THE REPERTORY OF ARTS AND MANUFACTURES:

CONSISTING OF

ORIGINAL COMMUNICATIONS,

SPECIFICATIONS OF PATENT INVENTIONS,

AND

SELECTIONS OF USEFUL PRACTICAL PAPERS

FROM THE

TRANSACTIONS

OF THE

PHILOSOPHICAL SOCIETIES

OF ALL NATIONS, &c. &c.

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CONTENTS

OF THE

SECOND VOLUME.

	Page
I. Specification of Mr. DONALDSON's Patent for preserving animal and vegetable Subftances,	1
II. Specification of Mr. BARCLAY's Patent for cafting Printing-Types, &c. which cannot be counterfeited,	4
III. Specification of Mr. PUGH's Patent for preparing Oils for makng hard Soap, — —	8
IV. Specification of Mr. HODSON's Patent for feparating foffil Alkali from common Salt, — —	14
V. Defcription of a Spring-Staple, to prevent Horfes being caft in the Halter, — —	17
VI. Defcription of an Improvement in Cattle-Mills,	19
VII. Method of bringing Boats from one Canal to another; by JAMES ANDERSON, LL.D. —	21
VIII. Defcription of a Furnace for drying Salts, &c. by Mr. BROWNE, — — —	36

Page
IX. Considerations on the Nature of Wool, Silk, and Cotton, as Objects of the Art of Dying, &c. by Mr. HENRY, — — — 41
X. On the Purification of corrupted Water; by Mr. LOWITZ, — — — 61
XI. Specification of Messrs. BRAMAH and DICKINSON'S PATENT for an Engine on a rotative Principle, — — — 73
XII. Spefication of Mr. ECKHARDT'S Patent for Cloth-Hangings resembling Damask, Lace, &c. 87
XIII. Specification of Mr. ECKHARDT'S Patent for Paper-Hangings, resembling Damask, Lace, &c. — 90
XIV. Description of a short Pendulum to vibrate Seconds; and of a nautical Watch; extracted from Mr. LESLIE'S Patent, — — 92
XV. On the Cure and Prevention of the Gut-tie in Oxen and Calves; by Mr. CLARK, — — 98
XVI. On the Conversion of animal Muscle into a Substance resembling Spermaceti; by GEORGE SMITH GIBBES, B. A. — — 105
XVII. On the Dry-rot in Timber; by ROBERT BATSON, Esq. — — — — 112
XVIII. Continuation of Mr. HENRY'S Considerations on Wool, Silk, and Cotton, as Objects of the Art of Dying, — — — 116
XIX. On making Alum from its constituent Principles; by Mr. CHAPTAL, — — — 134
XX. Specification of Mr. BELFOUR'S Patent for making Ropes and Cordage, — — 145
XXI. Specification of Mr. JAYNE'S Patent for preserving Eggs, — — — 117
XXII. Specification of Mr. GLENNY'S Patent for making Pot and Pearl Ashes, — — 178

Page

XXIII. Defcription of a Sea Gage, for founding in Currents, &c. by JOHN CHARNOCK, Efq. 180

XXIV. Method of making Otter of Rofes; by DONALD MONRO, M. D. — — 185

XXV. Procefs of making Attar, or effential Oil, of Rofes; by Lieutenant Colonel POLIER, — 187

XXVI. Continuation of Mr. HENRY's Confiderations on Wool, Silk, and Cotton, as objects of the Art of Dying, — — 192

XXVII. Conclufion of Mr. CHAPTAL's Method of making Alum, — — — 208

XXVIII. Procefs for depriving Treacle of its difagreeable Tafte; by M. CADET, — 215

XXIX. Specification of Meffrs. WRIGHT and HAWKSLEY's Patent for Machinery for combing Wool, &c. — — — 217

XXX. Specification of Mr. CUNNINGHAM's Patent for preparing Rags for making Paper, — 222

XXXI. Specification of Mr. HEMPEL's Patent for making Veffels for filtering Water, &c. — 230

XXXII. Specification of Mr. WELDON's Patent for a Machine for conveying Veffels from one Canal to another, — — 235

XXXIII. Idea of a Dendrometer, or Inftrument for meafuring Diftances; by WILLIAM PITT, Efq. 238

XXXVI. Conclufion of Mr. HENRY's Confiderations on Wool, Silk, and Cotton, as Objects of the Art of Dying, — — 249

XXXV. Obfervations on Gunpowder; by the Honourable GEORGE NAPIER, — — 276

XXXVI. Compofition of a Water for deftroying Infects; by C. TATIN, — — — 285

XXXVII.

Page

XXXVII. Specification of Dr. HIGGINS's Patent for a Water Cement, or Stucco, for plastering Walls, &c. — — — — 289

XXXVIII. Specification of Mr. SKEY's Patent for a Pump on a new Construction, — 301

XXXIX. Specification of Mr. Fleet's Patent for preventing the Rot in Sheep, — — 305

XL. Proposal for an universal Character, or Pangraph; by THOMAS NORTHMORE, Esq. — 307

XLI. Description of a proposed Improvement in the Construction of Cranes; by the Rev. E. C. 312

XLII. Description of an Implement for taking the Levels for watering Grounds; by JAMES ANDERSON, LL. D. — — — — 317

XLIII. Conclusion of the Honourable Mr. NAPIER's Observations on Gunpowder, — 320

XLIV. An improved Method of tanning Leather; by DAVID MACBRIDE, M. D. — 341

XLV. Addition to the Method of bleaching Cloths, and Thread, by the Oxygenated Muriatic Acid; by M. BERTHOLLET, — — 354

XLVI. Specification of Mr. ECKHARDT's Patent for applying the Use of Animals to Machinery in General, — — — 361

XLVII. Specification of Mr. WILDE's Patent for making Edge-Tools from Cast-steel and Iron united, — — — 368

XLVIII. Specification of Mr. HOOPER's Patent for manufacturing Leather and Paper, from Leather Cuttings, &c. — — 371

XLIX. On the Cultivation of Willows; by ROBERT LOWE, Esq. — — — 376

Page
L. Conclusion of Dr. MACBRIDE's improved Method of Tanning Leather, — — 382
LI. On ancient Inks, and on recovering the Legibility of decayed Writings; by CHARLES BLAGDEN, M.D. — — — 389
LII. A Method of cutting very fine Screws, &c.; by the Rev. GILBERT AUSTIN, — 399
LIII. On the Use of Oak-leaves in Tanning; by the Rev. GEORGE SWAYNE, — — 406
LIV. Account of a violent Explosion, which happened in a Flour Warehouse at Turin, &c. by Count MOROZZO, — — — 416

PLATES

IN THE

SECOND VOLUME.

	Page
1. Furnace for separating fossil Alkali; and Spring-staple,	18
2. Improvement in Cattle-mills, — —	20
3. Method of bringing Boats from one Canal to another,	34
4. Furnace for drying Salts, &c. — —	40
5, 6, and 7. Engine on a rotative Principle, —	86
8. Short Pendulum, and Nautical Watch, —	96
9, 10, and 11. Machine for making Ropes and Cordage,	176
12. Sea Gage for sounding in Currents, &c. —	184
13 and 14. Machinery for combing Wool, &c.	220
15. Machinery for conveying Vessels from one Canal to another, — — — —	236
16. Instrument for measuring Distances, —	248
17 and 18. Pump on a new Construction, —	304
19. Improvement in Cranes; and Implement for taking Levels, — — —	318
20. Rollers for Powder-mills, — —	340
21, 22, and 23. Method of applying Animals to Machinery, — — —	366
24. Method of cutting very fine Screws, —	404

REPERTORY OF ARTS AND MANUFACTURES.

NUMBER VII.

Printed by John Nichols, Red-Lion-Paſſage, Fleet-Street, London.

I. Specification of the Patent granted to Mr. John Donaldson, of Taviſtock-Row, Covent-Garden, in the County of Middleſex; for his new Method of preſerving animal and vegetable Subſtances.

Dated Feb. 19, 1793.

To all to whom theſe preſents ſhall come, &c Now know ye, that I the ſaid John Donaldſon, in compliance with the ſaid proviſo, do hereby deſcribe and aſcertain the nature of my ſaid invention to be, as is herein before ſet forth, a new method of preſerving animal and vegetable ſubſtances; and that farther I declare the operation to be performed by an exact combination of certain principles moſt wholeſome and nutritive, and which indeed are contained in vegetable bodies themſelves; that is to ſay, not by means of any one principle, but by proportioning the farinaceous vegetable principle with the coagulative or mucilaginous one, and ſupplying ſuch combination, by admixture, according as the quality of the ſubſtance or ſubſtances to be preſerved may require. To be yet more particular; in order to preſerve any vegetable which is in itſelf of a watery or deliqueſcent nature, a greater portion of farina and mucilage is required than for others that are more ſolid, and readily diſpoſed to dry. Let the ſubſtance to be preſerved, for example, be a carrot or turnip, the preſerving matter may be compounded of wheat or barley-meal, with a ſolution of any common gum or vegetable mucilage. The ſubſtances may be either preſerved in a raw ſtate, or previouſly boiled, or otherwiſe dreſſed, as their nature or occaſion requires; but as the matters that may be preſerved in this way,

including

including the preſerving ones, are innumerable and various, it is impoſſible that any uniform rule can be given. Thus any ſimple farinaceous vegetable matter, combined with a mucilaginous vegetable one, compoſes a preſervative for other freſh vegetable or animal bodies, or parts contained in them, which are of a leſs fixed or deſiccative nature. The ſubſtances being thus accurately prepared, are dryed in a way ſimilar to that by which maltſters dry their grain; that is, by ſtoves properly heated, or otherwiſe, as occaſion may ſuggeſt. And, laſtly, they are carefully put up into wooden boxes, or other cloſe packages, for keeping and uſe. In witneſs whereof, &c.

II. Specification of the Patent granted to Mr. ROBERT BARCLAY, of the Borough of Southwark, in the County of Surry, Brewer; for a Diſcovery, or Invention, communicated to him by FRANCIS BAILEY, of Philadelphia, in North-America, of a Method of making Punches for ſtamping and punching the Matrices of Printing-types, for Letters and Devices; and for impreſſing on Copper Cuts, or other printing Plates, and on Dies, and on various Metals, and on any other Subſtances, certain Marks; which Letters, Devices, and Marks, cannot be counterfeited.

Dated July 26, 1790.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that, in purſuance of, and compliance

compliance with, the ſaid proviſo and condition, I the ſaid Robert Barclay do hereby declare, that the nature of the ſaid diſcovery or invention, (communicated to me as aforeſaid,) and the manner in which the ſame is to be performed, are herein after particularly deſcribed and aſcertained; that is to ſay, the method of making punches, for ſtamping and punching the matrices of printing types, for letters and devices, and for impreſſing on copper cuts, or other printing plates, and on dies, and on various metals, and on any other ſubſtances, certain marks, which letters, devices, and marks, cannot be counterfeited, conſiſts of the following principles.

