per cent of its weight.

If the silk be intended to be dyed, the ungumming and boiling are performed in the same bath, which is boiled for 3 or 4 hours, making use of a quantity of soap proportioned to the fineness of the colour, or rather the white ground which it requires; 25 or 30 pounds are sufficient for common colours, and as much as 50 for those with saffranum, and poppy red, cherry colour, &c.

But when it is intended that the silk should be white, and, consequently, to bleach it, the
bags

bags are carried to the river, when they are taken out of the boiler, and the filk being taken out, is extended upon cords floating on the water and well washed.

A new bath, containing a pound and a half of soap to 30 pails of water (of about three English gallons each), in which a small quantity of litmus, with a portion of powder-blue or indigo, is diffused, according to the nature of the shade intended to be given. The boiler is filled, the bath heated, but never to boiling, and the filk is passed through it over the rods, until it has uniformly acquired the requisite shade. It is then wrung dry, and hung out, or else carried to the sulphuring room.

All the filks made use of in the white, in any manufacture whatever, require to be sulphured in order to bleach them more perfectly. One pound and a half or two pounds of sulphur are sufficient for one hundred pounds of filk. At the expiration of 24 hours, the room is ventilated, and must not be entered until the vapour of the sulphur is dissipated. The air which enters in summer is sufficient to complete the drying of the filk, but in winter this is performed by a chafing-dish or stove put into the room.

If the white or sulphured filk should not prove blue enough, a new shade is given with clear

water; the hardest water is best, after which it is sulphured a second time.

With regard to filks intended for gauzes and blonds (one of the principal qualities of which is derived from the natural rigidity of the filk), they ought not to be either ungummed or boiled. The whitest natural filks are chosen in preference, which are steeped and opened in a bath of clear hot water, or soap and water. In the first case, they are wrung, and afterwards sulphured. The fine filks of Nankin, which are of a beautiful white, have no need of this operation.

The following is the method published by Rigaud in 1778, for bleaching filks without ungumming them*.

The filk, intended to be bleached, is put into a glass vessel containing a mixture of spirit of wine and muriatic acid, in the proportion of a pound of the former to half an ounce of the

* This method differs a little from that published in 1793, by Baumé. See this last, *Journal de Physique* of the same year may be consulted, and for that of Rigaud, the *Gazette du Commerce* of the 7 Novembre, 1778. *Note of the Author.*

This method requires many precautions, and would be much too expensive if the materials were not afterwards recovered. An abridgement of Baumé's paper, which contains a detail of these objects, may be seen in Nicholson's *Philosophical Journal*, I. 11. 32.—N.

latter,

latter, and, in quantity, sufficient to float the silk. The vessel is then closed with wet parchment, and exposed for 12 hours to the sun, or otherwise it may be left 24 hours in the shade, at a temperature between 15 and 20 degrees of Reaumur. The silk is then taken out and pressed, and again macerated for the same time, and under the same circumstances, in fresh acidulated spirit of wine, in another similar vessel closed as before. The silk is then taken out, pressed, and washed for four or five minutes in pure spirit of wine. In the next place, it is kept for 24 hours in the sun, or 36 in the shade, in a third vessel, containing pure spirit of wine, which is to be renewed at intervals, after which the silk is to be taken out, pressed, and washed two or three times in clear water, which is to be changed at each washing. Lastly, the silk is exposed to dry upon a frame so contrived as to stretch it with considerable force, and prevent its curling up as it dries,

EXPLANATION OF THE PLATES.

The same Letters denote the same Things in the correspondent Figures of Plans, Elevations, Sections, and Profiles.

PLATE THE FIRST.

FIGURES 1, 2. 10, 11. The plan, section, profile, and detail of a distilling apparatus, entirely mounted and ready for service. It may be formed either with a single or double apparatus, as is shewn in the figures. Each apparatus is composed of two separate furnaces, which are, nevertheless, supported on the same structure, with two distilling-vessels, one pneumatic vessel, and a vessel for immersing the goods.

A. A structure of light wood-work, which supports the furnaces or their masonry in brick or plaster.

B. Platform of brick or tile, serves as a hearth to the ash-holes, C, of the furnaces.

D. A bed of clay, on which the brick platform is supported.

E. The wood-work, or planks of the vessels in which the bed of clay is placed.

F. A vacant space, in which the mixtures of muriate of soda and manganese in the proper doses or changing each distilling vessel, are kept

kept dry, for the purpose of procuring the oxygenated muriatic acid by the muriate of soda, instead of directly using the common muriatic acid at 25 degrees of concentration of the areometer of Mossy.

G. The door of each of these receptacles.

H. The drying pans. These are a kind of troughs or capsules of plate-iron of a square form, in which the muriate of soda is put to dry, either before or after pounding and sifting.

I. The vents or chimnies through which the smoke or fumes of the coal escapes, which is used in heating the distilling vessels.

J. The chimney of the furnace, leading under the drying place.

K. A capsule or vessel of plate-iron, either square or cylindrical, for the purpose of supporting the distilling vessels and the sand-bath in which they are placed. It is most adviseable to form this vessel cylindrical, because the flame, in that case, applies better to its external surface, and a less quantity of sand would be required to be heated.

L. The door of the furnace.

M. A ledge or step, fixed to the frame of the furnace, in order that the operator may raise himself upon it sufficiently high to pour the mixtures into the distilling vessels, or for any other operation relative to the furnaces.

N. The

N. The distilling vessel, or retort, having its neck O, and its adopter P, which last may be of glass, separate from the retort, or else a part or prolongation of the same, supposing the glass-men to be sufficiently skilful to give it this figure. In order to obviate the accidents of fractures, it may be made of stone-ware, porcelain, or, which is still better, of lead, as is shewn in the figure,

Q. A welt or projection of lute which fixes the adopter to the retort. Instead of the retort, the operator may use, with still greater advantage, balloons, or tubulated vessels, such as are described in plate 9, fig. 1 and 2. I prefer these last vessels because less expensive, more common, more generally useful, and, in particular, more convenient. Q. 1, a pipe of glass, stone-ware porcelain, or lead, the latter of which is preferable; its extremity, Q 2, is fitted to the adopter; and its other extremity, Q 3, suffers the oxygenated muriatic acid to escape in the form of bubbles into the pneumatic vessel.

R. The pneumatic vessel, placed on its three-legged support S.

T. The arbour of the agitator. U its fans, or arms. V. Handle for turning it. X. Diaphragms or false bottoms, beneath which the oxygenated muriatic acid gas is concentrated and absorbed; they are supported on one side by the regular inclination

clination of the staves of the vessel, and on the other by the pegs of wood Y : these false bottoms divide the pneumatic vessel into a number of separate receptacles.

Z. The pipe through which the gas passes from one cavity to the other ; its prolongation prevents the gas from immediately escaping into the upper-chamber ; the gas being by this means forced to remain for a time in the inferior chamber, where it is frequently agitated by the arms of the apparatus, becomes absorbed in the water to a certain degree. &c, a funnel of wood to facilitate the pouring of water into the pneumatic vessel, when its cover is fixed on, pinned fast, and the places secured by paper pasted on.

a. Spigot, or cock, to draw off the acidulated water for trial of its strength, by the known re-agents, indigo or cochineal, as mentioned in chap. 14. This cock may be formed of glass, or lead, or even copper ; but this last metal must be covered with a coating or two of white lead paint, to prevent its being rusted, or oxyded by the vapour of the gas, and its consequent spotting the various goods which may come into contact with it, or may be foiled by the falling of particles of verdigrease with which it would become covered.

b. The cocks, for emptying the bleaching liquor

quor into the vessels of immersion: they ought to be of wood, closed either with a cork, or with a turned pin, secured with flax; they must likewise be firmly fixed in the pneumatic vessel, and well defended with fat lute, within and without.

c. A tube of glass, of the size of barometer tubes; that is to say, 2 or 3 lines in diameter: it serves to shew the height of the liquor which remains in the vessel, when a portion has been drawn off for particular immersions; and it likewise indicates the greater or less action of the distillation, by the frequency with which the liquor oscillates up and down without. This last indication is particularly useful toward the end of the operation, when the slowness and weakness with which the bubbles escape, produce scarcely the least sound in the vessel, even though the ear be applied to its sides.

This tube is fixed at the distance of about an inch from the bottom of the pneumatic vessel; its place of junction is well secured with fat lute, within and without; its upper extremity is secured in its place, by a small piece of wood, *d*, pinned to the pneumatic vessel.

e. A short tube, of about the length of two inches, below each inferior false bottom; it does not suffer any gas to escape from one cavity to the other, excepting that portion which cannot incorporate

corporate with the water, either because it may already be nearly saturated, or because too large a quantity may be collected in the upper part of each cavity, respectively, for want of the agitator being worked with sufficient frequency.

f. Pipes of lead, or stone-ware; they may likewise be made of wood; one of them passes through all the false bottoms, the other passes only through the uppermost; they serve to introduce, upon the bottom of each cavity, either the quantity of potash necessary to fix the odour of the muriatic acid, or that which may be necessary to form the liquor, known under the denomination of the oxygenated muriate of potash.

These two pipes are closed during the distillation, with a stopper of cork; their upper extremity, being formed somewhat in the shape of a funnel, facilitates their suspension and support; they must be well secured with fat lute, at the place of contact, with the partition through which they pass.

g. The cover of the pneumatic vessel. It must be kept in its place by good pins of oak formed with heads, and its joints all round must be closed with strips of paper pasted on. The joints of the several pieces or planks which compose it, though tongued together, are likewise covered with paper: by means of these precautions, no smell of

the oxygenated acid exhales. In order likewise that this vapour should not escape through the small space between the cover and the arbour of the agitator, this last is surrounded with a small quantity of flax, or piece of rag, wetted, either with common water, or a solution of pot-ash. When the distillation is begun, the opening of the aperture of the funnel *t* must be closed with a cork.

b. Supports of the adopter of the retort: they rest on the cover of the pneumatic vessel, and receive the upper extremity of the tube, communicating with the internal part near the bottom of the vessel; this extremity is disposed in the form of a funnel; 1. To receive the beak of the adopter; 2. To facilitate the application of the lute. The two parts which compose the support are connected together, either with Iron-wires, or pack-thread, or else by means of hooks. *i* a hole to suffer the air to escape out of the pneumatic vessel when the water is poured in.

l. The vessel for immersions, mounted on its rollers *J.* *m* the reel to move the piece-goods in the liquor. *n* its handle. *o* the piece, or good, passing over the reel. *p* the dotted lines, representing the cover. It may consist either of a cloth, thrown over the vessel after the liquor has been poured in, or it may be much more

more suitably and conveniently formed, by means of two frames of light wood, with panes of glass, which open on the opposite faces, and close towards the upper part of the triangle, which they form by their junction. In order that the odour of the liquor may not be inconvenient to the workman, at the time it is poured into the vessels, in those cases, where it is not thought proper to extinguish it; either by a certain dose of sifted chalk, or a proper addition of solution of pot-ash in water, one of these frames has a proper opening to suffer the discharging cocks to pass through; and those parts of this opening, which are not accurately closed, are afterwards secured by means of cloths tied round the cock itself. In order, moreover, to avoid all smell from the pipes, communicating from the bottom of the pneumatic vessels to the vessels of immersion, these may be so disposed, as to convey the bleaching liquor to the bottom of this last, and cause it to rise gradually, instead of pouring it in with agitation.

Fig. 3.—Perpendicular view of the grate, or chafing-dish, upon which the coal and charcoal *a*, which heats the capsules and retorts, is placed. They may be raised higher or lower by placing them on one or more bricks. It is likewise very easy to take them out of the furnace by means of the handle *B*, when it is required, from any cause whatever,

whatever, that the distillation should speedily be checked.

Fig. 4.—The elevation in perspective of this grate.

Fig. 5.—Plate of iron, which serves as a door to the furnaces.

Fig. 6.—The same plate, or door, seen in profile; *a*, a projection which serves to raise it, or place it; *b*, borders, by means of which it rests on the joints, formed by the upper bricks of the furnace, which, at the time of its construction, are left open for this purpose.

Fig. 7.—Supports which surround the upper extremity of the tube of lead, which receives the beak of the adapter of the retort, or the retort only, if the glassman have made it all of one piece.

Fig. 8.—Elevation, in perspective, of the iron-trough, which contains the mixture of muriate of soda and manganese, which is set to dry, as before described, between the furnaces, under the drying place, during the time of distillation, in order that it may be ready for the subsequent process.

Fig. 9.—Plan of the same trough.

PLATE THE SECOND.

Fig. 1.—A machine for grinding the glass stoppers of vessels and bottles, which are required to be closed, as it were, hermetically.

A. A bottle with three necks.

B. The stopper fitted to close the middle neck.

C. A kind of brace, one extremity of which has its centre of motion in the wooden slider E, and the other extremity F receives in its socket G, the stem H, of the press I, the two jaws of which, I, K, hold fast the knob of the stopper, required to be ground in. The slider of wood E is not fixed, but must rise or fall according to the wear of the stopper in the neck of the bottle, in which it is intended to be fitted.

Fig. 2 and 3.—Plan and profile of a vessel, for immersing thread stockings, or other pieces of frame-work knitting; if, instead of the round figure, this vessel had been made square, the goods might have been stowed in a more advantageous manner. Three baskets of white wicker-work may be placed one upon the other, as is shewn in figure 2, each upper basket resting on the handles of that beneath. B, a bundle, or hank, of skains of thread spread out in the bath: there must not be more than three or four of these connected together in the same bundle, as, otherwise, they would be less conveniently exposed to the action of the bleaching liquor, and less easily wrung or cleared out. In order that no dirt may fall into the vessel, and to prevent any oppressive

vapour from incommoding the workmen, the whole is covered with a piece of cloth, designed for this purpose; or, rather, with a light covering of wood, cut into two pieces, to facilitate the management.

Fig. 4 and 5.—Plan and elevation of a small portable boiler for the purpose of immediately boiling the thread in alkaline lees, or any other small articles, which either cannot with convenience, in point of time, or otherwise, be put into the large boiler with piece-goods, or other articles, whether on account of their fineness, their small quantity, the speed required, or their being the object of some particular experiments.

a. The boiler, placed on its tripod, *b*, under the mantle of the chimney; *c* its cover, which must never be neglected to be put on, not only because the heat is more speedily produced, but likewise for the purpose of defending goods from soot, which may fall down the chimney, and would produce spots not easily discharged, as has been mentioned in chap. 15. This boiler may be heated by means of wood, or turf, or pit-coal, if a proper grate may be made use of.

Fig. 6.—The method of suspending, by means of an arbor *D*, the basket, containing the articles taken out of the boiler, and draining over it. In order that no impurities may fall either into the
lees.

lees, or upon the goods, during this operation, it will be proper that a close cloth, or frame of light wood, should be supported in that part of the pipe of the chimney which is immediately over them.

e. The basket, or plat form, of osier, supporting the goods; this plat-form may likewise be made of iron, covered with linen rags: if a basket be used, it must be perfectly cleared of its bark, for fear of spotting the goods.

The four cords *f*, which support the basket, are united in pairs, on each side, at the knot *g*, to the cord *h*, which winds on the arbor.

j. Supports, between which the arbor turns. *k*, a clump fastened on the arbor, to prevent its recoiling from the support *i*, in consequence of the friction upon *m*. *n*, the handle of the arbor.

Fig. 7.—Rollers, for the purpose of folding piece-goods into lengths, after they have received the dressings.

a. Cords, one extremity of which is attached to the ring *b*, fixed to the cieling, and the other extremity bears the two gudgeons of the wooden roller *d*.

e. Part of the piece of cloth, to be folded in two.

f. Part of the cloth already folded. In this operation,

operation, which is very speedy, the cloth is supported by holding one part, *f*, in one hand, and the other part, *e*, in the other, taking care to bring the edges together by raising this part of the cloth thus joined a little, the weight of the folded part, soon draws over that part to the other side of the roller, a new portion is successively folded, and is thus subjected to the same manipulation.

Fig. 8, 9. — Plan and profile of a machine for folding cloths in equal folds, whether it be required that the folds should be in the whole length, or that they should be folded in two, as has already been observed.

a. Uprights of iron, placed opposite each other, in the holes *b*, in the brads *c*, fixed on each side of the table *d*.

e. Rods of iron, or wood, placed in each fold of the cloth behind the two uprights.

f. Another rod, which raises from the heap of cloth, *g*, that part which is to be carried behind the upright, over the rods. In proportion as the folding advances, the lower rods are drawn out to be used in the progress of the work. By this means the operation may be performed with a dozen rods. The use of these rods, and the regularity which they afford in this method of folding, which is very expeditious, has caused it
to

to be named folding by the rod, in the same manner as that described in figure 7 is named folding by the roller.

Fig. 10.—End view of the manner in which the pieces are folded together after they are taken from the machine, fig. 9: the round fold, which is given to the piece, is secured by means of strings, more or less fine, *a a*, according to the quality of the merchandize. These cords, strings, or twist of silk, or flax, pass from the upper selvedge to the lower; they are fastened together with a knot, which is, last of all, covered with a tassel, *b*, of coloured thread, of silk, or linen, or thread, according to the beauty and fineness of the piece. Coarse goods are likewise fastened in front, as is shewn by the letter C.

Fig. 11.—Hanks of linen or cotton thread; the union of several skains, that is to say, five or six by a single string, *a*, forms what is called a hank: by the number of knots, *b*, made in one or other of the two ends of the string, the bleacher distinguishes the merchant to whom the article belongs. For this purpose the distinctive signs are entered in a book, opposite the name of the proprietor. With regard to other articles, such as piece-goods, stockings, &c. they may be distinguished by one or more coarse threads sewed to them, upon which any

number of knots at pleasure may be made. This method of marking goods appears to be much preferable to the different marks with crayons, red oaker, &c. which always, more or less, spot and soil the goods.

Fig. 12.---Shews the method of rinsing the skain on the pin to clear it of water, lees, or any other fluid it may contain. As the part which is nearest the pin is not so effectually wrung as that which lies near the middle, care must be taken in opening the skain, *c*, to replace it in such a manner that the part which was upon the pin, *a*, shall be near the middle at the time of the second wringing. After this second wringing, the thread is, for the most part, dry enough, and may be straitened out; which is done by passing it over the hand, and strongly jirking or shaking it by drawing out; or the operation may be performed with the wringing-pin instead of the hand.

Fig. 13.—The method of disposing the skains, so that they may not intermingle too much with each other, particularly those of sewing thread, which, instead of being wrung on the pin, are worked under the lower part of a kind of rammer or stirrer. The four fastenings, *a*, prevent the skains from becoming intermingled during this kind of fulling process. A tub or pail may
be

be used for this operation, according to the quantity of the article, intended to be cleared in this manner. A man or woman may work them with the instrument, fig. 14, without much difficulty: a certain degree of skill and intelligence is required to do the business in the most effectual manner.

a. Represents the handle of this instrument, and *b*, the lower part, which is made of beech cut into steps or notches, *c*, on each side, in order that it may take a slight hold of the goods, and afford a facility in turning them. These indentations must be rounded at the edges and corners.

Fig. 15, 16.—Plan and elevation of a washing implement, with which stockings, thread, and other small and fine articles, may be cleaned or rinsed in a tub or pail. *a*, exhibit the teeth or feet, between which the different goods dispose themselves, and are agitated against each other, for the purpose of clearing them of the different liquids, with which they are successively penetrated during the course of the bleaching. *b*, is a double handle, by the assistance of which this small instrument is moved.

Plate 3. Fig. 1.—*a*. Birds-eye view of the great boiler, in which piece-goods are heated in the alkaline solution or lees.

Fig. 2.—Section of the same boiler through the line A, B.

- a.* Floor of the shop.
- b.* The masonry, in which, the copper C is set.
- d,* the wooden cover, formed of two or more parts.
- e,* cross pieces which pass under the cramps *f*, fixed to the boiler itself, which keep down the covering and prevent it from rising by the force of the stream, which last is, by these means, compelled to re-act on the pieces of cloth, or other articles placed in the boiler.
- g.* A cavity or gutter surrounding the copper, and used for evaporating without any other heat than that which it receives from the boiler itself, the old lees, which are reserved after they have been applied to every use, which can be made of them, in order to recover the alkali.
- h.* A small boiler, heated by the heat which escapes from the great boiler, before it passes into the chimney. In this small boiler is kept a quantity of lees, ready prepared, of the proper strength. It here receives an increase of temperature, which prevents its sensibly retarding the boiling of the great boiler, when it is necessary to convey a certain quantity into this last vessel.
- i.* A cock, by which the pure solution of alkali is drawn off, and may be conducted to the

the great boiler, by a channel of tin or wood, &c. &c.

j. The fire-place under the boiler. Instead of the iron-bars, or a grate, which, on account of this distance between them, suffer too much air to pass, for the consumption of wood, and by these means waste much of that fuel, I have preferred an arch of brick-work, with openings of a sufficient size. This arch, while it saves the wood, likewise preserves the heat, on account of the space between the vents, upon which the burning fuel remains for a longer time. It might perhaps be possible to diminish the expence still further, by having no apertures at all through the arch. These apertures are also liable to be worn or broken, and require to be defended at their edges with iron.

k. The ash-hole.

l. The chimney, proceeding from the fire-place, immediately beneath the small boiler.

n. Stairs ascending from the floor, to the brick-work of the floor.

o. Another set of stairs, leading to the platform *p.*

q. A register for regulating the heat of both boilers.

r. Flue of the chimney.

Fig.

Fig. 3.—Section of figure 1, along the line *c d*. *a*, the floor. *b*, the masonry in which the copper is set. *c*, mouth of the fire-place of the great boiler. *d*, lower part of the chimney. *e*, ash-hole. *f*, register, to regulate the heat of the small boiler. *g*, the stairs from the platform of the masonry to the floor of the work-shop. *h*, stairs leading to the upper part of the masonry.

Fig. 4.—A crane, moveable on its axis, provided with tooth and pinion-work, by means of which the charge of the boiler, consisting of piece-goods, or other articles, may be raised. *a*, the shaft. *b*, the pivot. *c*, the arm. *d*, bracket, or support. *e*, a ratchet wheel, worked by a pinion with a double lever: round the barrel of this wheel is wound the chain, at the other end of which are three or four hooks, in which the chains *b* are held. These last are covered with cloth or cord, to prevent the effect of rust. The intermediate part between the two concentric circles, which form the vessel, or suspended apparatus, is likewise defended by small cords, in order that the various articles disposed therein may not escape; this stage, charged with the different articles which have undergone lixiviation, is, by means of the crane,

crane, conveyed over other vessels, where it is lowered down upon cross pieces, in order that the drainage may be completed.

Fig. 5, 6, 7.—Plan, section, and elevation, of an oven for calcining crude alkali, in order to convert it into potash. *a*, stairs, which lead to the back part of the oven, where there are placed two boilers of cast-iron, *b b*, in which the alkali is dried, after having been concentrated to a certain degree in the cavity surrounding the great boiler. See Fig. 1, 2. These two boilers may be appropriated alternately to dry the alkali entirely, whence it is to be conveyed into the calcining oven; and afterwards to complete the reduction of the concentrated alkalies to the consistence of extract; and may likewise be disposed in such a manner that the flame which they receive from the fireplace of the oven, before it passes into the lower part of the chimney, may heat a third boiler of cast-iron, of copper, or even of lead, which may be used to evaporate the old lees, or solutions of soap: for these last require the same management in order to obtain their alkali.

This concentrated alkaline solution from the upper boiler, may be suffered to fall, drop by drop, into the lower, in order that the evaporation,

tion, or complete drying, may not be impeded by too much water being suddenly poured in.

c. Passage from the fire-place to the space beneath the cast-iron boilers. It conveys a stream of flame, which is more than sufficient, and may be governed by means of registers. As this passage is constructed on a slope, which, for that reason, is not easy to be made in the masonry, a contrivance was used during the building of the roof of the fire-place, to fix in the proper place a roller of wood, upon which the bricks in part rested which were intended to form this passage; it may easily be imagined that this wooden roller could not be taken out after the construction was finished; it was, therefore, intended that it should be burnt out. To accelerate the combustion at that time, and during the heating of the oven, a hole of two or three inches in diameter was bored through it. This piece of wood may be of white deal, or any other material which is most readily consumed. The heat conveyed by this passage, of which I have ascertained the good effect by experiment, is very well regulated by means of a register made at the bottom of the space immediately beneath the boiler. This register is entirely shut when the boilers are not intended to be used.

When

When the calcining oven is not used, but the boilers are wanted to dry alkaline solutions, these last may be separately heated by a fire between both.

d. An aperture in the roof of the oven, through which the dried alkali is conveyed into the oven.

e. The calcining oven. In order that the alkali may be easily disengaged from the edges or angles of the floor where the walls take their rise, at which place it readily fixes itself by the aqueous fusion, it is adviseable that this part should be defended by a plate of iron, four or five inches high, and about half an inch thick. By this means the salt is more easily separated by the rake.

f. The stoke-hole for supplying the fuel. It is constructed in the same manner, and for the same uses, as that of the boiler for lixiviation.

g. A flight piece of brick-work, between the fire-place and the hearth of the oven, which prevents the fuel and the saline matter from communicating or mixing with each other.

h. A stone or cast-iron trough, into which the red hot calcined alkali is thrown when taken out of the oven. In this vessel it is left to cool before it is packed up in casks, in which last vessels it must be pressed as closely as possible, in order

order that it may be less liable to attract moisture from the air.

i. The mouth of the oven. It has two iron uprights, *j j*, forked at top, in which the ends of a raked bar *k* are placed. The handle of the rake, with which the alkali is stirred, is rested between the notches of this bar. The mouth of the oven is also provided with an iron plate, to be used either for closing it entirely, or more or less, as occasion may demand.

Instead of suffering the heat, which issues from the mouth of the furnace, to be lost, it may be very advantageously directed by a pipe rising under the boilers of cast-iron, or those which are placed above, for preparatory evaporation. None of these means ought to be neglected of employing the heat, which in almost every construction of this kind has been hitherto lost, for want of a proper degree of skill in the proprietors, or those who undertake to erect them.

Fig. 8.—Represents part of the chain, which is wound upon the drum of the ratchet-wheel of Fig. 4. It may be observed, that it is constructed on the same principles as the chains of pocket watches.

Fig. 9, 10, and 11.—Details relative to the raked

racked bar placed across the mouth of the calcining oven.

a. The teeth, between which the handle of the rake is moved. *b*, an elbow, which prevents the rake from moving the bar side-ways when once duly placed. *c*, crampons, or iron fixed pieces, which receive and steady the uprights. *d*, the masonry of the oven in which they are placed. *e*, the rake seen side-ways. *f*, its claw placed on the floor of the oven. *g*, its iron handle. *h*, the external part of its handle, which is made of wood, because the iron would communicate the heat too readily to the hand of the workman. Fig. 11. the claw of the rake seen in face. Fig. 12. an hook, by means of which the rake is lifted up or changed for another, either on account of its being too hot to be touched, or in danger of bending. *a*, the hook. *b*, its handle. In order that the iron handle of the rake may slide more readily between the teeth of the cross-bar, it is occasionally rubbed with a piece of bacon nailed to a small piece of wood.

PLATE THE FOURTH.

Fig. 1.—Elevation of a mill proper to cleanse piece-goods and other articles, which are more
or

or less bulky. It is moved by a horse; or its mechanism may be set in motion by wind, water, or other powers, by making suitable arrangements for that purpose.