Firſt, that there is an infinite variety in all the works of nature, whence it will follow, that any hard brittle ſubſtance, broken into two parts, will exhibit certain irregular figures, which, in infinite repetitions of the experiment, will never be exactly imitated; and this principle I call the accidental part of my invention. Small bars of ſteel, drawn to the proper ſize of the punch required, and then broken off, will without more preparation form a punch, to punch or ſtamp

matrices

matrices for types for devices; and no ingenuity will ever be able to imitate them with a tool, fo as to deceive upon a careful infpection; and a punch fo formed will ferve for marking copper, or any other printing plate or cut, or a die for milling of coin or medals, or for ftamping paper or parchment, or for ftamps for any affay office, or for any other private mark, on any fubftance capable of an impreffion.

My fecond principle is, to combine art with nature, to render the natural or accidental marks above mentioned more obvious to a flight infpection. Thus, when the grain of the fteel is very fine, and the light and fhade to be produced will not be fufficiently diftinct, it may be rendered more fo by enlarging the hollow parts with counter punches of a fmaller fize, regular or irregular, cutting or grinding down the prominent parts; by drilling or punching fmall holes, and varying them with regular or irregular cuts of a graver, punch, chifel, or other tool, until a device is formed or produced that pleafes the eye, and fatisfies the artift that it is inimitable; and this may be infinitely varied.

My

My third principle is, that regular, accidental, and irregular cuts with a graver or chiſel, or other tool; regular and irregular counter punches, ſtruck or cut on a plain ſurface, of either wood, metal, or other ſubſtance, may alſo produce an inimitable device; drilling holes, and bending the periphery of one into another, by punches, &c. will increaſe the difficulty of imitation. This combination of art and accident may be extended to any given length, as punches for letter-preſs types may be formed of ſteel, broken as above, by cutting, drilling, punching, bending (and all their varieties, upon the ſame principle,) parts of the letters, and leaving the grain of the ſteel, &c. to form the lines or ſtrokes, with all its accidental irregularities; and in this way title-letters, and two-line-letters, facs, and complete founts of types, might be caſt, every letter of which would vary in its lines from every other, and in larger letters a little art might be combined with accident, ſo as to make the diſtinctions from all others obvious to a common obſerver. In witneſs wherefore, &c.

III. Specification of the Patent granted to Mr. SAMUEL PUGH, late of Bishopſgate-ſtreet, London, but now of Rouen, in the Kingdom of France, Soap-boiler; for his new-invented Method of preparing Oils, for the making and manufacturing of hard Soap, with or without Tallow, or any other Greaſe, or Roſin, at much leſs Price than by the Method now in Uſe.

Dated Nov. 6, 1790.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that in compliance with the ſaid proviſo, I the ſaid Samuel Pugh do hereby declare, that my ſaid invention is deſcribed in manner following; that is to ſay, take newly-burnt lime, ſlake it with water till it is reduced to a very fine powder, let it remain in that ſtate till it is quite dry, which it generally is in twenty-four

four or thirty-ſix hours, particularly if the lime is ſlaked in a heap; let this powder, thus dry, be ſifted, to ſeparate from it the ſtones which were promiſcuouſly mixed with the lime, as well as thoſe parts of calcareous earth which were not ſufficiently burnt, and which in conſequence would not ſlake: this powder being ſo prepared, mix with it any kind of oil, (deſigned to be prepared,) till it is of the conſiſtence of thick cream, then let this mixture be ground in a mill, of the ſame deſcription as thoſe commonly uſed for grinding white lead, or let it be ground between any two ſurfaces, till the cream is free from any lumps of powdered lime, and is perfectly ſmooth and mixed. This being done, uſe an iron pan, a copper or earthen veſſel, (but the iron is to be preferred for the ſecurity it affords,) let this pan be charged with this mixture of oil and lime, only one eighth full, then add the ſame quantity of the ſame oil, ſo deſigned to be prepared, to this mixture, and ſtir them well together; (the iron pan will be now one fourth full,) make a tolerably briſk fire, taking particular care that the mixture is continually ftirred at the bottom, to prevent it from fticking, (an iron inftrument fhould be ufed for this purpofe;) the contents of the pan will foon begin to fwell or boil, and perhaps will reach the top of the pan, and will fome time afterwards fubfide; the fire muft, however, be kept up, and fo muft the ftirring, till the mixture begins to fwell and boil a fecond time, and to emit thick clouds of fmoke; at this period oil muft be added, and ftirred very brifkly indeed, till this violent ebullition is fuppreffed. The lime is now united to the oil, and has the appearance of one complete body; when cold it will be of the confiftence of wax. If the oil, fo prepared, fhould be required lefs compact, oil muft be added, which, by the application of a moderate heat, will mix very readily; on the contrary, if the prepared oil is wanted to be more compact and hard, it muft be taken out of the pan whilft it is in this violent ebullition; however fome oil muft neceffarily be added while the pan is emptying, or a great part of the compofition would be converted into a cinder. This oil, fo prepared, is is adapted to make hard ſoap, as after mentioned; it will alſo bleach by expoſure, and, it is preſumed, may be applied for any ornamental figures, inſtead of wax, and for ſeveral other purpoſes to which wax is generally applied; it may be alſo uſed with roſin, to cover bottles, &c. inſtead of yellow wax, as the conſiſtence of this prepared oil may be varied at diſcretion. To make hard ſoap with the oil thus prepared, put any given quantity of it into a pan, either alone or in conjunction with tallow, roſin, or greaſe; or indeed oil unprepared may be added to the prepared oil, to half its weight, more or leſs; let the whole be melted, and made moderately hot; add ley of mineral alkali, (in manner herein-after deſcribed,) the force of which muſt be calculated by its ſpecific gravity to that of water. Any force of alkali will combine with this prepared oil, from the vaſt increaſe of affinity it has gained by the preparation. For ſoap that is wanted for immediate uſe, the force of the ley ſhould be from 1120 to 1140, ſuppoſing water to be 1000; as this ley is very ſtrong, and contains but little water, the operation of boiling will be but ſhort. The prepared oil is now in the pan, and melted: the force of the ley is known by its ſpecific gravity, and the proportion of alkali to each pound of oil is calculated by the abſolute weight of the ley, which proportion may be varied at the diſcretion of the ſoap-maker. (The variation of ſtrength has been hitherto from two to four ounces of alkali to every pound of fat, oil, &c. though this was always done at hazard; whereas this mode affording the certainty of any given force, the *conſumer* may always have a ſtandard quality.) This being done, one third, or thereabouts, of the ley muſt be put gently into the pan, the ſpecific gravity of which ley being firſt reduced to 1030, or 1040, by the addition of water, this in boiling will unite very readily; after it is perfectly combined, the reſt of the ley, of the gravity of 1120 to 1140, muſt be added; let it boil, and when it is perfectly combined, and forms a ſtout maſs, let it be cleanſed into frames. Before the ſoap is quite finiſhed it would be proper to ſtir the bottom; this will facilitate the

the boiling, and prevent the ſoap from adhering to the bottom, for in this method there is no ſeparation in the pan, or at leaſt a very partial one; when the ſoap is in the frame there will be, as uſual, a ſmall diſcharge of impure ley; this ſoap is made moſt conveniently in ſmall pans. When roſin is uſed in the compoſition, it would be proper, when the ſoap is ſufficiently boiled, to add a ſmall quantity of ſoft water, as is now practiſed. If, when the ſoap is quite cold, it is not hard, it is certain that it was not ſufficiently boiled; however this, in a ſhort time, would become hard by the ſpontaneous evaporation of the water contained in it. In witneſs whereof, &c.

IV. Specification of the Patent granted to Mr. GEORGE HODSON, of the City of Chester, Soap-boiler; for his new Method of separating the fossil or mineral Alkali from the muriatic Acid, as it exists in common Salt; and also of separating the fossil or mineral Alkali from the common Salt, as it exists in Kelp.

WITH A PLATE.

Dated August 30, 1792.

TO all to whom these presents shall come, &c. NOW KNOW YE, that, in compliance with the said proviso, I the said George Hodson do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, is particularly described and ascertained as follows:

lows; that is to ſay, to extract the alkali from common ſalt, I proceed thus: with a ton of ſalt, I mix to the amount of ſixteen buſhels of ſmall-coal, or charcoal, (I give the preference to the ſmallcoal,) and, in this ſtate, throw it into the furnace by the door, (ſee E in the draught hereupon indorſed, Plate I.) for the purpoſe of fuſion. During the progreſs of the fuſion, it muſt be ſtirred at times with the rake, (ſee D in the ſaid draught,) in order to effect a proper union of the materials, and to expoſe (by bringing all the parts ſucceſſively to the ſurface) the whole maſs to the action of the reverberating flame. After the fuſion is completed, it is to remain one hour in the furnace, and then to be drawn out. The ſubſtance thus drawn is the aſh, in its impure ſtate; to refine it, nothing farther is requiſite than to form a lixivium, and evaporate it to dryneſs.

To extract the alkali from the common ſalt, as it reſides in kelp, a ton of kelp muſt be broken into ſmall lumps, and mixed with ten buſhels of charcoal, or ſmallcoal, inſtead of ſixteen. In every other reſpect the proceſs correſponds with the above deſcription. The *rationale* is as fol-

lows.

lows. The phlogiſton contained in the ſmall-coal, or charcoal, being liberated by the fire, exerts its agency on the common ſalt, and effects a decompoſition in it. The acid of the ſalt, being ſeparated from its alkaline baſis, is diſſipated, and the alkali, left in conjunction with the reſiduum of the charcoal, or ſmallcoal, forms the aſhes.

EXPLANATION OF THE DRAUGHT REFERRED TO.

(See Plate I.)

A. The furnace door.

B. The bottom of the furnace.

C. The chimney.

D. The rake, with which the ſubſtances are ſtirred.

E. The door, by which the ſubſtances are put in, and taken out of the furnace.

F. The flue.

V. Defcription of a Spring-ftaple, to prevent Horfes being caft in the Halter; in a Letter to the Editors.

WITH A PLATE.

Gentlemen,

Being very near lofing a favourite horfe of mine lately, by his being caft in the halter, I contrived a fpring-ftaple for the halter-ring to hang in, as a means of preventing the like accident in future; an accident which is frequently happening, and by which many valuable horfes have been ruined, and fometimes killed. I fhall be happy if you think this communication, with the drawing that accompanies it, worthy a place in your publication.

I am, &c.

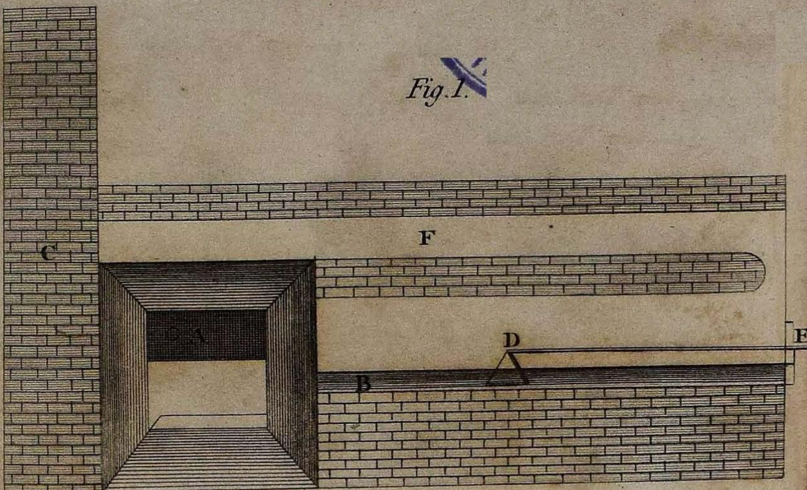
X. Y.