A, the principal shaft. B, the bar, to which the horse is attached. C, the wheel. D, lantern. E, the arbor, which gives motion to the stocks or pestles E, by means of certain tripping pieces. See Fig. 1. and 2, Plate V. F, mortices, in which the tripping pieces move to raise the pestles. It is adviseable that the part which is acted upon by the tripping piece should be defended, either by a plate or roller of copper. G, cross-pieces, between which the pestles rise and fall. H, the box or receptacle, in which the goods are placed. The figure represents the internal part, in consequence of a portion of the wood-work in front being removed. One of the spaces is larger than the other, for the purpose of subdividing the different kinds of work. The receptacle is commonly made of elm, and the rammers of beech. I, holes made at different heights, to draw off the water. J, a door, which may be taken down or put up at pleasure by means of buttons. It must always be up during the time of work. K, a pipe, which supplies the work with water. Out of this proceed a number of
short

short pipes answerable to the respective chambers. L, a stop, to prevent the pestle from descending too low, and injuring itself. M, a lever fixed to a cross-piece, N, behind the four uprights, O. By means of the pin P, and the string Q, the fulling rammer may be raised so high, that the tripping pieces cannot reach it. While it remains thus fixed, the goods may be examined or taken out, as occasion may require.

Fig. 2 and 3.—A sucking-pump, which furnishes the water to the work. Fig. 2, shews the same in profile, and Fig. 3, the front view.

A is the extremity of the arbor which works the fulling apparatus. B, prolongation of the axis or pivot of this arbor. It turns on the brass bed C; and its extreme part D is bended into a handle, which gives motion to the pump, rods E F. The latter is attached to the stem of the piston which moves in the body of the pump. H. I, the pipe, which supplies the reservoir J with water. K, the pipe which conveys the water to the fulling works.

PLATE THE FIFTH.

Plan and elevation of the same machine for washing and cleansing piece-goods. A, the turning

turning arbor, with its tripping pieces B. C, the mortices, in which the tripping pieces enter to raise the hammers. D, holes, through which the rammers traverse. E, bolts, which hold together the lateral partitions, and connect them with the uprights F. G, the fulling rammer, resting on its stop H. I, the lever, to throw the fulling rammers in or out of work. The dotted lines J denote the position of the levers when the work is stopped. The cord K being fastened to the hook L, keeps the lever in this position; but when M is fixed to the same hook, it keeps the lever clear of the working bar. N, the inside of the receptacle for the goods. O, holes for drawing off the water. P, the door. Q, the pipe which brings water to the work. R, a table, on which the goods are laid before or after they have been put into the engine. T, a board to defend the workman from being wetted.

Fig. 2.—A, the principal arbor, with its tripping pieces B. This figure shews in what manner they are disposed in order to produce their alternate effects on the rammers.

Fig. 3.—Plan of the wheel fixed on the upright shaft, which serves to shew the manner of its construction.

Fig. 4.—The lantern which moves the arbor.

A, repre-

A, represents the arbor itself, upon which the lantern is solidly fixed. The bolts B connect the two drum-heads.

Fig. 5, shews the method of disposing the goods in the trough of Fig. 1, when it is more particularly intended to work them across their length. Fig. 6. The method of disposing them when, on the contrary, it is intended to work them in the direction of their length.

PLATE THE SIXTH.

Fig. 1, 2.—Plan and profile of the machine for squaring and rolling out the pieces after they have received the dressings. *a*, the stage on which the goods are placed. *b*, the piece folded back and forwards. *c*, the stretcher, through the mortice of which the cloth passes. At one of its extremities there is a ratchet-wheel, *d*, by means of which the necessary tension is given, that the cloth may undergo a slight degree of friction against its rounded edges during its course. *e*, cross-pieces, at such a distance from each other, that the cloth, by passing alternately over one and under the other, may be gently rubbed against their blunted edges. *f*, another stretcher, through the mortice of which the piece likewise passes before it arrives at the wooden cylinder.

cylinder. This is likewise provided with a ratchet-wheel, *g*, for the purpose of stretching the cloth more or less. As the tension is considerable in this part, there is a lever, *h*, fixed on for the purpose of facilitating the turning. *i*, a cylinder or roller of wood, upon which the cloth is rolled, and left for a longer or shorter time, as may be necessary for it to keep the figure and dimensions which it has received. The workman, who stands before this roller, takes care for this purpose to arrange and draw out the selvages in such a manner that they may apply at every turn upon the same parts of the cloth which are already rolled, and preserve the same width throughout. *j*, a moveable piece, which may be thrown forward, and serves to keep the roller in its place endways, and when drawn back, leaves it at liberty to be taken out for the purpose of unrolling the cloth. A groove is made lengthways in the roller, for the purpose of fixing the end of the cloth therein, which is first wrapped round a wooden rod, and then lodged in the groove. *l*, brass rollers, upon which the wooden cylinder turns. *m*, the square, into which the square end of the cylinder is lodged. *n*, wheel of the arbor, which carries the square. *o*, the lantern or pinion, which gives motion to the wheel, and is itself carried

carried round by the handle *p*, worked by one or two men, according to the force or velocity required to be exerted. *q*, a fly, armed with balls or plates of lead, which serves as a reservoir of force, and greatly assists the workman. *s*, a trough of plate-iron, in which hot embers are put for the purpose of drying, or giving a proper degree of firmness to certain goods before they are rolled on the cylinder, upon which they preserve the state and appearance it is intended they should receive.

Fig. 3 and 4.—Plan, section, and profile, of the earthen furnace, made *au rue Mazarin*, of which mention is made in Chapter II. *a*, the furnace. *b*, the ash-hole. *c*, the door of the ash-hole. *d*, the fire-place. *e*, door of the fire-place. *f*, grate of earthen-ware; instead of which, if preferred, a grate of iron may be substituted. *g*, the chimney. *h*, a protuberance for more easily removing the furnace. *i*, the pot. *l*, sand-bath. *m*, tubulated bottle, containing the mixture for distillation. Instead of the bottle, a tubulated retort may be used, which, in that case, may be placed in a bath suited to its figure. *n*, the neck, to which the tube of lead is to be adapted, for the purpose of conveying the gas into the pneumatic vessels. *o*, the aperture, into which the sulphuric or muriatic acid is to be

poured, accordingly as the distillation is performed with or without the muriate of soda. *p*, a stand or base of stone, upon which the furnace may be raised, either for the purpose of giving it a proper elevation, or to preserve the floor from the danger of fire.

This kind of furnace is usually composed of one single piece ; but for the facility of removing and fixing them, when constructed of a certain size, they ought to be formed of several pieces which may be easily fixed together by means of indentations made in them before they are baked.

PLATE THE SEVENTH.

Fig. 1, 2, and 3.—Bird's-eye view, elevation, and profile, of the machine for calendering piece-goods with or without heat. *A*, a double handle which gives motion to the pinion *B*. This machine, as well as the one just described, may easily be moved by connecting it with the fulling mill, in the same manner as the pump receives its motion, namely, by a branch or tumbler, which on the one hand is applied to the arbor of the mill, and on the other to the leading axis of the machine. It is necessary of course to arrange the workshops accordingly. The
pinion

pinion drives the toothed wheel C; on the axis of which is fixed the lantern or pinion P, which moves the great wheel E, to which is adapted the brass cylinder F, and this in its turn communicates its motion to two cylinders of walnut-tree G.

H, the stage upon which the piece I is placed ready for calendering, having previously received all the other dressings; it is folded, as the figure shews, in alternate folds, in order that it may be more easily delivered. It first passes between the cross-pieces J, thence through the mortice K, of the stretcher L, which is provided with a wheel and click, M, to stretch the piece more or less and regulate its course. It afterwards passes back under the brass cylinder N, over that of walnut-tree, and returns in front under the upper wooden cylinder, which it envelopes as it passes over and falls behind O of the machine on the roller P, and against Q, where it is ranged in alternate folds on the stage R, whence it is taken to be regularly made up for sale.

S. The pressing screw, by means of which the upper wooden cylinder may be urged more strongly against that of brass, accordingly as it is required that the face of the cloth should be more or less acted upon.

T. Piece of cast-iron, which slides in grooves made in the uprights U, and bears upon the pivot V of the upper cylinder, accordingly as the screws press upon the cross-piece X, to which this piece of cast-iron is fixed.

Fig. 4.—The brass cylinder seen at one end, where it is open to receive the bars of red-hot iron which heat it.

A. The cylinders of wood to which the brass cylinder communicates its motion. Instead of wooden cylinders, others may be substituted of card-paper, composed of the quantity of leaves necessary to fill the space which is determined between the plates of brass adjusted at the extremity of their axis. They are strongly pressed by these plates, which are retained in their position by powerful screws. Cylinders of paper, properly turned, give to fine goods a glaze which they cannot acquire by the wooden cylinders. They have likewise the advantage of retaining their figure, which is not the case with wooden cylinders. These last require to be occasionally rectified in the lathe, and at last become too small for use.

The lathe used for turning any of these cylinders ought to be constructed in such a manner, as to render it a matter of certainty that the diameter

diameter should continue equal from one end to the other.

B. The cylinder of brass.

C. The neck on which it turns in the manner of a pivot.

D. The aperture through which the bars of red-hot iron are introduced with tongs. The aperture is then closed with a cover to keep in the heat.

U. The uprights between which the brass cylinder moves against the plates V.

Fig. 5.—The form of the pieces of cast-iron with which the cylinder is heated. Two are commonly put in, and they are usually changed every hour, or oftener, according to the nature of the work.

PLATE THE EIGHTH.

Fig. 1 and 2.—Plan and section of a vessel particularly designed for submitting fine piece-goods, such as muslins, linens, &c. to the action of the oxygenated muriatic acid.

a. A frame armed on each side with small leaden points or pins, *b*, the central parts of which are iron; they may be altogether of iron, painted with white lead, and well wrapped with strips of linen or string. These points are of
use

use to suspend the piece-goods in a zigzag form, as is shewn by these figures, either immediately by the selvedge of the piece, or by loops of tape sewed to the pieces themselves.

c. Rings of lead cast upon rings of iron, which they cover; otherwise rings of iron alone, painted with white lead, and wrapped with cloth or twine to defend them from the rust. The cords *e*, which are fastened to these rings, pass over hooks at *d*, fixed to the cord *f*, which, by means of the pulley *g*, is used to raise or lower the frame. When the latter is entirely plunged in the bleaching liquor, the cords are detached from the hook *g*, and the vessel is covered to prevent the introduction of any impurities, as well as to defend the workmen from any disagreeable odour.

An apparatus of this kind may be used, not only for immersing of the goods in the oxygenated muriatic acid, but likewise for the lees, as well as the bath of sulphuric acid, &c.

Fig. 3 and 4.—Elevation and profile of the frame for stretching the skains of thread when taken out of the bleaching vessels. *A*, upright pieces, in which a number of holes, *B*, are pierced for the purpose of supporting *C*, the cross-pieces, over which the skains of thread, *D*, pass singly. These cross-pieces have their angles

angles well rounded, and are set at a greater or less distance, according to the degree of tension to be produced, by means of the iron pins inserted in the holes of the uprights.

The thread is first well wrung upon the pin, or with the hand, after which it is stretched upon the pannel, and left to dry. Care must be taken that those skains which are put on at any one time shall all be of the same length, in order that the tension may be equal throughout.

If these threads, when taken out of the bleaching vessels, should be so entangled or mixed as to seem incapable of being cleared without breaking, they may easily be brought to their original state by plunging them in water, and gently striking them with the edge of the hand. This operation may, if thought fit, be repeated at each immersion, in case it should be supposed that the thread would be too difficult to clear after the entire bleaching.

The skains of thread, thus adjusted and dried, are afterwards twisted together in dozens or scores, or any other count, according to the custom of the market; or they may be packed in small parcels in coloured paper, according to their quality, and the orders of the vender.

Fig. 5, 6, 9, 10.—Plan, profile, and parts of the machine for scorching or singeing muslins,
and

and other piece-goods, which are particularly required to have an even face similar to goods of the same kind imported from England.

A, posts fixed in a cavity, B, in the pavement or floor of the workshop. They are connected by the cross-pieces, C, fixed at their upper extremities by the bolts or screws D. These posts may be taken up at pleasure, in order to leave more space in the workshop. E, axis of a roller placed between each post, the prolongation of which is bended into a handle, F, for regulating the tension of the piece by the ratchet-wheel G. A short piece of cloth or canvas, H, is nailed to each of these rollers, and to these the extremities or ends of the piece to be singed are fixed with the needle or rod of iron, K. One of these rollers takes up that part of the piece which is singed, while the other gives off or unfolds a new length to be subjected to the same operation.

L, the bended iron, with which the singeing is performed by passing it over the surface, from one edge to the other, in a light, speedy, and dextrous manner. The flat part M being first made very hot, is well wiped on a cloth or pad, in order that it may not soil or grease the piece, which last action would endanger its being burned. This iron is to be passed two or three times

times over the extended part of the cloth, in order that it may produce its effect more uniformly.

If the piece require to be singed on both sides, it must be afterwards turned, by changing the rollers M for N. The brown scorched colour which the piece acquires by this treatment speedily disappears in the bleaching.

Fig. 7 and 8.—A plate of cast-iron, viewed in face and edgewise, which is advantageously used to smooth or lay the nap of certain piece-goods, such as velverets, fustians, coverlets, &c. This plate is heated to the proper degree; and one or two men, according to the weight and dimensions of the plate, and the nature of the stuff, pass it along, more or less speedily, over the piece intended to be thus ironed or smoothed. The same care must be taken to wipe the plate when it comes out of the furnace as was described for the singeing. The handles, B, of the plate, are wrapped round with cloth, in order to defend the hands of the workman.

Fig. 14.—A brush, with short hair, used to raise the fibres or nap of the piece-goods intended to be subjected to either of the operations here described.

Fig. 11, 12 and 13.—Plan, elevation, and section of a press proper for drying or expressing the
water

water from piece-goods, whether in the course of the several operations, or at the end of the bleaching process. This press may likewise be employed to advantage, to give a neat appearance to folding goods, or for the close packing of bales.

A. The platform or table of the press upon which the goods are placed. This table is hollowed out to the depth of one inch, and is inclined towards the gutter or beak, B, in order that the waters which flow from the goods may be received in a pail placed underneath for that purpose.

C. The pressing screws which rise and fall between the uprights, D, in order that the whole surface of the table may be left clear.

PLATE THE NINTH.

Fig. 1 and 2.—Plan and section of the distilling apparatus mentioned at the commencement of this work.