THIS STAPLE IS REPRESENTED IN PLATE I. FIG. 2.

In which A is a ſpring, which paſſing through a mortiſe in the ſhank of the ſtaple, (as near as may be to where it ſcrews into the manger-rail,) preſſes againſt the lever B, and keeps it ſhut.

Should the horſe get his leg over the halter, his pull being downwards, he will overcome the power of the ſpring, and ſet himſelf at liberty. If he has a double-reined halter on, he will ſtill be confined.

Fig. 1.



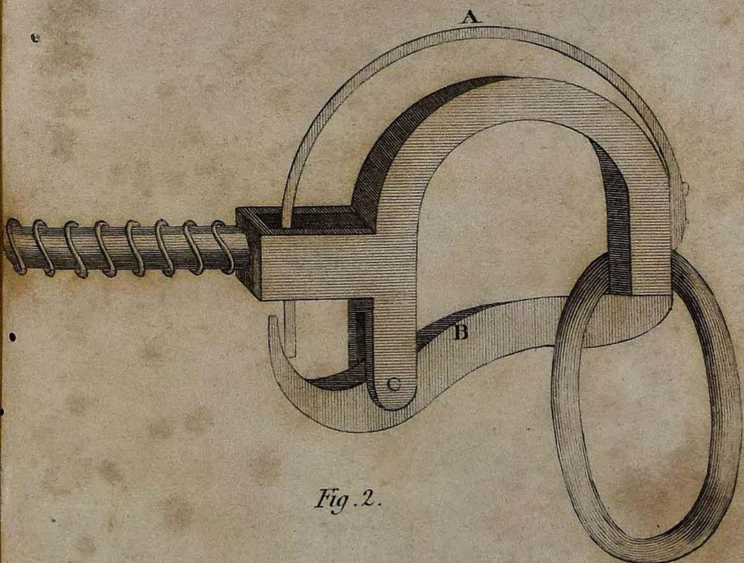


Fig. 2.

VI. Defcription of an Improvement in Cattle-Mills, particularly intended for thofe which move Carding-Machines; in a Letter to the Editors.

WITH A PLATE.

GENTLEMEN,

I SHALL be happy to contribute any thing in my power to your undertaking; and, fhould you give the following paper a place in your work, I fhall confider the pains it has coft me to be well beftowed. I am, &c.

R. B.

One of the greateft evils attending the cattle-mill, as commonly conftructed, when applied to the purpofe of moving carding-machines in the cotton-manufactures, is, that if the cattle fhould go a ftep or two backward, they will reverfe the motion, and entirely deftroy the teeth of the cards. With an intention to remedy this evil, the writer erected feveral mills in two of the principal manufacturing towns of Scotland, upon the conftruction defcribed below; and they have given ſo much ſatisfaction, that he underſtands ſeveral more have been built in the neighbourhood, upon the ſame principle.

At A B, in Fig. 1, (Plate II.) two wooden arms are fixed in the ſame ſhaft, for the purpoſe of ſupporting a movable barrel, of which A B C D, (Fig. 2.) is a ſection.

a a, (Fig. 1, 2, and 3,) are the draught-beams, fixed to the barrel by means of iron-ſtraps.

On the top of the barrel is fixed an iron ratch-wheel, H I, which is repreſented in the plan, Fig. 3, by *b c d e*.

At K L, (Fig. 1.) on the ſhaft, is fixed a ſtrong piece of caſt iron, from which four pieces of malleable iron project; upon theſe are hung four ſtrong catches, which act into the ratch-wheel.

When the draught-beam goes forward, the ratch-wheel is preſſed againſt the catches, and thereby puts the reſt of the machinery in motion. On the contrary, ſhould it be carried backward, none of the machinery will be moved, except the barrel.

The addition of a fly-wheel, to a cattle-mill of this conſtruction, will greatly regulate the motion.

VII.

Fig. 1.

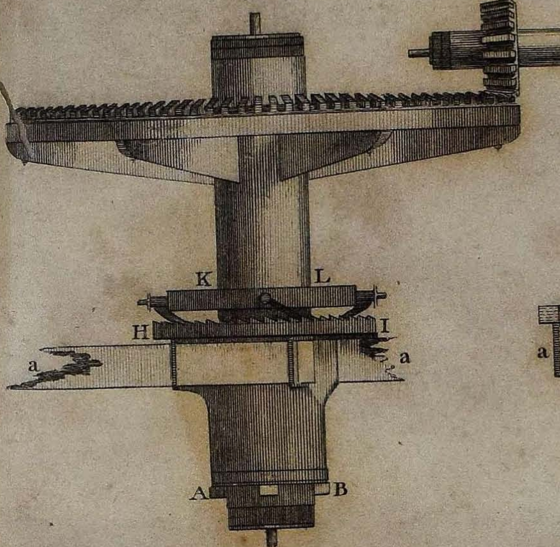


Fig. 2.

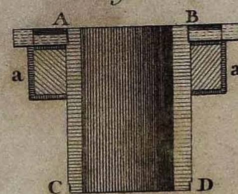
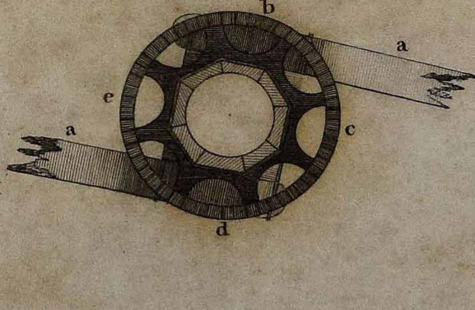


Fig. 3.



VII. Method of bringing Boats from one Canal into another, of different Heights, without the Affiftance of Water-Locks.

WITH A PLATE.

From the general View of the Agriculture of the County of Aberdeen; drawn up, for the Confideration of the Board of Agriculture, by JAMES ANDERSON, LL. D.

IT is in many cafes a matter of fo much difficulty to provide water, in fufficient quantities, for the confumption of a canal where many boats are to pafs, and the interruption is fo great, in paffing numerous locks, where the rife is confiderable, that it has often been wifhed that an eligible method of lowering and elevating boats could be devifed, without the affiftance of water-locks; and though it is evidently at firft view practicable, and feveral different modes of doing

doing it have been ſuggeſted, ſome of which have actually been carried into effect, yet all of them have been found to be attended with ſuch inconvenience as to render an improvement in this reſpect ſtill neceſſary.

In China, where water-carriage is more generally practiſed than in any kingdom of Europe, boats are raiſed and lowered from one canal into another, by ſliding them along an inclined plane; but the contrivances for effecting that purpoſe are ſo aukward, and ſuch a number of hands are required, that it has in general been deemed inexpedient to reſort to that mode of practice in Europe. Several devices, that diſcovered conſiderable ingenuity, however, have been publiſhed, with a view to facilitate this operation; either by rendering the motion up the inclined plane more equable, or producing a power ſufficient to move theſe great weights, but none of them have yet been ſo ſimple in their conſtruction as could be wiſhed, nor have they afforded ſatiſfaction in practice. The following device is therefore now offered to the public, as poſſeſſing at leaſt the merit of ſimplicity in as high a degree as could

perhaps

perhaps be wiſhed; and, in the opinion of very good judges of matters of this ſort, to whom the plan has been ſhewn, it has been deemed fully adequate to the purpoſe of raiſing and lowering boats of a moderate ſize; that is, of twenty tons, or downwards; and it is the opinion of moſt men with whom I have converſed, who are beſt acquainted with inland navigations, that a boat of from ten to fifteen tons is better than thoſe of a larger ſize. When ſeveral are wanted to be ſent at once, they may be affixed to one another, as many as the towing-horſe could conveniently draw. Were boats of this ſize adopted, and were all the boats on one canal to be of the ſame dimenſions, it would prove a great convenience to a country in a ſtate of beginning improvements; becauſe the expence of ſuch a boat would be ſo trifling, that every farmer could have one for himſelf, and might of courſe make uſe of it when he pleaſed, by the aid of his own horſe, without being obliged to have any dependence on the time that might ſuit the convenience of his neighbour; and, if two or more boats were going from the ſame neighbourhood, one horſe could ſerve the whole.

You

You are to ſuppoſe that Fig. 1, (Plate III.) repreſents a bird's-eye view of this ſimple apparatus, as ſeen from above. A is ſuppoſed to be the upper reach of the canal, and B the lower reach, with the apparatus between the two. This conſiſts of three diviſions; the middle one, extending from C to D, is a ſolid piece of maſonry, raiſed from a firm foundation below the level of the bottom of the ſecond reach: this is again divided into five parts, viz. *d d d*, where the wall riſes only to the height of the water in the upper reach, and *e e*, two pillars, raiſed high enough to ſupport the pivots of a wheel or pulley *g*, placed in the poſition there marked.

The ſecond diviſion *h* conſiſts of a wooden coffer of the ſame depth nearly as the water in the upper reach, and of a ſize exactly fitted to contain one of the boats. This communicates directly with the upper reach, and, being upon the ſame plane with it, and ſo connected with it as to be water-tight, it is evident, from inſpection, that nothing can be more eaſy than to float a boat into this coffer from the upper reach. The part of the wheel that projects over it being at a ſuf-

ficient

ficient height above it, ſo as to occaſion no ſort of interruption.

Third diviſion. At *i* is repreſented another coffer, preciſely of the ſame dimenſions with the firſt; but here two ſluices which were open in the former, and only repreſented by dotted lines, are ſuppoſed to be ſhut, ſo as to cut off all communication between the water in the canal and that in the coffer. As it was impoſſible to repreſent this part of the apparatus on ſo ſmall a ſcale, for the ſake of illuſtration it is repreſented more at large in Fig. 4, where A, as before, repreſents the upper reach of the canal, and *b* one of the coffers. The ſluice *k* goes into two cheeks of wood, joined to the maſonry of the dam of the canal, ſo as to fit perfectly cloſe; and the ſluice *f* fits, equally cloſe, into cheeks made in the ſide of the coffer for that purpoſe; between theſe two ſluices is a ſmall ſpace *o*. The coffer, and this diviſion *o*, are to be ſuppoſed full of water, and it will be eaſy to ſee that theſe ſluices may be let down, or drawn up, at pleaſure, with much facility.

Fig. 5. repreſents a perpendicular ſection of theſe parts in the ſame direction as in Fig. 4, and

in which the ſame letters repreſent the ſame parts.

Things being thus arranged, you are to ſuppoſe the copper *b* to be ſuſpended, by means of a chain paſſed over the pulley, and balanced by a weight, that is ſufficient to counterpoiſe it, ſuſpended at the oppoſite end of the chain. Suppoſe then, that the counterpoiſe be made ſomewhat lighter than the coffer with its contents, and that the line *m n* (Fig. 5.) repreſents a diviſion between the ſolid ſides of the dam of ſeparation, which terminates the upper reach, and the wooden coffer, which had been cloſed only by the preſſure of its own weight, (being puſhed a very little, from A towards B, beyond its preciſe perpendicular ſwing,) and that the joining all round is covered with liſts of cloth put upon it for that purpoſe; it is evident that, ſo long as the coffer is ſuſpended to this height, the joining muſt be water-tight, but no ſooner is it lowered down a little than this joining opens, the water in the ſmall diviſion *o* is allowed to run out, and an entire ſeparation is made between the fixed dam, and this movable coffer, which may be lowered

down

down at pleaſure without loſing any part of the water it contained.

Suppoſe the coffer now perfectly detached, turn to Fig. 2, which repreſents a perpendicular ſection of this apparatus, in the direction of the dotted line *p p* (Fig. 1.) In Fig. 2, *h* repreſents an end view of the coffer, indicated by the ſame letter as in Fig. 1, ſuſpended by its chain, and now perfectly detached from all other objects, and balanced by a counterpoiſe *i*, which is another coffer exactly of the ſame ſize, as low down as the level of the lower reach. From inſpection only it is evident, that, in proportion as the one of theſe weights riſes, the other muſt deſcend. For the preſent then, ſuppoſe that the coffer *h* is by ſome means rendered more weighty than *i*, it is plain it will deſcend, while the other riſes; and they will thus continue till *h* comes down to the level of the lower reach, and *i* riſes to the level of the higher one.

Fig. 3. repreſents a ſection in the direction A B, (Fig. 1.) in which the coffer *i* (ſeen in both ſituations) is ſuppoſed to have been gradually raiſed from the level of the lower reach,

B, to that of the higher, A, where it now remains ftationary; while the coffer *h* (which is concealed behind the mafonry) has defcended in the mean time to the level of the lower reach, where it clofes by means of the juncture *r s*, Fig. 5, (which juncture is covered with lifts of cloth, as before explained at *m n*, and is of courfe become water-tight,) when, by lifting the fluice *t*, and the correfponding fluice at the end of the canal, a perfect communication by water is eftablifhed between them. If then, inftead of water only, this coffer had contained a boat, floated into it from the upper reach, and then lowered down, it is very plain, that when thefe fluices were removed, after it had reached the level of the lower reach, that boat might have been floated out of the coffer with as much facility as it was let into it above. Here then we have a boat taken from the higher into the lower canal; and, by reverfing this movement, it is very obvious that it might be, with equal eafe, raifed from the lower into the higher one. It now only remains that I fhould explain by what means the equilibrium between thefe counter-balancing weights can

can be deſtroyed at pleaſure, and the motion of courſe produced.

It is very evident, that if the two correſponding coffers be preciſely of the ſame dimenſions, their weight will be exactly the ſame when they are both filled to the ſame depth with water. It is equally plain, that ſhould a boat be floated into either or both of them, whatever its dimenſions or weight may be, ſo that it can be contained *afloat* in the coffer, the weight of the coffer and its contents will continue preciſely the ſame as when it was filled with water only; hence then, ſuppoſing one boat is to be lowered, or one to be raiſed at a time, or ſuppoſing one to be raiſed and another lowered at the ſame time, they remain perfectly in equilibrium in either place, till it is your pleaſure to deſtroy that equilibrium. Suppoſe then, for the preſent, that both coffers are loaded with a boat in each; the double ſluices both above and below cloſed; and ſuppoſe alſo that a ſtop-cock *u*, in the under edge of the ſide of the lower coffer (Figs. 3 and 5.) is opened, ſome of the water which ſerved to float the boat in the coffer will flow out of it, and conſe-

consequently that coffer will become lighter than the higher one; the upper coffer will of course descend, while the other mounts upwards. When a gentle motion has been thus communicated, it may be prevented from accelerating, merely by turning the stop-cock so as to prevent the loss of more water, and thus one coffer will continue to ascend, and the other to descend, till they have assumed their stations respectively; when, in consequence of a stop below, and another above, they are rendered stationary at the level of the respective canals *.

Precisely the same effect will be produced when the coffers are filled entirely with water.

It is unnecessary to add more to this explanation, except to observe that the space for the coffer to descend into must be deeper than the bottom of the lower canal, in order to allow a free descent for the coffer to the requisite depth; and of course it will be necessary to have a small conduit to allow the water to get out of it. Two

* It does not seem necessary to adopt any other contrivance than the above for regulating the motions; but, if it should be found necessary, it would be easy to put a ratch-wheel on the same axle.

or

or three inches free, below the bottom of the canal, is all that would be neceſſary.

Where the height is inconſiderable, there will be no occaſion for providing any counterpoiſe for the chain, as that will give only a ſmall addition to the weight of the undermoſt coffer, ſo as to make it preponderate, in circumſtances where the two coffers would otherwiſe be in perfect equilibrium; but, where the height is conſiderable, there will be a neceſſity for providing ſuch a counterpoiſe; as, without it, the chain by becoming more weighty every foot it deſcended, would tend to deſtroy the equilibrium too much, and accelerate the motion to an inconvenient degree. To guard againſt this inconvenience, let a chain of the ſame weight, *per* foot, be appended at the bottom of each coffer, of ſuch a length as to reach within a few yards of the ground where the coffer is at its greateſt height (ſee Fig. 2.); it will act with its whole weight upon the higheſt coffer, while in this poſition; but, as that gradually deſcended, the chain would reach the ground, and being there ſupported, its weight would be diminiſhed in proportion to its deſcent;

while

while the weight of the chain on the oppofite fide would be augmented in the fame proportion, fo as to counterpoife each other exactly, in every fituation, until the uppermoft chain was raifed from the ground. After which it would increafe its weight no more; and, of courfe, would then give the under coffer that preponderance which is neceffary for preferving the machine fteady. The under coffer, when it reached its loweft pofition, would touch the bottom on its edges, which would then fupport it, and keep every thing in the fame pofition, till it was made lighter for the purpofe of afcending.

What conftitutes one particular excellence of the apparatus here propofed is, that it is not only unlimited as to the extent of the rife or depref-fion of which it is fufceptible; (for it would not require the expenditure of one drop more wa-ter to lower it one hundred feet than one foot;) but it would alfo be eafy fo to augment the number of pulleys at any one place as to ad-mit of two, three, four, or any greater number of boats being lowered or elevated at the fame time, fo that let the fucceffion of boats on fuch

a canal

a canal be nearly as rapid as that of carriages upon a highway, none of them need be delayed one moment to wait an opportunity of paſſing; a thing that is totally impracticable where water-locks are employed; for the intercourſe, on every canal conſtructed with water-locks, is neceſſarily limited to a certain degree, beyond which it is impoſſible to force it.

For example: ſuppoſe a hundred boats are following each other, in ſuch a rapid ſucceſſion as to be only half a minute behind each other: By the apparatus here propoſed, they would all be elevated preciſely as they came; in the other, let it be ſuppoſed that the lock is ſo well conſtructed as that it takes no more than *five* minutes to cloſe and open it; that is, ten minutes in the whole to each boat, (for the lock, being once filled, muſt be again emptied before it can receive another in the ſame direction); at this rate ſix boats only could be paſſed in an hour, and of courſe it would take ſixteen hours and forty minutes to paſs the whole hundred; and as the laſt boat would reach the lock in the ſpace of fifty minutes after the firſt, it would be detained

 fifteen

fifteen hours and fifty minutes, before its turn would come to be raiſed. This is an immenſe detention; but if a ſucceſſion of boats, at the ſame rate, were to follow continually, they never could paſs at all. In ſhort, in a canal conſtructed with water-locks, not more than ſix boats, on an average, can be paſſed in an hour, ſo that beyond that extent all commerce muſt be ſtopped; but on the plan here propoſed ſixty, or ſix hundred, might be paſſed in an hour if neceſſary, ſo as to occaſion no ſort of interruption whatever. Theſe are advantages of a very important nature, and ought not to be overlooked in a commercial country.

This apparatus might be employed for innumerable other uſes as a moving power, which it would be foreign to our preſent purpoſe here to ſpecify. Nor does its power admit of any limitation, but that of the ſtrength of the chain, and of the coffers which are to ſupport the weights. All the other parts admit of being made ſo immovably firm as to be capable of ſupporting almoſt any aſſignable weight.

Fig. 1

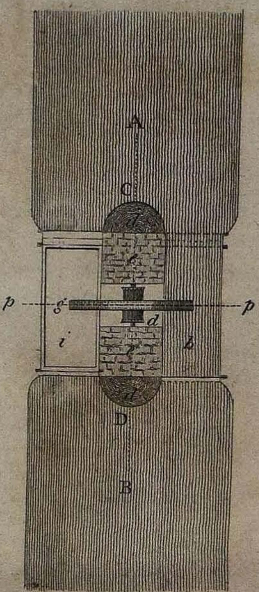


Fig. 2

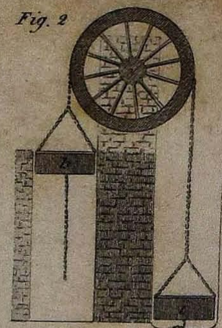


Fig. 3

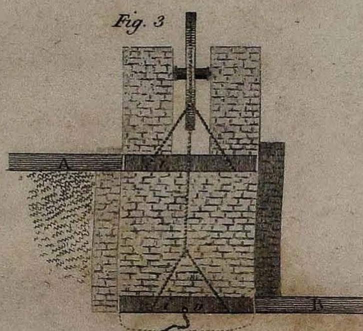


Fig. 4

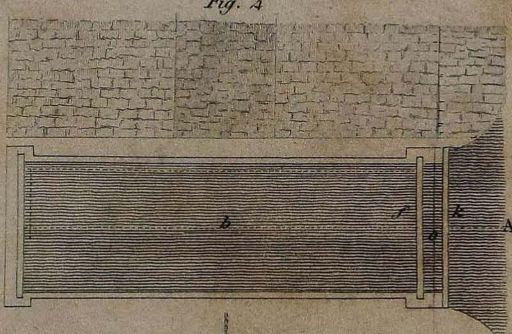
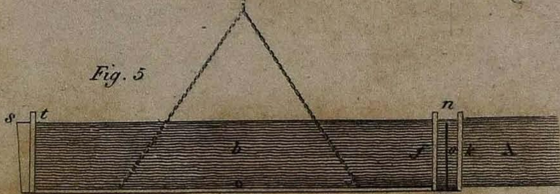


Fig. 5



I will not enlarge on the benefits that may be derived from this very ſimple apparatus; its cheapneſs, when compared with any other mode of raiſing and lowering veſſels that has ever yet been practiſed, is very obvious; the waſte of water it would occaſion is next to nothing; and, when it is conſidered that a boat might be raiſed or lowered fifty feet, nearly with the ſame eaſe as five, it is evident that the interruptions which ariſe from frequent locks would be avoided, and an immenſe ſaving be made in the original expence of the canal, and in the annual repairs.