A. The double furnace with its fixed grate. B a cover of plate-iron of a square or round figure with flat edges, which may be raised or placed in contact with the furnace. C the sand bath which surrounds the capsule; it ought to be very dry, fine and uniform. D, the cylindrical bottle

bottle with two necks; one in the middle, E, to receive the stem, F, of the communication of the pneumatic vessel, and the other for pouring in the sulphuric acid, when muriate of soda is used, or the common muriatic acid, if that salt be not applied. Instead of the cylindrical bottle, a balloon, or globular vessel with a neck on one side, may be used, as is shewn in figure 2. The choice of these vessels will, in a great measure, depend on the skill of the workmen, at such glass manufactories as may be in the neighbourhood of the bleaching works. In strictness, the neck or tube on one side may be dispensed with, and it is here mentioned only because it adds a convenience to the operation.

From these observations on balloons, it is easily seen, that those who, in pursuance of the directions in the memoir upon bleaching, in the second volume of the *Annals of Chemistry*, may have used the matras, the neck of which sooner or later must break at the termination of the chimney of the dome of the furnace there recommended, may afterwards use these globular vessels with advantage.

J. The door or opening to the fire-place.

Instead of glass bodies, it might probably be of advantage to use leaden vessels heated by a water-bath, or in any other manner which would

not

not endanger the fusion of those vessels. This danger would be less to be feared when manganese and the muriatic acid were used alone; but vessels of this kind would always have the disadvantage of not allowing the operator to see what passed within them, as he may with glass, nor whether the vessels were well cleaned. These two inconveniences, which can hardly admit of any remedy, unless a glass could be fixed in the upper part, have hitherto prevented me from using them, though they might, probably, be attended with very considerable advantages.

K. The ash-hole; this is closed in the same manner as the aperture of the furnace, by sliding doors; or more simply as has been described in the explanation of the furnace exhibited in plate I.

G. A tube of lead formed all of one piece, without folder, and cast at one single pouring, or several successive pourings like water pipes in copper moulds. It may also be cast very short at one single pouring, provided it be made thick enough to be afterwards drawn out. These successive drawings reduce its thickness to a single line, while its internal diameter is kept at seven or eight lines, which proportions are very convenient. This pipe is fixed in the pneumatic vessel in such a manner that it may be freely raised

raised and lowered in the groove L, made for this purpose in the piece which secures it on each side in its place, by means of the wooden pins M.

N. Another tube for a second distilling apparatus, if it be thought fit to place one beside that already formed, whether for the purpose of obtaining a high degree of concentration in the oxygenated acid, or great speed in the composition of the gas, on account of the haste required in the work.

O. Arms of the agitator, which may be sloped off on both sides. This form agitates the liquor, and facilitates the absorption of the gas more effectually than any other.

P. A socket applied to the arbor Q of the agitator. If the pneumatic vessel be constructed according to the representation in the figure, and the explanation given in the chapter IV. the sockets, R, here expressed become unnecessary, as well as the inverted stages, whether they be made with hoops, as at S, or constructed of thin wood-like sieves, as at T. They are placed in this drawing only to shew the manner of disposing them in case they should be preferred. The cross-pieces, U, of the bottoms of these kind of vessels, placed upon cleats fixed to the staves of the vessel, shew the manner in which they are

to be fixed, with wooden pins, that they may not be subject to rise, nor become loose in any respect.

X. The cover of the pneumatic vessel.

Y. A stool upon which the vessel itself is supported.

Fig. 3.—Exhibits the manner in which the hoops of thin wood are joined for the purpose of forming the inverted vessels, as well at their terminations, where one part overlaps the other, as upon the circumference attached to the bottom itself.

a. Wooden nails with heads. Oak is the best material. The extremities of the hoop of thin wood overlapping each other, and secured on each side in the joint of their ligature with wooden wedges.

b. The extremities of the circle of thin wood lying over each other, and confined on each side in the joint of their ligature with wooden wedges.

Fig. 4.—The manner in which the hoops are put on which hold the small staves of the second construction together. The circles *a* are kept together without binding, merely by a scarf or notch made in each end. These hoops are stripped of their bark.

c. The

c. The staves. These, as well as the bottoms themselves, may be made of yellow deal.

a. The scarfed ends of the hoops, which are turned inwards.

Fig. 5.—The method of disposing the transversal bars to which the bottoms of the inverted vessels are fixed. *a* the cross-bars. *b* the bottom of the inverted vessel. *c* the staves. *d* the scarfed hoops. *e* wooden pins which fix the bottom of the inverted vessel to the cross-bar. They are rivetted beneath, by splitting the lower point of the pin, and driving a wedge into the notch. *f* a small block or cleat, fixed to the staves of the cask with wooden pins, *g*, driven slantways above the cross-bar to keep it steady in its place.

Fig. 6.—The method of fixing the inverted vessels, which have a border of thin wood like a sieve. *a* the hoop or circle of thin wood pinned to the circumference of the bottom. *b* heads of the pins which fix the circular part. *c* boards making part of the bottom, but left of a greater length, in order that they may be fixed down to the support *d*.

As these circles of thin wood are not likely to join exactly to the circumference of the bottom of the vessel, they must be made good with putty, after previously stopping the larger vacuities with tow driven firmly in. Pitch may be used

instead of putty, if it should be found more convenient.

Fig. 7 and 8.—Section and plan of the vessel for immersing linen, hempen or cotton thread. It is placed on rollers or trucks, *a*, for the convenience of removal.

A. Bars with the corners rounded off, which are supported at each end in a notch or mortice, B, in the-cross piece *c*.

d. Skains of thread, separate or ranged in bundles of two or three only. The position of these must be changed once or twice during the immersion, in order that the part which rests on the bar may be subjected in its turn to the action of the oxygenated muriatic acid.

E. A pipe of lead or wood, through which the vessel is filled from beneath. If the acid were to be poured upon the thread, it would bleach more speedily at the upper part than elsewhere. Instead of one pipe there may be more, or the diameter may be sufficiently large for the speedy filling of this vessel.

F. A funnel through which the bleaching liquor flows from the pneumatic vessel. In strictness it may be suppressed, and the apparatus so disposed that the cocks from that vessel may discharge themselves immediately into the upper part of the pipe, which must be fixed within the
the

the vessel, in order that it may not impede the covering and uncovering. The cover ought to be composed of several portions or frames of glass, as was directed with regard to the vessel for immersing piece-goods; as by this means facility of management, and speed in the process, are insured.

G. A small door or sliding piece, in which a plate of glass is set, through which it is easy to observe the progress of the work. This may be opened from time to time to examine the goods without raising the covers.

This method of disposing the skains of thread in the oxygenated muriatic acid, is likewise applicable to their immersion in the sulphuric acid; when either of these liquors is exhausted, it may easily be drawn off, either by means of syphons or of a cock placed near the bottom.

Fig. 9.—Section of a vessel for immersing piece-goods, to which a pair of hooks is affixed to wring out the pieces in parts at a time, particularly if of considerable magnitude.

A. uprights, which may be easily adapted to the two opposite sides of the vessel by means of the two clamps, B, which are fixed to the vessel with a hinge on one side and a staple and pin on the other or by staple and pin on each side, if

intended to be applied to other vessels. The lower ends of these uprights are inserted into holes in the floor or pavement of the workshop. The hook D is fixed and unmoveable. The hook E is capable of revolving upon its flank, the outer end of which is fixed by plates of iron and screws to the levers I.

The use of this apparatus for wringing is equally applicable to the bath of oxygenated muriatic acid, or sulphuric acid or lees, or the macerations, &c.

Fig. 10.—A tube of glass divided into several equal parts called degrees, it is of use to ascertain the strength of the oxygenated acid. This tube is easily made out of any cylindrical bottle or piece of tube, the lower end of which may be simply stopped with a cork. White glass is to be preferred, and it is convenient that it should be about an inch in diameter.

Fig. 11.—A small measure of glass, tin, lead, or pottery, which when full contains the quantity of liquor necessary to form one of the degrees traced on the external surface of the tube with a flint or the edge of a file. The trial is made by pouring one of these measures of the oxygenated muriatic acid intended to be proved into the vessel, fig. 10, and afterwards observing how many

many of the same vessels filled with indigo blue, or tincture of cochineal, &c. prepared as directed in Chapter IX—XIV, it will discolour. From the result of the experiment, the liquor is judged to be more or less adapted to the bleaching process.

many of the same vessels filled with indigo blue, or tincture of cochineal, &c. prepared as directed in Chapter IX—XIV, it will disclose. From the result of the experiment, the liquor is judged to be more or less adapted to the bleaching process.

APPENDIX ;

OR,

SUPPLEMENTARY CHAPTER.

I. Nomenclature.

AT the end of the original work, the author has given a short table of synonymous terms, to which the following is equivalent :

Scientific Names.

Names in the Market, or common Names.

Marine or muriatic acid	—	Spirit of salt.
Oxygenated muriatic acid	—	Dephlogisticated marine acid of Scheele.
Nitric acid	—	Spirit of nitre; aqua fortis.
Sulphuric acid	—	Oil of vitriol.
Ammoniac	—	Spirit of sal ammoniac with lime.
Carbonate of ammoniac	—	Sal volatile.
Alumine	—	Pure clay.
Potash	—	Pearl ash (which is im- pure).
Carbonate of potash	—	Salt of tartar.

Soda

*Scientific Names.**Names in the Market, or
common Names.*

Soda —	— Barilla.
Carbonate of Soda —	— Salt of soda.
Sulphate of potash —	— Vitriolated tartar.
— of soda —	— Glauber's salt.
— of alumine —	— Alum.
— of iron —	— Copperas; green vitriol.
— of copper —	— Vitriol; blue vitriol.
— of zinc —	— White vitriol, or copperas.
Acetite of copper —	— Verdigris, or distilled verdigris (if in crystals).
Muriate of soda —	— Common sea salt.
Oxide —	— The rust or calx of a metal.

2. Measures and Weights.

I have not been able to discover the laws of graduation of the areometer of Mossy, which is mentioned in this work. It is much to be regretted that all measures, and instruments for specific gravity, are not reduced to the usual numbers of the tables in which that of water is taken as unity.

Measures of Temperature, according to Reaumur's scale, are reduced to that of Fahrenheit by this Rule: Multiply the degrees by 9; divide the product by 4, and to the quotient add 32, if the temperature

temperature be above the freezing water point ; or otherwise, if below freezing, take the quotient from 32. The sum or remainder will be the degree sought.

Measures of Length. The old French measures of length are used throughout this treatise. The Paris foot, compared with the English (Philos. Transf. 1768), is as 1.06575 to 1, which answers to somewhat more than 12 inches and three quarters English. The Paris ell (aune) being 44 French inches, will therefore measure 46.89 English inches, or rather more than 46 inches and seven eighths. Whence 5 Paris ells are very nearly equal to $6\frac{1}{2}$ English yards, the latter quantity being less than half an inch shorter.

Measures of Capacity. The Paris pint is 2.017 English wine pints, or a little more than a quart ; and the muid of wine 280 pints, or very nearly $70\frac{1}{2}$ gallons. The septier or chopine is half a pint. In corn measure of Paris, 3 bushels make 1 minot ; 2 minots, 1 mine ; 2 mines, 1 septier ; and 12 septiers, 1 muid. The muid is not quite 52 Winchester bushels.

Weights. The Paris pound is 7561 English grains, or one pound, one ounce, and $24\frac{1}{2}$ grains avoirdupois.

Money. The livre is commonly reckoned at
ten

ten pence English, and is divided into 20 sols, each consisting of 12 deniers*.

With regard to the articles made use of, the oil of vitriol, or sulphuric acid, may be rated at $6\frac{1}{2}$ d per lb.; salt, at $1\frac{1}{2}$ per lb.; manganese, about one penny per pound; pearlash, 6d. per lb.; soap, 4 l. per cwt.; coals and other fuel very different in price, according to the situation of the manufactory.

3. *Observations on the Process.*

The new method of bleaching, for which we are undoubtedly indebted to Berthollet, in his application of the oxygenated acid, first discovered by Scheele, to this useful purpose, was very speedily introduced into our manufactories at Glasgow and Manchester, and has since been very generally adopted in Ireland, Germany, and France. Some of our bleachers in Ireland immerse one thousand pieces daily. The obstacles which at first impeded the progress of this new art arose from the prejudices of bleachers, their ignorance in chemistry, and the real difficulties

* For the new weights, measures, and money of France, which, however, are not used in the foregoing treatise, see Nicholson's *Philos. Journal*, I. 199.

of the process *, the chief of which, as is very strikingly shewn by our author, consisted in the intolerable exhalations of the oxygenated acid, which rendered it nearly impossible and highly dangerous for any workman to handle the goods during the immersion, while it seemed no less impracticable to contrive a close apparatus, in which the goods should be exposed through all their parts to an equal action of the bleaching liquor. Various contrivances were tried with little success, till it was discovered that an addition of alkali deprived the liquor of its pungent effluvia, but left it in possession of its bleaching power. It seems to have been generally thought that the only inconvenience of this addition was the expence of the alkali; but Mr. Rupp †, in a late excellent memoir, has shewn that the usual addition of one pound of pearlash to the liquor for every three pounds of sulphuric acid in the matras, renders the bleaching upon an average 15 *per cent.* less effectual, which, with the cost of the alkali, adds 40 *per cent.* to the cost of the unsaturated liquor.

* Mr. Watt at Glasgow, and Mr. Henry and Mr. Cooper at Manchester, were among the first by whose exertions this art was introduced.

† Manchester Memoirs, v. Part i.; or Nicholson's Journal, II. 268.

The

The same ingenious chemist has proposed a machine for the gradual and regular exposure of the surface of piece-goods to the bleaching liquor in a closed vessel. It consists of two rollers, upon one of which the cotton is wound, and from which another roller draws it by means of a winch. During this action, the evolved face is exposed to the liquor, and when all the cloth is thus wound off, it is rolled back again upon the original cylinder, to which the handle is for that purpose shifted. It does not, however, appear that the inventor has ever used his apparatus, and I very much fear that the piece would run endways upon the cylinders so as to defeat the operation *.