It is alſo evident that an apparatus, on the ſame principle, might be eaſily applied for raiſing coals or metals from a great depth in mines, wherever a very ſmall ſtream of water could be commanded, and where the mine was level-free.

VIII. Defcription of a Furnace, or Evaporator, for drying various Kinds of Salts, and other Subftances; by Mr. HENRY BROWNE, of Derby.

WITH A PLATE.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal of the Society was voted to Mr. BROWNE for this Invention; the Defcription of which is preceded by the following letter from him.

I HEREWITH fend a plan of a furnace I ufe for evaporation, and which I have found more ferviceable, for that purpofe, than any copper or boiler I ever faw; and I am of opinion it might be advantageoufly applied to drying malt, as the heat is more equally difperfed, and the vapour carried

carried off much quicker, than by the mode now practifed. I have not obferved the exact quantity of moifture which may be exhaled in a given time, by a given quantity of fuel; but I can with fafety fay, that at leaft one half of the fuel, and a great deal of trouble, are faved by this contrivance; as it does not require near the attendance that boilers in general do, in fupplying it with liquor or fuel, which need only be done twice in twenty-four hours: for the fire being confined in the firft inftance to the bottom, and the evaporation being regular, a certain quantity, either of fuel or liquor, may be put in at certain times. But the greateft advantage this furnace poffeffes, and which I flatter myfelf may be called new, is that the atmofphere is rendered of an equal heat with the liquor; by which means more moifture is carried away by the current of hot air than by any other means I am acquainted with.

The utility of this evaporator therefore is, in my opinion, two-fold: firft, the evaporation is much quicker, with a lefs quantity of fuel, than in the generality of the boilers now in ufe; fecondly, neither the operator nor the neighbourhood

hood can be in the leaſt affected or annoyed, let the vapour or ſteam be ever ſo pernicious. That evaporation is much greater by this mode will appear very plain when the courſe of the heat is pointed out: it is firſt carried under the veſſel, then reverted back on the ſides, and, finally, it is carried over the ſurface; by which means the air that is in contact with the liquor is ſo heated, and highly rarified, that the fluid is raiſed into vapour or ſteam much quicker, and with leſs fuel, than if the atmoſphere was cold; and, as the air neceſſary to keep the fuel in combuſtion paſſes over the ſurface of the liquor, all pernicious vapour is carried with it into the fire, where it is decompoſed, or at leaſt ſo changed as to be no longer pernicious.

As the diminution of labour in all operations is much to be wiſhed, I think it neceſſary to add, that by this contrivance one man can do more work than three can in the uſual method; the fire-place being ſo contrived, that as much fuel may be put on at one time as will ſerve twelve, or even twenty-four, hours; and the ſame may be ſaid of ſupplying the veſſel with freſh liquor.

DESCRIP-

Description of the Evaporator.

(See Plate IV.)

Fig. 1. View of the whole furnace, or evaporator, complete.

Fig. 2. Longitudinal fection of the boiler, fire-place, &c.

Fig. 3. Tranfverfe fection of the boiler and flues, looking towards the fire-place.

Fig. 4. Plan of Fig. 2, from A to B.

Fig. 5. Plan from C to D.

Fig. 6. Plan from E to F.

Fig. 7. Plan from G to H.

a the opening, or hole, through which the air enters; and, being then admitted through the three holes *b b b*, paffes over the furface of the liquor in the ciftern or boiler *x*; and then paffing again, by fimilar openings *y y*, at the oppofite end of the ciftern, defcends by the vacuity *c*, and, by the holes *d d*, is conveyed, along the paffages *e e*, to the afh-hole, or underfide of the grate, and thus ferves to actuate the fire, bringing with it the fteam arifing from the boiler.

The

The air and ſteam, having thus ſerved the purpoſe of actuating the fire, are, with the ſmoke ariſing from the fuel, conveyed by the back of the furnace *g*, under the boiler along the paſſage *h*; and, riſing through an aperture *i*, under an inclined caſt iron plate *k*, paſſes through two holes *l l*, into the paſſages *m m*, then riſes, by two other holes *n n*, into a vacuity *o*, whence it riſes again by two holes *p p*, enters the flues *q q*, and thence into the chimneys *r r*.

s. The ſtoking-hole of the furnace.

t. The aſh-hole.

v. The opening through which the fuel is put into the furnace.

w. The door, or opening to the ciſtern.

The ſame letters refer to the ſame parts, in all the figures.

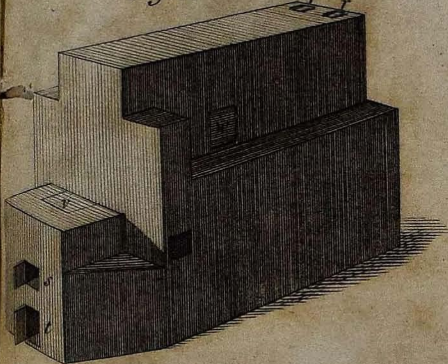


Fig. 1.

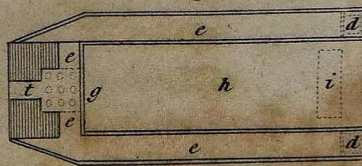


Fig. 4.

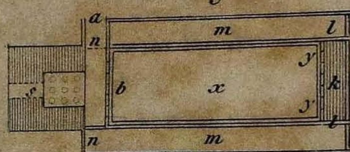


Fig. 5.

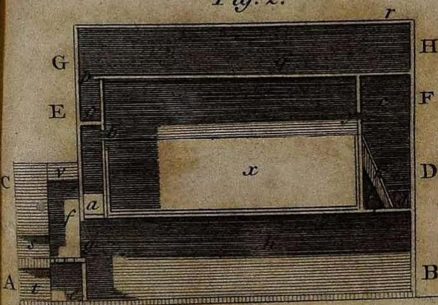


Fig. 2.

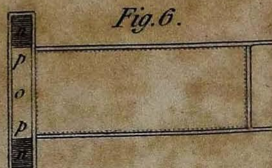


Fig. 6.

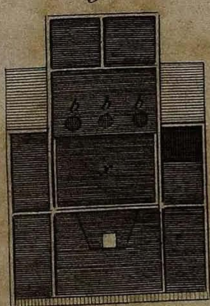


Fig. 3.

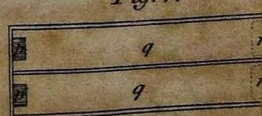


Fig. 7.

IX. Conſiderations relative to the Nature of Wool, Silk, and Cotton, as Objects of the Art of Dying; on the various Preparations, and Mordants, requiſite for theſe different Subſtances; and on the Nature and Properties of Colouring-Matter. Together with ſome Obſervations on the Theory of Dying in general, and particularly the Turkey Red; by Mr. Thomas Henry, F. R. S. and of the American Philoſophical Society.

From the Memoirs of the Literary and Philosophical Society of Manchester.

PART I.

In the following memoir, on a ſubject to which too little attention has been directed by Engliſh writers, my principal attention is to preſent, at one

one view, the preparatory and other proceffes for the dying of wool, filk, and cotton; and to endeavour to deduce a theory better fuited to account for the refults than has hitherto been advanced. In the execution of this undertaking it will be neceffary to repeat feveral things from Hellot, Macquer, and d'Apligny, who have written feveral treatifes on the dying of thefe materials; and I am to confefs great obligations to that very celebrated chemift M. Berthollet, whofe refearches are, every day, affording new and important information in the feveral departments of the hermetic art.

The art of dying, or of imparting to different materials, employed for the fabrication of garments and furniture, thofe beautiful colours which are afforded by many articles of the vegetable, animal, and mineral, kingdoms, appears to have been of high antiquity *. As moft of thefe materials are, of themfelves, either of dark and difagreeable colours, or elfe devoid of all colour, it is probable, that, even in the very earlieft ages,

* Delaval on light and colours.

the love of ornament, which is natural to mankind, would induce them to ftain their veftments with various colouring-ingredients, efpecially with vegetable juices. But the art of imparting *permanent* dyes to colours, and affixing to its fibres fuch colouring-materials as could not eafily be wafhed out by water, or obliterated, or greatly changed, by the action of the air, or of certain faline fubftances, to which they are liable to be expofed, and which are neceffary to render them clean, when foiled; this was an art which required the knowledge of principles not within the reach of untutored men, and only to be obtained by gradual inveftigation, and in long procefs of time.

It has been proved by our ingenious affociate Mr. Delaval, that the Egyptians were poffeffed of the art of dying, and even of that of printing on cloths. In a paffage which he has quoted from Pliny, that author relates, that the Egyptians having befmeared, or drawn on, white cloth, with various fubftances, which were in themfelves colourlefs, but capable of abforbing colouring-matter, threw it into a caldron of hot liquor, tinged with dying materials, and that, though the parts, thus drawn upon, were not diſtinguiſhable before the cloth was immerſed in the colouring-liquor, and though this liquor contained only one colour, it was ſurpriſing to ſee the cloth taken out ſtained with ſeveral different colours, according as the different parts of it had been impregnated with the various ſubſtances capable of receiving and altering the nature of the pigment.

This is ſo plain a deſcription of the art of what is now called callico-printing, that though it is my intention to refer thoſe gentlemen, who wiſh to be more intimately acquainted with the ancient hiſtory of dying, to that written by Mr. Delaval, and prefixed to this ingenious treatiſe on light and colours, yet I could not refrain from relating it on this occaſion.

Permit me alſo to mention another hiſtorical fact, from the ancient hiſtory of this art. The Phœnicians held a decided pre-eminence in the tinctorian art for many ages; their purple and ſcarlet cloths were ſought after by every civilized nation, and the city of Tyre, enriched by its commerce, increaſed to an amazing extent. But her career was ſtopped by the vanity and folly of the eaſtern emperors, under whoſe dominion this opulent city had unfortunately fallen. Deſirous of monopolizing the wearing of the beautiful cloths of Tyre, theſe misjudging tyrants iſſued moſt ſevere edicts, prohibiting any one from appearing in the Tyrian blue, purple, or ſcarlet, except themſelves, and their great officers of ſtate. The enacting and enforcing of ſumptuary laws require great judgement and delicacy, and much caution ſhould be uſed, leſt, in curbing exceſſive luxury, the arts, which are ſupported by its moderate indulgence, ſhould be deſtroyed: ſuch, however, was the fate of the Tyrian dyes. Under the impolitic reſtraint impoſed on the conſumption of the Phœnician cloths, the manufacturers and dyers were no longer able to carry on their trade; it grew languid, ſickened, and expired, and, with the trade, the art likewiſe periſhed.

This example, of the interference of government ſo materially injuring, and even annihilating, an uſeful art, and the commerce depending on it, though carried to an exceſs never likely to be

imitated

imitated in theſe days, ſhould make miniſters cautious that they do not form laws which may diſcourage or fetter our manufactures, for, freedom is the very ſoul of trade, and, in proportion as the one is invaded, the other will certainly decline.