Mr. Rupp found the bleaching liquor to be always strongest when the distillation was carried on very slowly, and that this strength is much increased by diluting the sulphuric acid more than is usually done. The following proportions afforded the strongest liquor: three parts manganese, or more or less, according to its quality; eight parts common salt; six parts oil of vitriol; and twelve parts water.

The author of the present treatise mentions

* On this subject, which is the chief difficulty in cylinder printed, see the Journal last quoted, I. 23.

lime as a substitute for alkali in the bleaching liquor, but without particularly insisting upon it as possessing superior advantages. Our bleachers, however, doubtless from experience, at least in point of cheapness, set a considerable value upon it. Mr. Turner, of Darnly, near Glasgow, obtained a patent * in January, 1798, for the sole use of this earth in a state of mechanical suspension in the bleaching liquor, and has even received premiums or rents from other bleachers for permission to use his method. But I understand that the validity of this grant is likely to be contested.

* See Repertory of Arts, ix. 303.

THE END.

It is a mistake for any in the scientific
world, but without particularly inquiring upon
it as a point for advantage. Our object is
not, however, to compile from experience, at
least in point of character, but a considerable
value upon it. A. Turner, of London, a
Glasgow, obtained a patent in January, 1835,
for the sole use of the same in a class of un-
dermined and in the following manner:
The even surface of the ground is covered
with a layer of earth to the depth of 18 in.
I understand that the value of this grant is
likely to be considerable.

• 2. Report of A. A. 1835.

THE END.

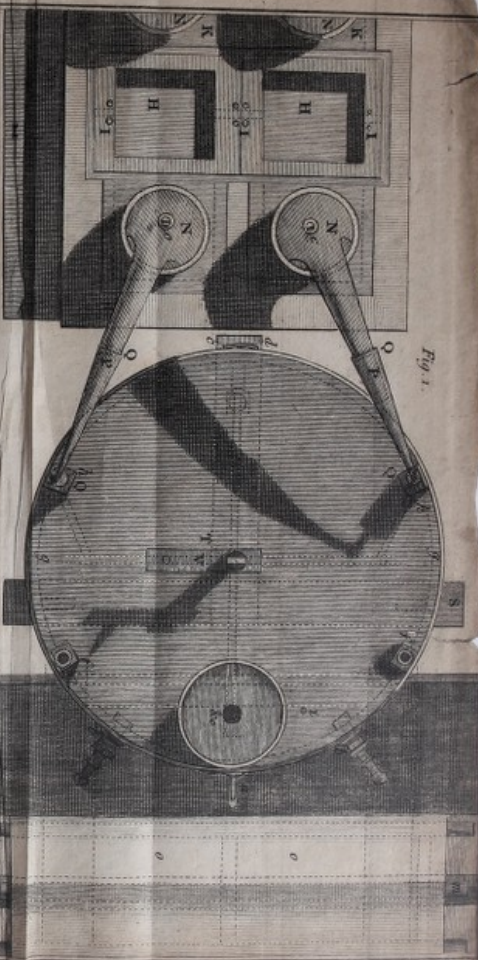


Fig. 1.

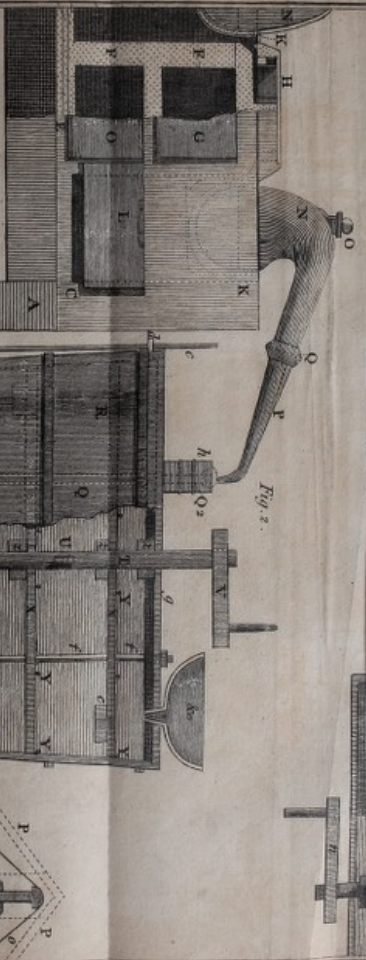


Fig. 2.

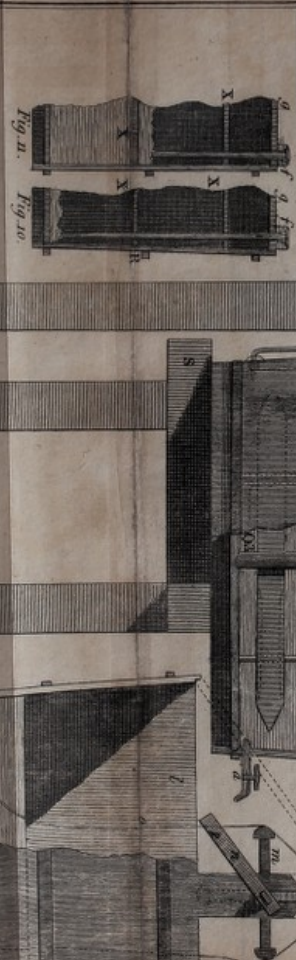


Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.

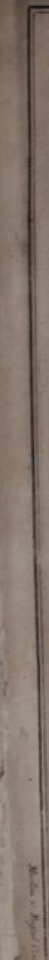
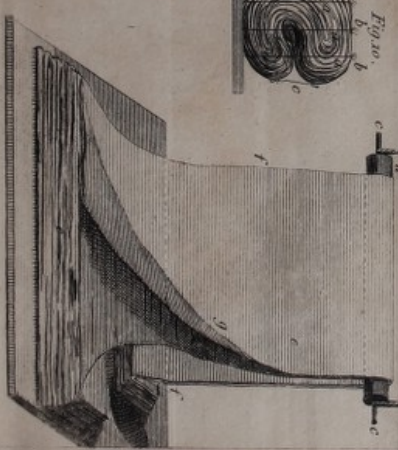
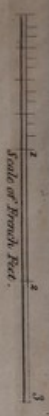
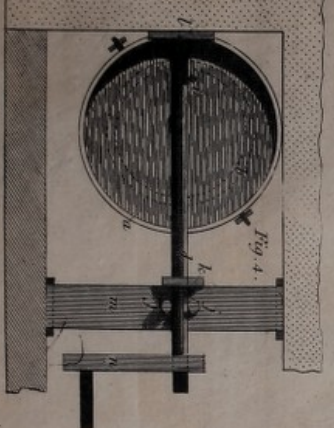
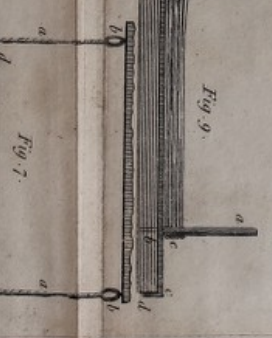
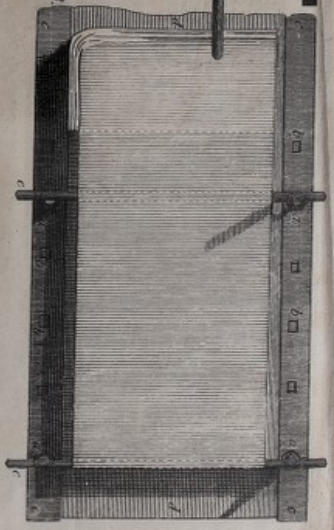
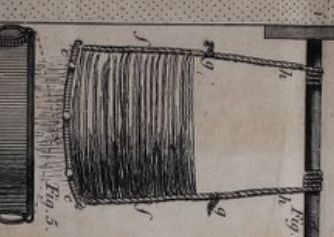
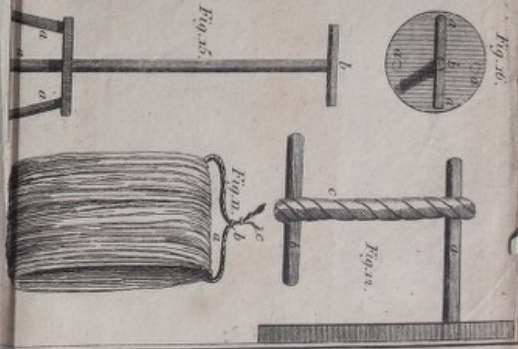
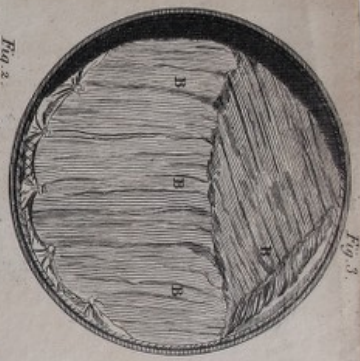
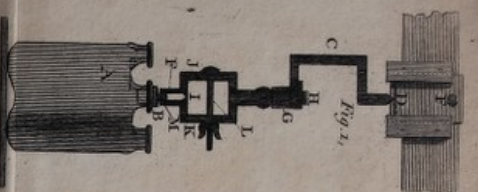
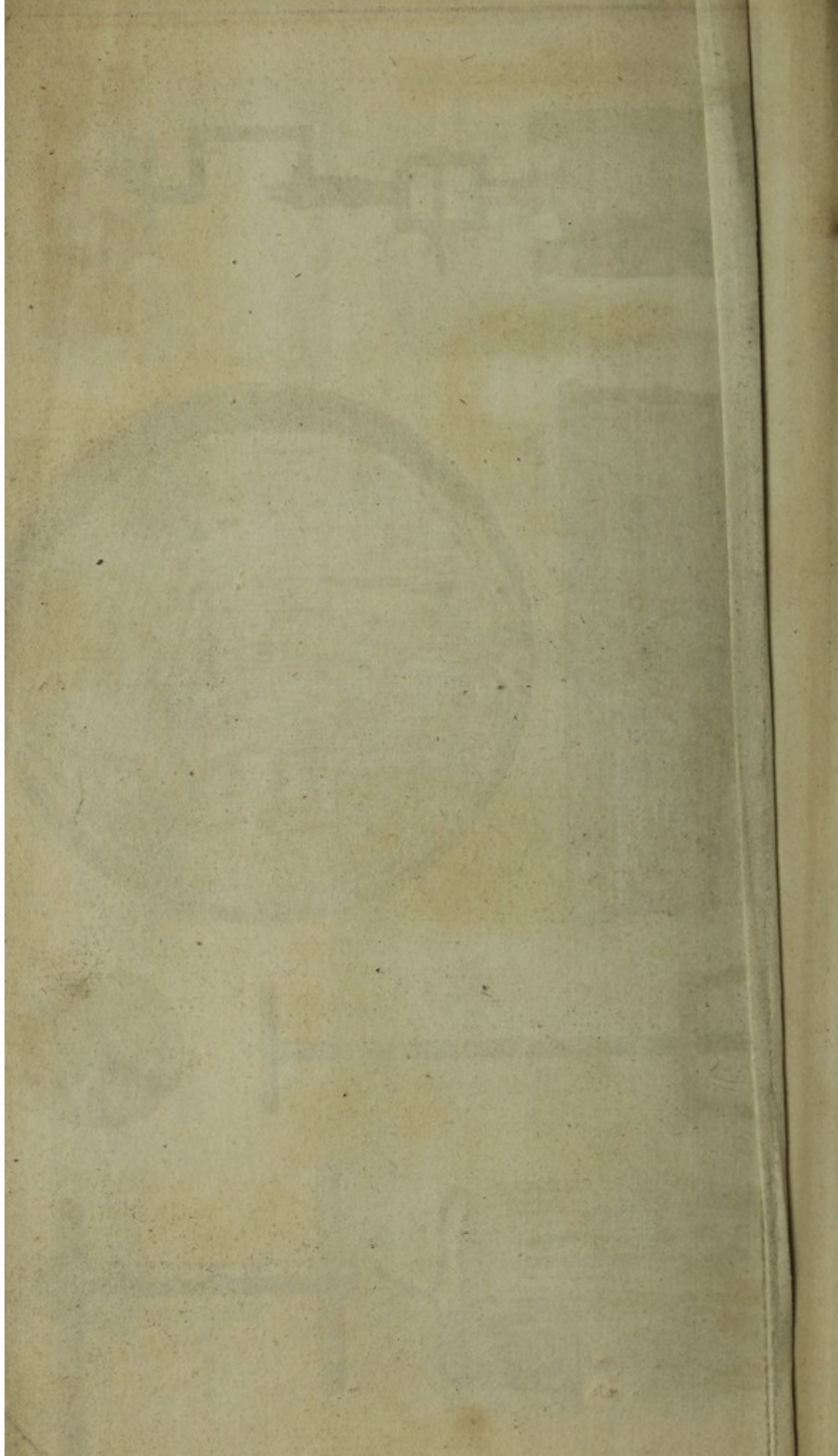
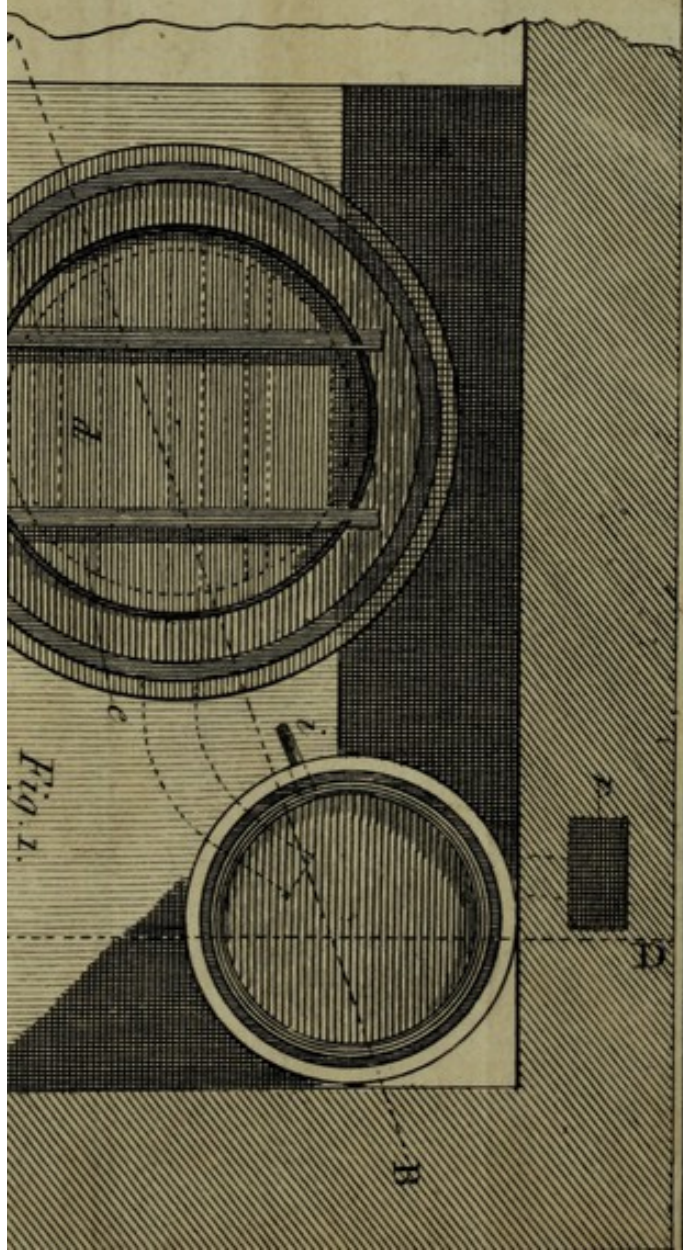
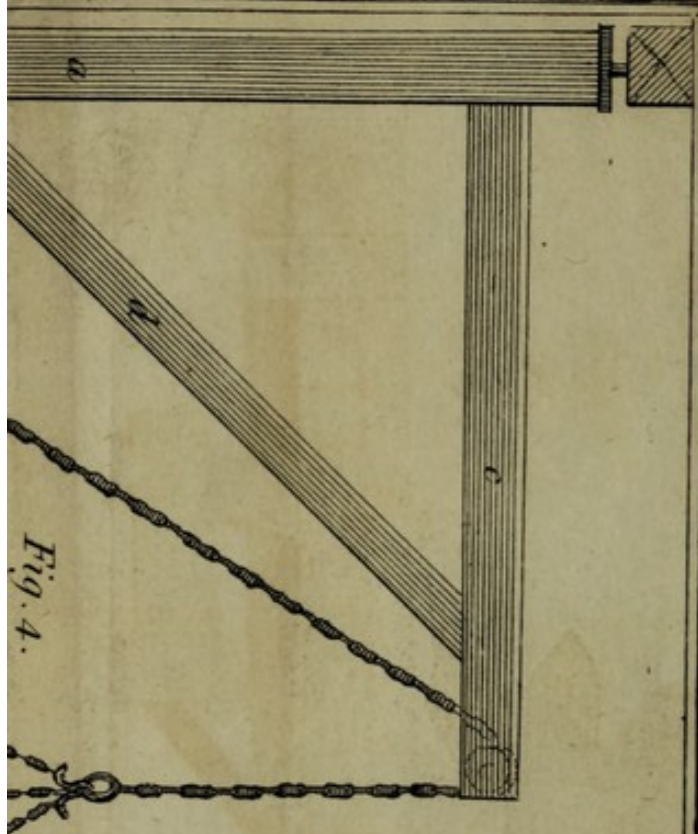