In this nation, the art of dying had made no conſiderable progreſs till about the beginning of the laſt century *; before that period our cloths were ſent to Holland to be dreſſed and dyed. Probably, however, this was practiſed only in the caſe of particular colours; for, it appears that the dyers of London received their charter of incorporation from Henry the Sixth. My friend Mr. Charles Taylor has put into my hands a ſmall tract, entituled, *A profitable Book, declaring Divers approved Remedies to take out Spots and Staines, in Silkes, Velvets, Linen, and Woollen Clothes; with divers Colours how to dye Velvets and Silkes, Linen and Woollen, Fuſtian and Threade. Alſo to dreſs Leather, and to colour Felles, &c. &c. very neceſſarie for all men, eſpecially for thoſe who hath or*

* Chambers's Cyclopædia, article Dying.

ſhall

ſhall have any Doings therein; with a perfect Table thereto, to find all Things ready, not the like reveled in England heretofore. Taken out of Dutche and Engliſhed by L. M. imprinted at London, by Thomas Parfoot, dwelling in the New Rents, 1596.

This little book, publiſhed at ſo early a period, contains many good porceſſes, and it is to be lamented that, during ſo long a lapſe of time, the Engliſh nation has not produced any work on this ſubject, that I know of, much ſuperior to it. The mode of computing the length of time, employed in many of the proceſſes contained in this publication, is curious. The immerſion of the ſubject in the dying liquor is, in general, ordered to be continued, not for ſo many minutes, but for five, ſix, or ſeven, *pater-noſters* long.

The dying of woollen and ſilken goods has long ſince attained a conſiderable degree of excellence, while the manufactures of cotton, owing to the ſmall attraction of that ſubſtance for colouring matter, have been very deficient in this point. Till within theſe few years, the colours employed in the dying of fuſtians and cotton velvets were few; and, even at this day, many of them are fugitive.

fugitive. But it muſt be allowed that great improvements have been made within theſe few years; improvements principally owing to the ingenuity and public ſpirit of Mr. Wilſon, of this ſociety, who, by the application of chemical principles, and by a diligent inveſtigation of the nature of colouring-ſubſtances, laid the foundation on which the preſent fabric is erected.

Much room is, however, ſtill left for the improvement of the art; and I am convinced that it is only by our practical dyers acquiring chemical knowledge, that it can ever be effected to any great extent. While men do not underſtand the grounds on which they ſhould proceed, many errors muſt ariſe; many needleſs materials muſt be employed; and much expence, which might be ſpared, muſt be incurred. To promote this deſirable end, I ſhall, with the permiſſion of this ſociety, lay before them, not only ſuch information as I have extracted from the beſt writers on the ſubject, but ſuch facts as I have been able to collect, and obſervations which I have had opportunities of making, tending to form a juſt

theory

theory of dying, and eſpecially of thoſe proceſſes where mordants are employed.

The variety, which obtains in the facility with which animal and vegetable ſubſtances attract colouring matter, is a curious ſubject for inveſtigation. It is known that ſome colouring-ingredients, which are moſt readily imbibed, and tenaciouſly held, by wool, have much leſs effect on ſilk, and are either wholly rejected, or very ſlightly attached to cotton or linen: different preparations and mordants, applied under different circumſtances, are requiſite for theſe ſeveral materials. M. du Fay's experiment, which he made before the Royal Academy of Sciences, has been ſo often related, that I ſhall not quote the particulars. Let us rather refer to the theories which have been advanced to account for theſe phenomena; enquire how far they appear to be founded on truth; and give the chemical analyſis of the various ſubſtances, which may perhaps ſerve to throw ſome new light on the ſubject.

Theſe phenomena have been variouſly explained: ſome have attributed the variety, in the power of the ſeveral ſubſtances to retain the dying-ingredients applied to them, to the different ſtructure of their filaments; to the poroſity of wool, and to the impenetrability of cotton and linen *; at leaſt to the latter poſſeſſing pores of much inferior dimenſions; ſilk being ſuppoſed to hold a middle rank. Wool, ſay theſe theoriſts, is compoſed of numerous filaments, ſimilar to hairs, and, like them, conſiſting of tubes containing a medullary or oily matter. The ſides of theſe tubes are alſo perforated with an infinite number of ſmall orifices, communicating with the longitudinal canal. From this mechaniſm, it is excellently adapted for receiving extraneous bodies, which are not only capable of being applied to the ſuperficial pores of the filaments, but even of penetrating into the interior ſtructure of the tubes, when diveſted of the *medulla* they naturally contain.

Silk is deſcribed, by theſe writers, as a glutinous liquor, formed in, and excreted from, the body of the ſilk-worm; who ſpins it into a kind of thread, which hardens on expoſure to the air.

* D'Apligny; Art de la Teinture des fils, & étoffes de cotton.

An

An operation which is facilitated by another ſubſtance, analogous to wax, which the worm alſo ſecretes, and with which the ſurface of the filament is varniſhed. This thread being formed by a continued ſeries of the dried glutinous particles, in the act of dying many pores muſt be formed on its ſurface. But theſe pores are ſuperficial; and the thread, not containing a longitudinal canal, is therefore incapable of admitting any but minutely-divided particles, and thoſe in very limited quantities; and, as theſe particles cannot penetrate deeply into the ſubſtance of the ſilk, they require, for their confinement, ſome addition which ſhall more ſtrongly agglutinate them than is neceſſary in the dying of wool. Hence the difficulty of attaching permanent colours to ſilk; and hence the greater waſte of the dying-materials; for, as only the fineſt particles can be admitted into the pores, the remainder is loſt.

Cotton is repreſented as a filamentous ſubſtance, enveloping the ſeed of the cotton-plant. The filaments are ſaid to be tabular, and, like wool, to have exterior lateral pores, communicating with the longitudinal tubes. Theſe are much ſmaller than thoſe of wool, and are filled with an unctuous matter, of which they muſt be deprived before they can be penetrated by the particles of the dying-materials. This matter is difficult of ſolution, and hence, and from the minuteneſs of the tubes, ariſes the labour requiſite to complete the dying of cotton. That it really contains this unctuous ſubſtance is evident, they add, from the ſlow manner in which cotton imbibes water previous to its being prepared or ſcoured, and from its increaſed power of abſorption ſubſequent to that operation; by which alſo, though opaque before, it is rendered clear and tranſparent.

Linen, in the ſtate of flax, is probably alſo porous; but its pores being ſmaller than thoſe of the other ſubſtances, and being of a more compact texture, they admit with more difficulty the tinging particles, eſpecially thoſe of the good dye. The particles of the falſe dye, however, find pretty eaſy admittance. But, when the flax is ſpun, a number of accidental pores are formed in the thread, into which the particles of the greater or true dye may enter, and be better retained than in the flax; and for this reaſon the

twiſted

twisted thread takes a better colour than either the flax, or *single* thread.

If we allow the authenticity of the above facts, they will certainly account, in a satisfactory manner, for the different effects produced, by the same tinging-materials, on subjects composed of wool, to those produced on silk, cotton, or linen. If they be all porous, and the dimensions of the pores of each be different, the substance which has the largest pores will be capable of receiving a much greater portion of tinging-matter than that which has the smallest. It may seem some confirmation of this theory that cloths, woven in various modes, are said to receive colour more or less freely, according to their texture. But perhaps the various shades, observable in these cases, may proceed from some circumstances in the reflection and transmission of the rays of light, arising from the alteration in the position of the reflecting and transmitting bodies.

To this theory it has been objected, and with much appearance of reason *, that the colouring-

* Macquer, Dictionnaire de Chymie, edit. 2. vol. IV.

matter

matter is not merely inſinuated into the pores of the ſubſtances to be dyed, but becomes firmly attached to it; and that, the more numerous and large the pores are, the more of the colouring-matter ſhould be abſorbed, and, as it were, hidden within them; whereas wool, which is ſuppoſed to contain pores more numerous and large than thoſe of ſilk, receives an equally brilliant crimſon from two parts of cochineal as is produced by five parts on ſilk; both ſubjects being prepared in the ſame manner, by aluming. And this, not becauſe the ſilk rejects any of the colouring-particles of the cochineal; for, the liquor is equally exhauſted of colour in one caſe as in the other; but it ſhould ſeem that ſilk can abſorb much more colouring-matter, and yet is much leſs eaſily dyed, than wool. It is, therefore, more probable that dying is a mere application of colouring matter to the fibres of the materials to be dyed, aided by a chemical attraction between theſe ſubſtances; and that the entrance of the colour into the pores of the cloth, &c. is an ill-founded hypotheſis.

But

But is it not probable, admitting that a different mechanifm may exift in the ftructure of thefe fubftances, that there may be alfo a difference in the nature of their conftituent or proximate principles? which may vary the force of their attraction for the tinging-matter, or for thofe fubftances which are ufed as bafes for that matter to adhere to, into the nature of which we fhall hereafter examine. Neuman analyzed, by fire, wool, filk, and cotton, and he found them to confift of proximate principles differing in each from thofe of the others *.

From one pound, avoirdupois, of wool, he obtained by diftillation one ounce fix drachms of volatile alkaline falt, feven ounces of urinous fpirit, and two ounces and a half of empyreumatic oil; the *caput mortuum* weighed three ounces fix drachms, of which two drachms were diffipated by calcination.

Silk yielded, from a fimilar weight, nine ounces of mixed matter, confifting of four ounces two drachms of urinous fpirit, three ounces fix

* Neuman's Chemiftry by Lewis, vol. II.

drachms

drachms of volatile ſalt, and one ounce of empyreumatic oil. The reſiduum weighed ſeven ounces, loſt one ounce on calcination, and then afforded to water forty grains of fixed ſaline matter.

Cotton did not yield the ſame fœtid ſmell as wool when burned in the open air, nor any urinous ſalt or ſpirit in cloſe veſſels. A pound, avoirdupois, of cotton gave over, on diſtillation, ſeven ounces of an acidulous, fuliginous, oily ſpirit, and about ten drachms of an empyreumatic oil; the remaining coal was reduced, by calcination in a crucible, to eight ſcruples of white aſhes, which afforded a ſmall portion of fixed alkali. Monſieur Berthollet, a very ingenious French chemiſt, has lately analyzed theſe ſubſtances in a different manner *.

On diſtilling ſilk with nitrous acid, he obtained ſaccharine acid, and a greaſy matter, which, though it at firſt congealed on the ſurface of the liquor in the receiver, was afterwards diſſolved in it, by means of heat, even though diluted with

* Journal de Phyſique, vol. XXIX. Part II.

water,

water, with which it paſſed through the filter. Wool alſo afforded the ſame greaſy matter, and acid of ſugar; the latter in much larger portion than any other ſubſtance which he treated in the ſame manner. But the oil of vegetable ſubſtances was entirely deſtroyed by this treatment, no greaſy matter being produced; on analyzing cotton, he procured ſaccharine acid, but no other product, and the quantity of that acid was far inferior to that yielded by animal ſubſtances *.

* M. Berthollet found the portion of ſaccharine acid, yielded by cotton, to be very ſmall indeed; nor did he find any other reſiduum in the retort, or any thing but the pure nitrous acid in the receiver. Almoſt the whole, therefore, of this vegetable matter ſeems to have been changed from a ſolid to an aërial form, and to have been diſſipated as gas; a ſtate to which the ſaccharine acid is alſo eaſily reducible. Thus, ſays he, probably are the moſt ſolid bodies convertible into elaſtic vapours; as, on the other hand, the moſt compact ſubſtances in nature may be formed by the union of different gaſes.

The ſaccharine acid was firſt diſcovered by Bergman in ſugar, but is obtainable from many other ſubſtances, both animal and vegetable, which contain its baſis, particularly from galls, which yield it in great abundance.

It ſhould appear then, that there is a conſiderable difference between the conſtituent parts of animal and vegetable ſubſtances. Animal ſubſtances contain much more oil than vegetable ones; and this oil is ſoluble in water, which the vegetable oil is not. The animal oil, on diſtillation, yields an alkaline, the vegetable, an acid, liquor. On the different properties of theſe oils, the diſtinction between the nature of animal and vegetable ſubſtances ſeems chiefly to depend. It is to be remarked, (in the analyſis of wool by M. Berthollet,) that though animal ſubſtances yielded much volatile alkali on diſtillation, no nitrous ammoniac was formed in his proceſs, which might have been expected, had the alkali been previouſly contained in the wool. This fact favours the opinion that the volatile alkali is formed during the proceſs of diſtillation. It is at leaſt probable that the alkali is ſo combined in animal bodies, as to require the aid of heat to free it from thoſe ſubſtances which neutralize or conceal it. Or, as we know that there is a ſtrong reſemblance between volatile alkali and the inflammable principle, may we not ſuppoſe that this

principle

principle may be forced, by heat, into combination with the animal acid, and the alkali be thus created *? Vegetables yield but little of this volatile alkali, but much acid liquor.

It may be added, that vegetable ſubſtances, whoſe oil is wholly deſtroyed by nitrous acid, and to whoſe texture the mineral acids in general are highly injurious, bear ſteeping in ſolutions of cauſtic alkali, of ſuch ſtrength as would prove totally deſtructive to wool.

How far theſe varieties, in the component parts of animal and vegetable ſubſtances, may influence their power of attracting colouring matter, I do not pretend to determine; but the propriety of a different previous treatment ſeems clearly deducible from them.

Wool has naturally ſo ſtrong an attraction for colouring matter as to need but little preparation,

* M. Berthollet has ſtill proved the volatile alkali to be formed by the union of inflammable, with phlogiſticated, gas; and that it does not exiſt in animal ſubſtances, previous to their diſtillation or putrefaction. The effects therefore that have been aſcribed to the ſuppoſed volatile alkali of theſe ſubſtances, in the proceſſes of dying, muſt depend on ſome other cauſe.

previous to the more immediate proceſſes of dying; it is only neceſſary to ſcour from it a greaſy or fatty ſubſtance, called the *yolk*, which is contained in the fleece. For this purpoſe an alkaline liquor is neceſſary; but, as alkalies injure the texture of the wool, it is requiſite that a very dilute ſolution be employed; for, were the quantity of ſalt greater than is ſufficient for converting the yolk into a ſoap, it would attack the ſubſtance of the wool. Putrid urine, therefore, is generally uſed, as being cheap, and containing a volatile alkaline ſalt which, uniting with the greaſy matter, renders it ſoluble in water *.

* Hellot, Art de la Teinture des Laines, &c.

TO BE CONTINUED IN OUR NEXT.

X. Memoir on the Purification of corrupted Water.

Read at the ŒCONOMICAL SOCIETY of PETERSBURGH; by Mr. LOWITZ.

WATER is one of thoſe ſubſtances without which mankind cannot exiſt, yet every one knows that it is very apt to become putrid, and to contract, in conſequence of its being ſo, qualities which render its uſe unſafe. This circumſtance is particularly embarraſſing in ſea voyages; and it deſerves no leſs conſideration in thoſe diſtricts where the inhabitants are often obliged to make uſe of ſtagnant water, or of ſuch as, from its hepatic taſte and ſmell, is very diſagreeable. It would be uſeleſs here to enumerate the various diſorders occaſioned by the uſe of ſuch waters; but it is undoubtedly an object of great importance to make known the means by which the putrefaction of water may be prevented, and by which

which that water, wherein putrefaction has already taken place, may be rendered perfectly ſweet.

Having employed myſelf, during the courſe of laſt year, in making a great number of experiments on the purifying powers of charcoal, I ſaw with great ſatisfaction, that it poſſeſſed, among other properties, that of almoſt inſtantly depriving the moſt putrid water of its bad ſmell. From that circumſtance, I immediately conceived an idea that it might have a very powerful effect in preventing water from becoming putrid, and the numerous trials I have ſince made have convinced me that I was not deceived in my opinion.

Pure water, properly ſo called, when deprived of all heterogeneous parts, is not ſubject to become putrid; but it is very difficult to keep it long in a pure ſtate, on account of its diſſolving powers. To preſerve water for a length of time in that ſtate, it would be neceſſary to keep it in veſſels of glaſs, or of earthen ware; but the brittleneſs of theſe veſſels renders it impoſſible to make uſe of very large ones, and we are therefore obliged to have recourſe to wooden veſſels, which, though they are not ſubject to be broken,

like

like the others, have the great disadvantage of imparting to the water a great quantity of mucilaginous and extractive particles, which hasten its putrefaction. It is well known that these particles, in a state of division, furnish an innumerable quantity of living creatures, the almost perpetual and uninterrupted destruction and regeneration of which communicate to water that degree of corruption and putrefaction which renders its use so dangerous; it is not, therefore, from the water itself, but from the continual decomposition of the substances dissolved in it, that its disposition to putrefaction arises.

From what has been said it evidently appears, that the first means of preserving from putrefaction water which we are obliged to keep in wooden vessels, or casks, consists in having these reservoirs perfectly clean. The smallest quantity of matter already corrupted being left in them acts as a real ferment, and very quickly disposes the fresh water, with which these vessels are filled, to become putrid in the same manner. For this reason I advise, that the casks, or other vessels, be well washed with hot water and sand,

or

or with any other ſubſtance capable of removing the mucilaginous particles; and afterwards, that a certain quantity of powder of charcoal be employed, which will entirely deprive ſuch caſks, &c. of the muſty or putrid ſmell they may have contracted.

When water is preſerved by having certain ſubſtances mixt with it, theſe ſubſtances act, either by their antiputreſcent powers, or by mechanically abſorbing the putrified particles. Vitriolic acid poſſeſſes the firſt of theſe properties, and powder of charcoal fulfils the ſecond intention, in a very ſtriking manner.

To ſatisfy myſelf that charcoal, when uſed alone, poſſeſſes the property of preſerving water from corruption, I undertook, in the ſummer of the year 1790, a courſe of experiments which completely fulfilled my hopes; but, at the ſame time, I was convinced that the effect of the charcoal is rendered much more ſpeedy by uſing, along with it, ſome vitriolic acid.

The following, according to the reſult of my experiments, is the beſt proportion of charcoal powder, and vitriolic acid: viz. one ounce and a

half

half of charcoal in powder, and twenty-four drops of concentrated vitriolic acid, (oil of vitriol,) are ſufficient to prove three pints and a half * of corrupted water, and do not communicate to it any ſenſible acidity. This ſmall quantity of vitriolic acid renders it unneceſſary to uſe more than one third part, at moſt, of the charcoal-powder which would be wanted if the acid were not made uſe of; and, the leſs of that powder is employed, the leſs is the quantity of water loſt by the operation, which, in ſea-voyages, is an object worthy of conſideration. In proportion to the quantity of acid made uſe of, the quantity of charcoal may be diminiſhed or augmented; and it muſt be obſerved, that all acids produce nearly the ſame effects. Neutral ſalts alſo, particularly nitre and ſea-ſalt, may be uſed for the purpoſe in queſtion, but vitriolic acid certainly is preferable to any of theſe; water which is purified by means of this acid and charcoal will keep a longer time than that which is purified by charcoal alone.

* The *ſtoff*, which is the meaſure made uſe of by Mr. Lowitz, is equal to about three pints and a half.

The cleanneſs of the caſks in which water is kept, in ſea-voyages, is an object which ſhould never be neglected: I have already deſcribed the beſt method of cleaning them, and of depriving them of any bad ſmell; and it would not be amiſs if that operation were repeated every time they are about to be filled with freſh water. I would adviſe that ſix or eight pounds of powdered charcoal be uſed to each caſk, (it is better to put too much than too little of this powder,) and as much vitriolic acid as is ſufficient to communicate to the water a degree of acidity hardly to be perceived. To hinder the charcoal from ſettling at the bottom of the caſk, in the form of a paſte, it will be proper to ſtir the whole together with a ſtick, at leaſt twice every week; by this means the charcoal will be better diſperſed through the whole maſs of water, and conſequently will perform its office more completely.

Powder of charcoal and vitriolic acid are two antiputreſcent ſubſtances; the firſt prevents the water from acquiring that yellow colour which it uſually contracts by time, and the acid particularly contributes to clarify the water, which the powder

powder of charcoal, when employed alone, generally renders turbid. If we wiſh to make uſe of the water ſo preſerved, we ſhould try it firſt, by paſſing a ſmall quantity of it through a ſtrainer, in the form of a jelly-bag, filled with powder of charcoal; ſuch a ſtrainer or bag ſhould always be in readineſs, to be made uſe of for ſuch trials.

When we mean to purify any given quantity of corrupted water, we ſhould begin by adding to it as much powder of charcoal as is neceſſary to deprive it entirely of its bad ſmell. To aſcertain whether that quantity of powdered charcoal was ſufficient to effect the clarification of the ſaid water, a ſmall quantity of it may be paſſed through a linen bag, two or three inches long; if the water, thus filtered, ſtill has a turbid appearance, a ſmall quantity of powdered charcoal muſt be added, till it has become perfectly clear: the whole of the water may then be paſſed through a filtering bag, the ſize of which ſhould be proportioned to the quantity of water.

If vitriolic acid, or any other, can be procured, a ſmall quantity of it ſhould be added to the water, before the charcoal powder is uſed; the quantity of acid muſt be regulated according to the ſtate of putridity in which the water is; it ſhould be ſufficient to communicate to the water a degree of acidity juſt perceptible to the taſte. If the water is intended merely for dreſſing meat and vegetables for the ſhip's crew, inſtead of the acid, ſuch a quantity of ſea-ſalt as would have been proper for ſeaſoning the above articles may be employed. Saline ſubſtances, like acids, haſten the effects of the charcoal-powder; by making uſe of acids, (as was before obſerved,) a much leſs quantity of powdered charcoal is neceſſary; and, ſo eaſy is the proceſs to any one a little accuſtomed to operations of this kind, that four or five minutes only are required to render ſeveral gallons of very putrid water fit to drink.

To improve the taſte of theſe ſpring-waters which have naturally an hepatic flavour, and are therefore unpleaſant to make uſe of, nothing more is neceſſary than to filter them through a bag half-filled with powder of charcoal: if ſuch waters are not very much loaded with mucilaginous particles, the addition of an acid is not neceſſary. With reſpect to the beſt method of preparing

paring the powder of charcoal, what I have faid on the fubject in Crell's Annals for the year 1788, pages 36 and 131, of the fecond volume, and in the firft volume for the year 1791, pages 308. 398. and 494, may be confulted.