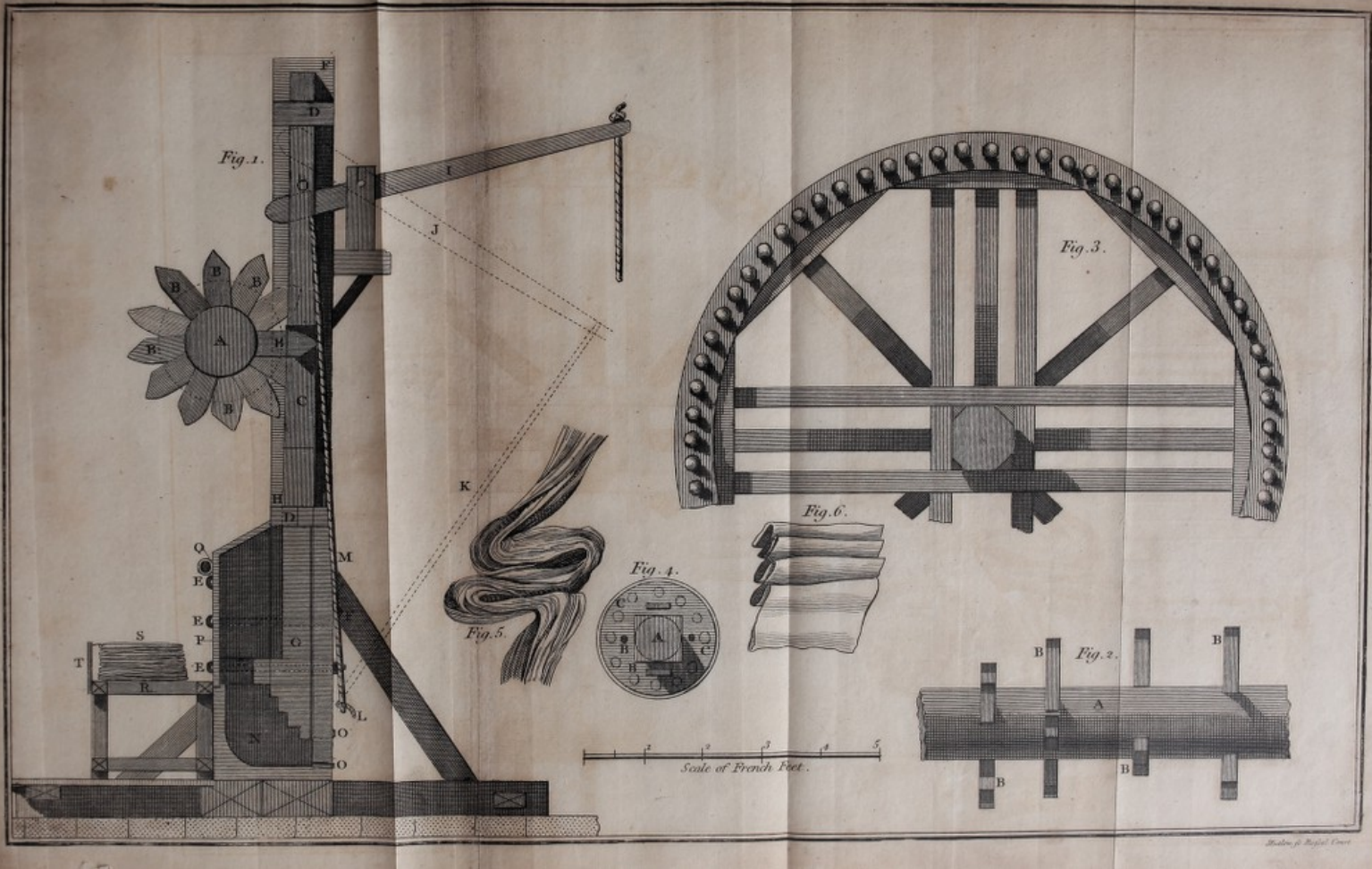
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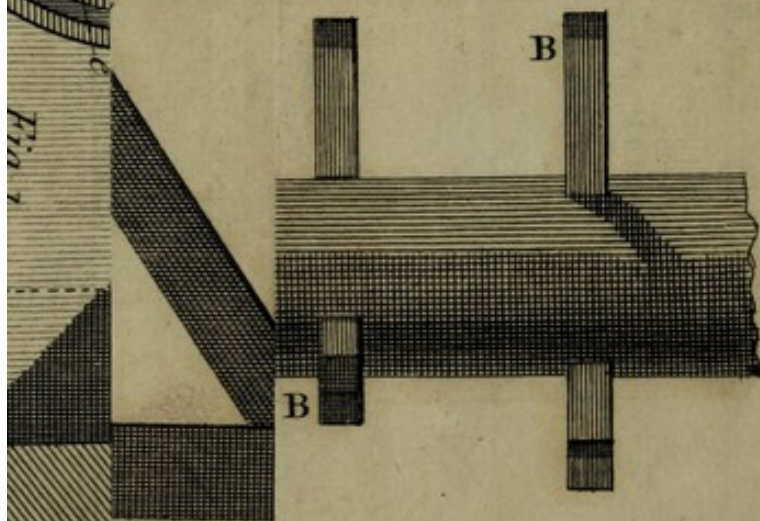
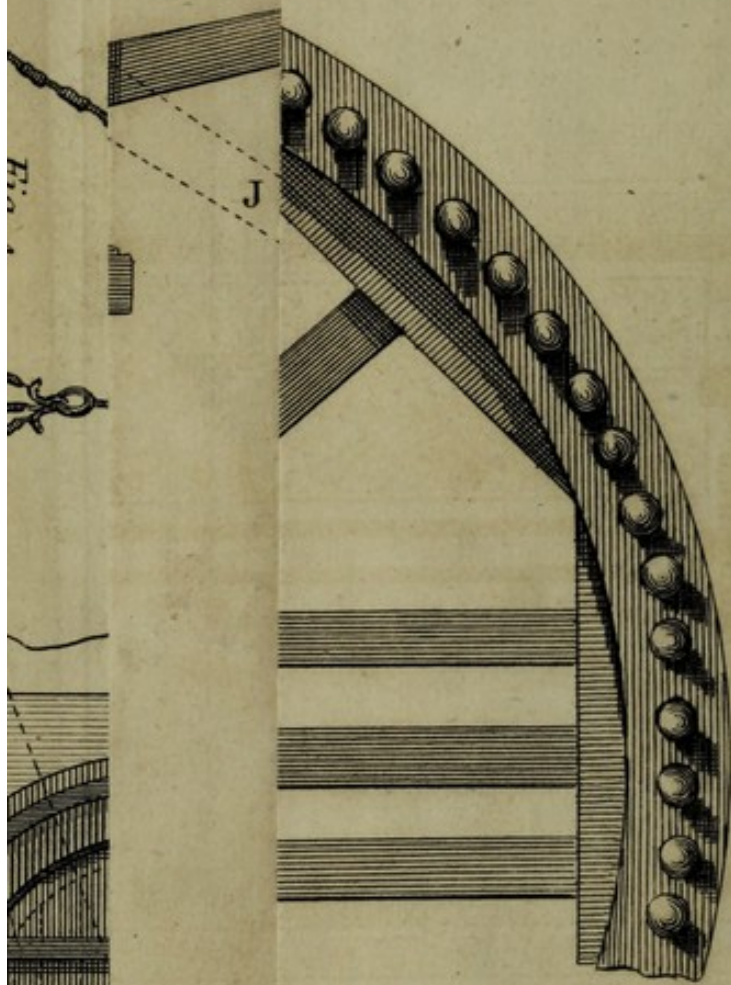


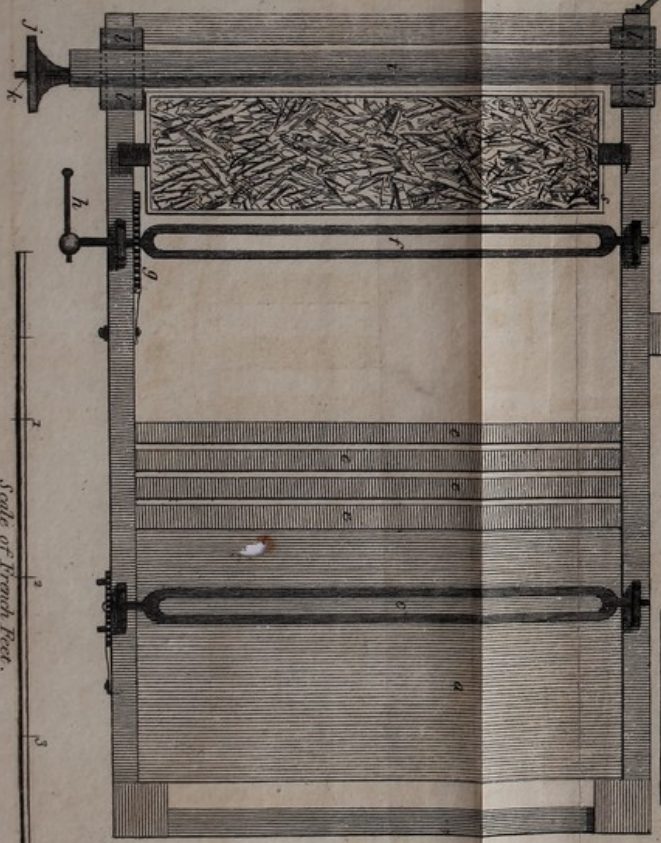
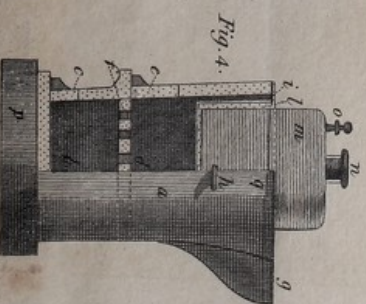
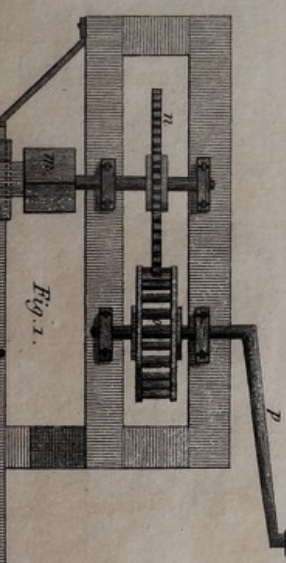
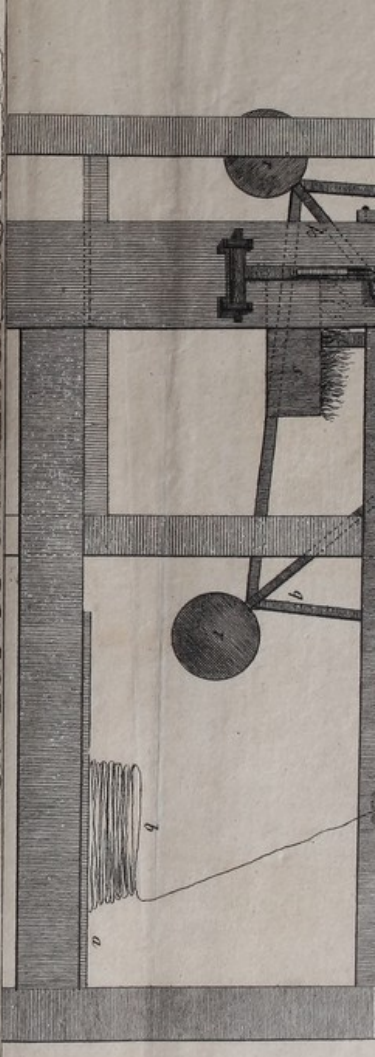












Scale of French Feet.

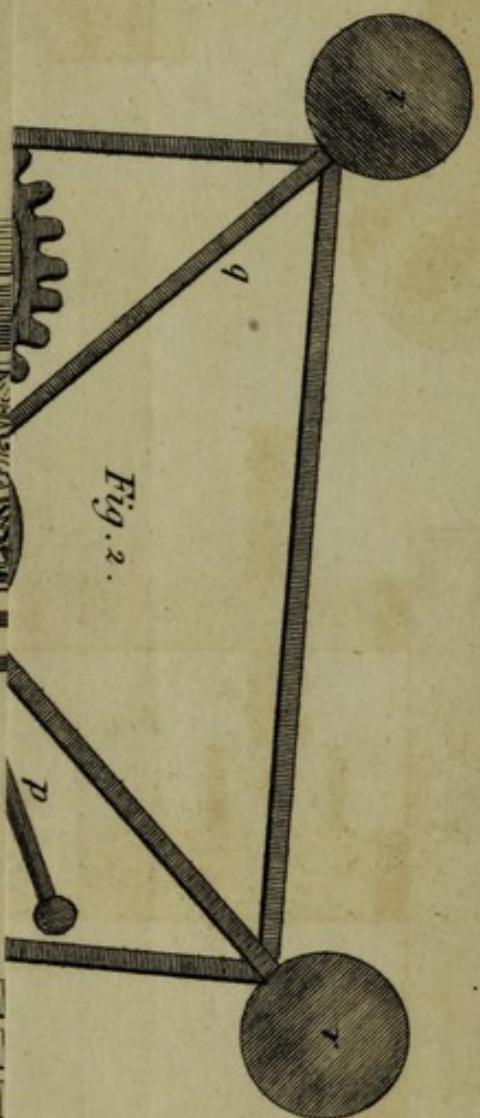


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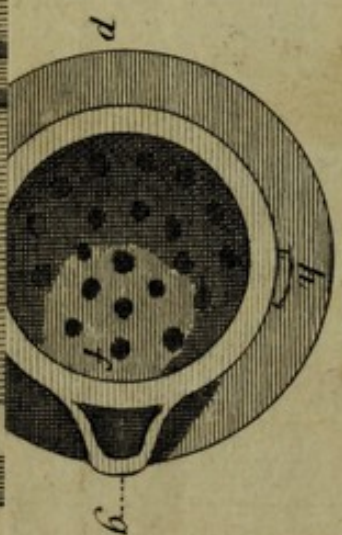


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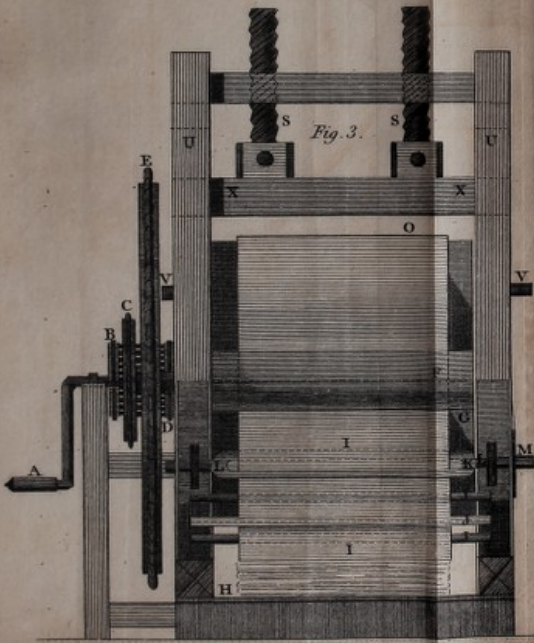
Fig. 4.



Fig. 5.



Fig. 3.



Scale of French Feet.

Fig. 1.

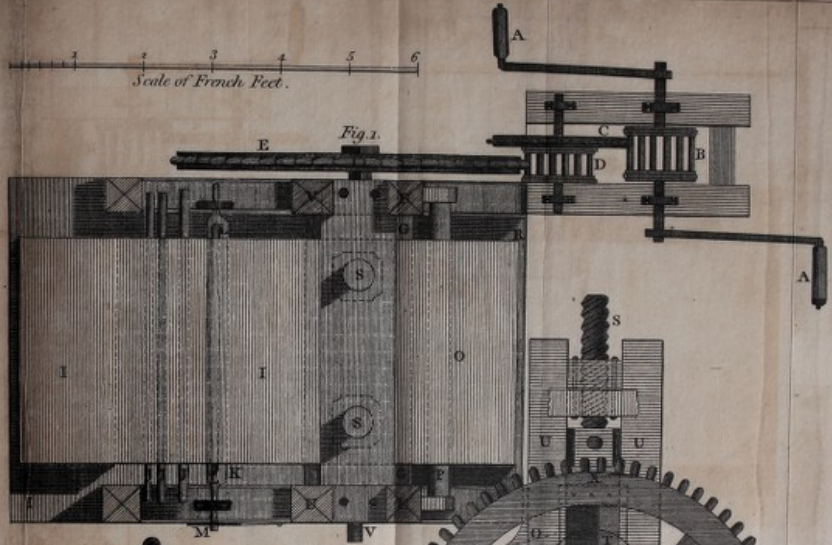
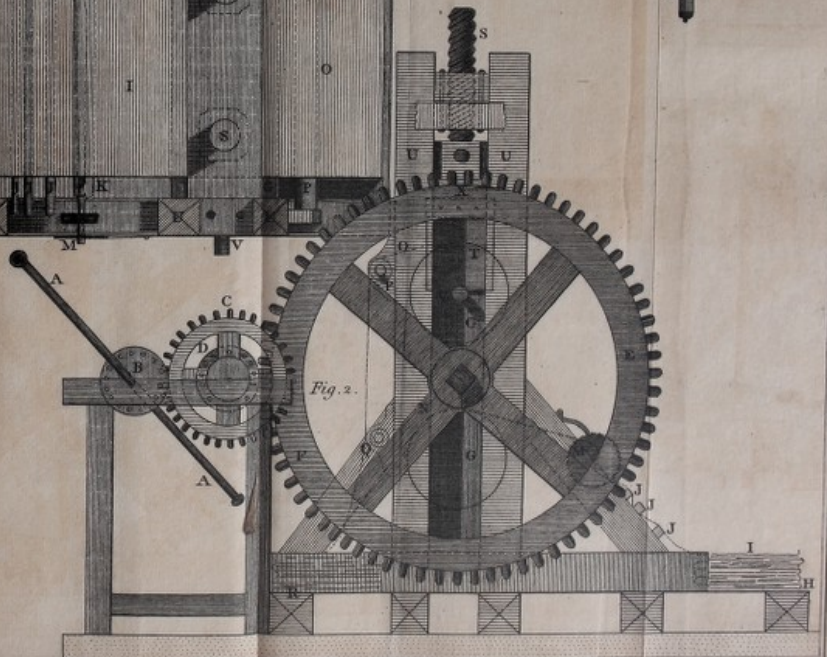
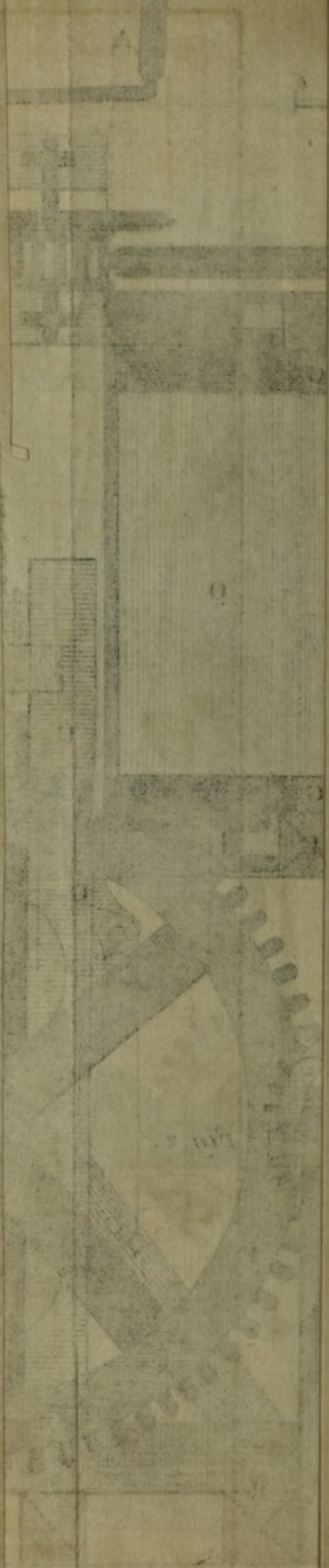
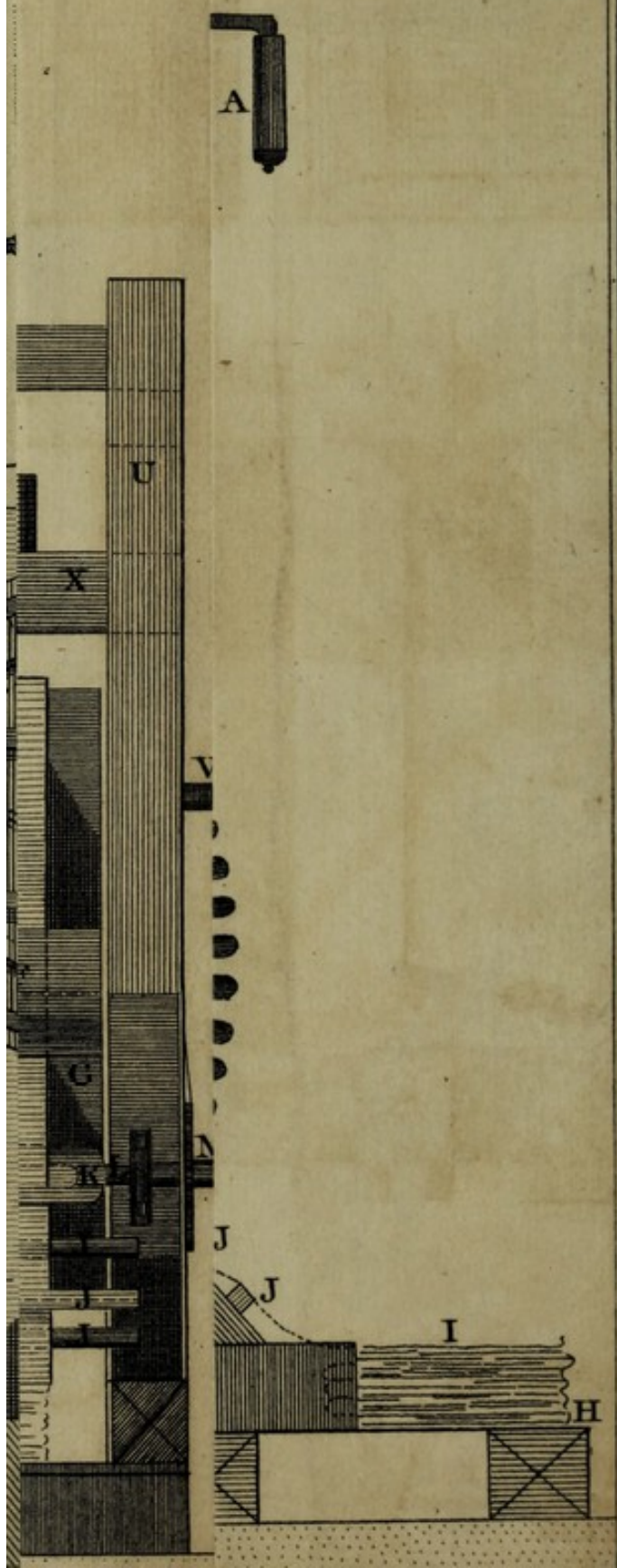


Fig. 2.





Scale of French Feet.

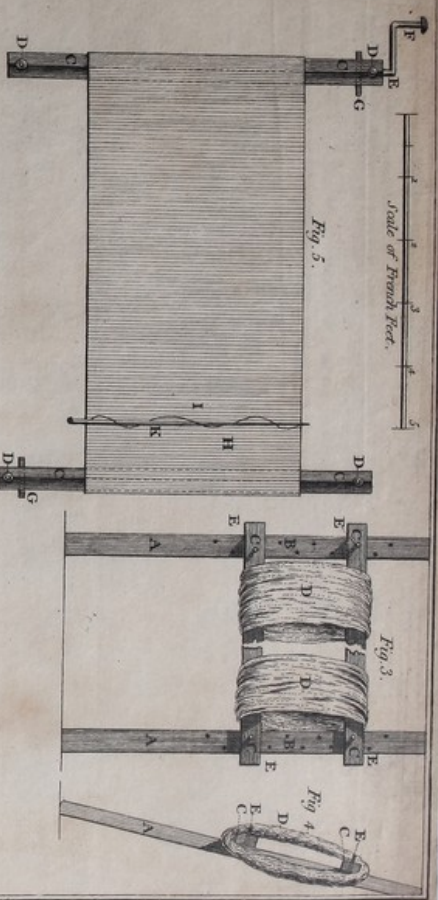


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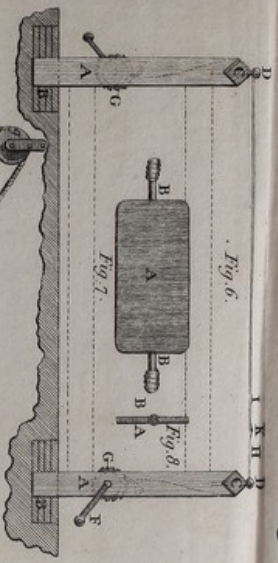


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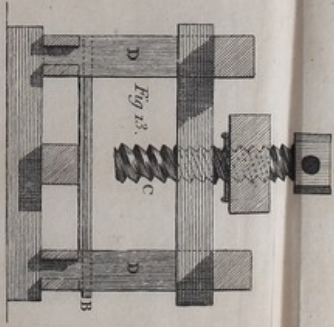


Fig. 7.

Fig. 8.

Fig. 9.

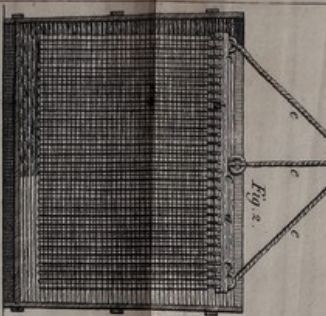


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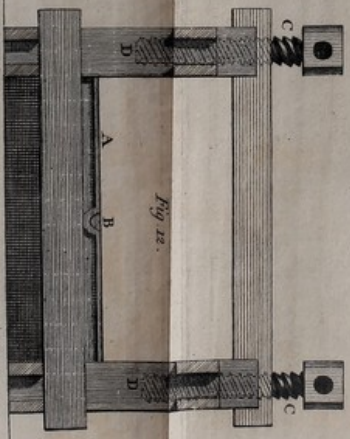


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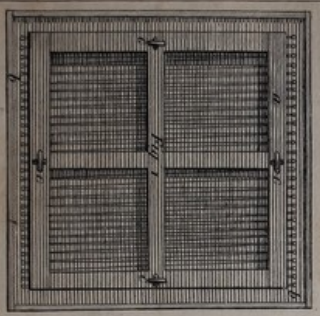


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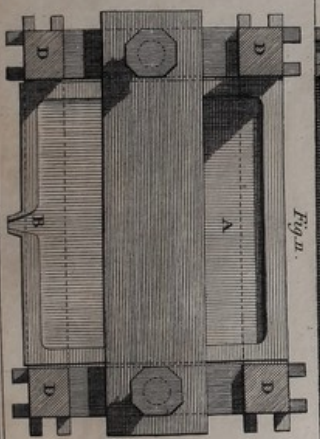
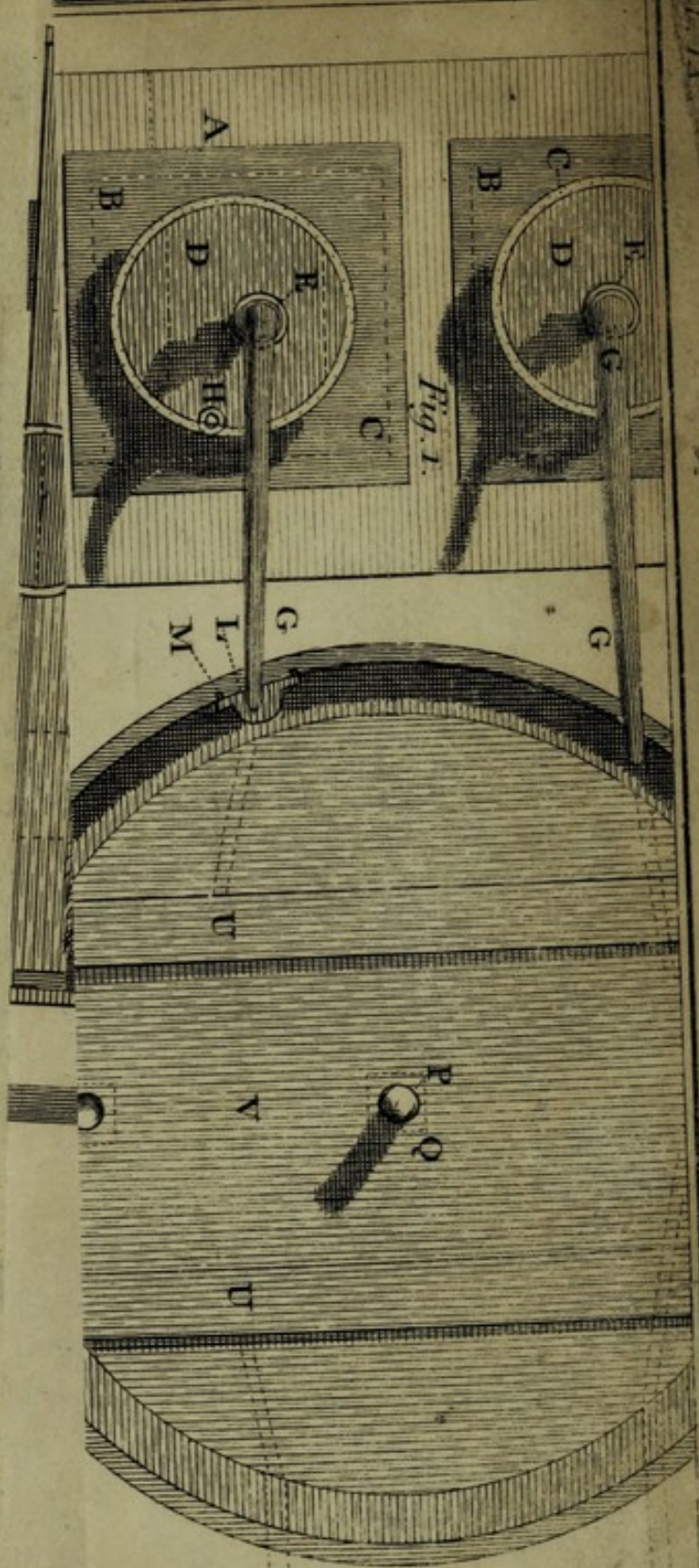


Fig. 13.



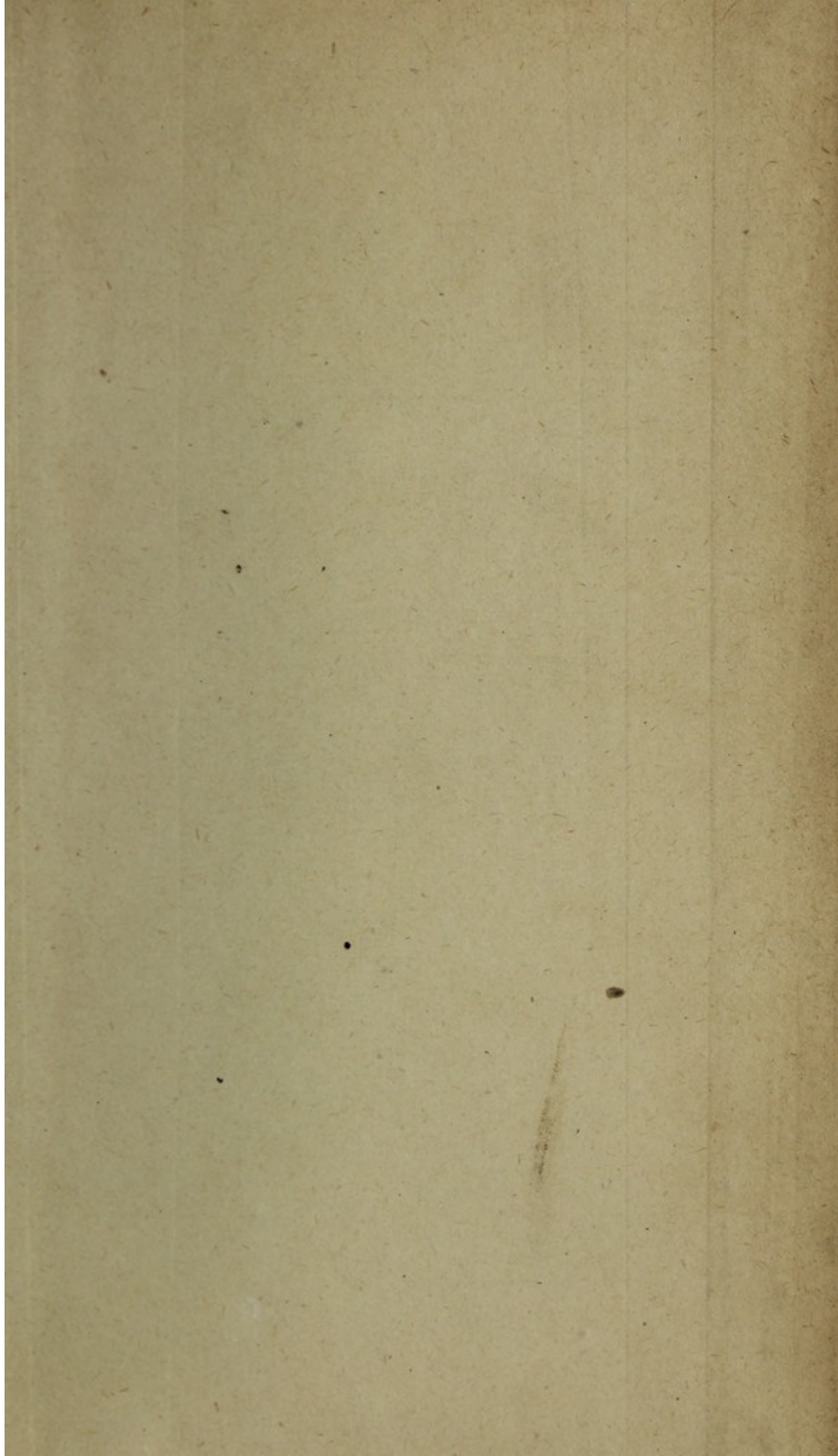
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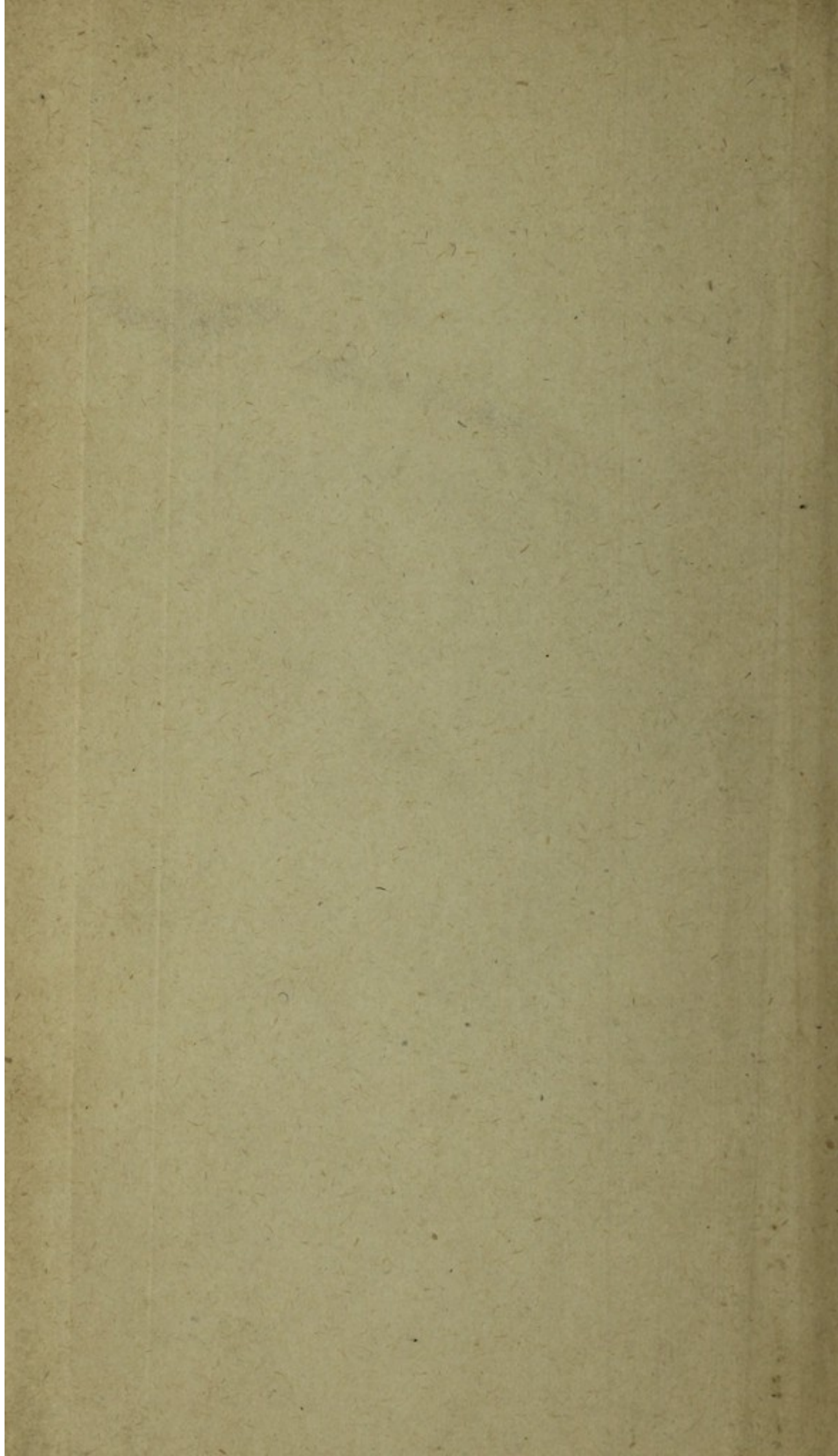




$\frac{1}{2}$ French Feet.

$\frac{2}{3}$ French Feet.







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