Powder of charcoal, when prepared according to the method as defcribed above, is a very light fubftance, a circumftance which may perhaps appear embarraffing, on account of the room it will take up in a fhip, fuppofing the quantity of it to be in proportion to the quantity of water taken on board. The following is the refult of my experiments refpecting the fpace required for ftowing the charcoal.

Firft, four ounces and a half of powdered charcoal, a quantity which is fufficient to purify three pints and a half of water, when no acid is made ufe of, take up as much fpace as fixteen ounces of water; but, if this powder is ftrongly compreffed, it will take up only the fpace of nine ounces of water; confequently two cafks of powdered charcoal would be required to purify eleven cafks of water.

Secondly,

Secondly, one ounce and a half of powdered charcoal is ſufficient to purify three pints and a half of water, provided a ſmall quantity of vitriolic acid, or ſea-ſalt, is at the ſame time made uſe of; one caſk of powdered charcoal, therefore, if tightly packed, is ſufficient for ſeventeen caſks of water.

In the laſt experiments I made on this ſubject, I found that ſix drachms of powdered charcoal were ſufficient to deprive three pints of water of its bad ſmell, and to render it perfectly clear, provided, at the ſame time, twenty-four drops of vitriolic acid were added; in this way, therefore, one caſk of powdered charcoal would be ſufficient to purify thirty-four caſks of corrupted water. Theſe experiments, however, muſt be conſidered as liable to ſome variation; for, in order to obtain effects equal to thoſe I have related, the charcoal powder muſt be prepared with the greateſt care; it muſt alſo be obſerved, that, though the above ſmall quantity was found ſufficient to deprive the water entirely of its bad ſmell, and to render it very clear, a large quantity

quantity will be required to deprive it of its bad taſte.

In order to ſave the charcoal-powder on-board a ſhip, as that is an article not eaſily procured at ſea, I adviſe, that the powder ſhould not be thrown away after it has been once uſed; for, if it is afterwards well dried, and again beat to powder, it will by that means acquire new ſurfaces, and will ſerve, a ſecond time, to purify a quantity of water almoſt as great as that for which it was uſed the firſt time. Nay, charcoal-powder which has been ſeveral times made uſe of, and has in conſequence thereof entirely loſt its purifying power, will immediately recover it by being made red-hot in a cloſe veſſel; this operation is certainly a troubleſome one on-board a ſhip, but it may, perhaps, in ſome circumſtances, be rendered more eaſy. As on-board all ſhips there is a fire every day, œconomy requires that we ſhould ſave the charcoal of the wood which has been uſed; and, inſtead of letting it burn to aſhes, it ſhould be extinguiſhed by water, or by any other means, and kept to be made uſe of when wanted.

The

The cinders of pitcoal, provided they are perfectly burnt, and reduced to powder, may ferve, in cafe of neceffity, for the purification of water; but, when this kind of coal is made ufe of, no acid of any kind muft be added to the water, as the metallic particles which pitcoal contains, even after it is thoroughly burnt, might, if acids were employed, communicate dangerous qualities to the water.

It is proper to obferve here, that charcoal takes from the water a part of the acid which has been made ufe of; if two drops of oil of vitriol are put into four ounces of water, the water will become fenfibly acid, but this acidity will immediately difappear, if a fmall quantity of powdered charcoal be added to the water.

Printed by JOHN NICHOLS, *Red Lion Paffage, Fleet Street, London.*

REPERTORY OF ARTS AND MANUFACTURES.

NUMBER VIII.

Printed by NICHOLS and SON, Red-Lion-Paſſage, Fleet-Street, London.

XI. Specification of the Patent granted to Mr. JOSEPH BRAMAH, of Piccadilly, in the County of Middleſex, and Mr. THOMAS DICKINSON, of Bedworth Cloſe, in the County of Warwick; for their new improved Engine, or Machine, on a rotative Principle.

WITH THREE PLATES.

Dated Jan. 15, 1790.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, and in purſuance of the ſaid ſtatute, we the ſaid Joſeph Bramah and Thomas Dickinſon do hereby declare, that our ſaid invention is compoſed and made in manner following; that is to ſay, this invention having unergone a very copious deſcription in a former patent, and being a machine calculated for a great variety of applications, which may from time to time render ſundry non-eſſential variations in its conſtruction neceſſary, we think it uſeleſs to repeat a formal exemplification in words, which would tend only to perplex rather than inform. The merits of this machine depends on its having two wheels, or cylinders made of braſs, or any other kind of metal or material proper for the purpoſe; one of theſe wheels or cylinders is of a greater, and the other of a leſs, diameter, in any required proportion; their lengths muſt be always nearly equal, but are ſubject to any increaſe or decreaſe, in conformity to the purpoſe to which the machine is applied. The larger of theſe wheels or cylinders being fixed, the ſmalleſt one is placed within the larger, and is fixed on an axis or pivot, in ſuch a manner as to be capable of turning in a rotative or circulating direction round its centre:

centre: the ſaid ſmaller wheel or cylinder being thus ſtationed, it may occaſionally be fixed, and the outer or larger wheel or cylinder may be turned in the above direction round the ſmaller one; however, the former of theſe has in all caſes the preference. There is, at each end of the larger wheel or cylinder, a flanch to which are ſcrewed two plates or caps, which incloſe the ends thereof, and into which the ends of the ſmaller or inner wheel or cylinder may be a little inſerted, in order to render the junction nearly or water-tight: through one or both of theſe plates or caps the axis or pivot of the inner wheel or cylider paſſes, in order that motion may be communicated thereto from without: or the ſaid inner wheel or cylinder being moved on its axis or pivot, by ſome power or force acting upon it from within, the ſaid axis or pivot may be applied ſo as, by its external end or ends, to give motion to any other engine or machine thereunto applied. This being done, the effects of this engine or machine are produced as follows: the difference in the two diameters of theſe ſaid wheels or cylinders cauſes a circular channel or groove to be formed, between the extreme ſpherical ſurface of the inner or leſs wheel or cylinder and the inner ſurface of the larger one. In the ſaid channel or circular groove are performed all the operative effects of the machine, and that by means of two or more ſliders, which may be ſtationed either in the inner wheel or cylinder, or in the periphery of the outer one, in ſuch a manner as, by the motion of the machine, the ſaid ſliders are ſucceſſively moved or projected into the channel or groove, ſo as to fit nearly or water-proof, in order to act therein as a piſton or fan; either to ſweep and empty the ſaid channel or groove of all its contents, when turned round, or, when a current of water, ſteam, or other fluid having force, is admitted into the ſaid channel or groove, and paſſes through, it may, by acting on the projected part of the ſaid ſliders, cauſe the inner wheel or cylinder to be turned round its centre or axis, with a power equal to the cauſe of *primum mobile*, i. e. the ſpecifick gravity, or the elaſtic force of the fluid. The figures or drawings, hereunto annexed, will more fully ſhew the true

natur

nature of this our ſaid improved invention. In witneſs whereof, &c.

Fig. 1. and 2 (Plate V.) repreſent the plan and ſection of a machine, conſtructed in the moſt ſimple manner the principle is capable of. AA, and BB, ſhew the ends of two ſhort cylinders or rings of different diameters, one placed in the centre of the other. C. is the channel or circular groove, formed between the two circles. The ends of the cylinder or rings BB are ſhut up by two flat plates DD, as in the ſection; to theſe plates is joined an axis or ſpindle EE, which axis or ſpindle paſſes through the ends or caps FF, which incloſe the ends of the cylinder or ring AA, and which is made air-tight by means of a ſtuffing box, in the uſual way. By this axis or ſpindle the cylinder or ring BB may be turned round from without, any external power being applied for that purpoſe; or this axis or ſpindle may be applied to give motion to any other machine, when the cylinder BB is turned round by any power or force acting on it within. In the cylinder or ring BB are fixed two ſliders GG, croſſing each other at right angles in the centre, where they are notched, or half-ſpliced, ſo far as

to

to allow them to ſlide backwards and forwards as much, at leaſt, at the diameter of the channel or groove C. The length of each of theſe ſliders is equal to the diameter of the cylinder or ring BB and one diameter of the channel or groove C, and their width is equal to the height of the channel or groove C: ſo that the points which perforate the extremity of the cylinder or ring BB, when they are puſhed out into the channel or groove, may entirely fill the ſame, ſimilar to a piſton working in a common cylinder; in order that, when the cyilinder BB is turned round, the channel or groove may be, by that part of the ſlider, totally ſwept or emptied. In this channel or groove is fixed the partition H, which fills the ſame in that part, and, by its being fitted againſt the periphery of the wheel BB, prevents the paſſage of any fluid that way round the channel, when the caps or ends are ſcrewed down. On each ſide the partition H is fixed a rib I I, or piece of ſuch ſhape as to perfectly fit the circle BB one quarter of its circumference, between the dotted lines 1, 2; and the remaining part is continued in a ſhape inclining to the circle of the greater

greater cylinder AA. with which it forms an eaſy juncture at the other quartile points 3, 4. When the cylinders B B, with the ſliders, are turned round in either direction, the inclined parts of the ribs I I force the oppoſite end of the ſliders G G ſucceſſively into the channel or groove, where they are obliged to remain during one quarter of the revolution, being kept in that poſition by the circular part of the rib between 1 and 2. K M are two pipes of any required diameter, which may be inſerted into the channel or groove, in any direction the ſituation of the machine may require, between the points H 3 and H 4. The ſliders are rendered ſufficiently tight, at their junction with the channel, by means of oakum, or any other flexible material, being forced into the cavities made for that purpoſe, at the bars LLL; and alſo the partition H in the ſame way. The cylinder or ring BB being thus armed with the ſliders, and the caps or ends FF ſcrewed on by the flanches at A A, the machine is complete, and ready for action. Now, ſuppoſing that through the pipe K a ſhaft of water, ſteam, or any other fluid, from any conſiderable

derable height, is admitted into the channel or groove C, it would immediately force againſt the ſlider projected in the channel as at N, and alſo againſt the fixed partition H; which partition preventing its paſſing that way to the evacuation-pipe M, the whole weight or force of the fluid in like manner reſting on the ſlider at N, would cauſe the cylinder BB to be forced round, from 3 towards 4, with power equal to the preſſure of the ſaid column or ſhaft of water, or any other fluid, in proportion to its altitude; and by the time the ſlider at N has reached the end of the pipe M, where the ſpent water is diſcharged, the next ſlider in ſucceſſion has paſſed or covered the junction of the aſcending pipe K, ſo that each ſucceſſive ſlider receives the preſſure before it has done acting on the former; by this means an uniform rotation is maintained in the cylinder BB, and its velocity will be equal to the deſcent of the water in the pipe K, and its force equal to the ſpecific gravity of the ſame. Thus this machine may be worked by ſteam, condenſed air, wind, or any other elaſtic or gravitating fluid, for the purpoſe of working mills, or any other kind

of

of machine or engine whatſoever, they being properly connected with the axis or ſpindle EE; and when any power is externally applied to the ſaid axis, which may turn the machine in any direction, it becomes a complete pump, poſſeſſing all the properties of every other ſort of hydraulic engine whatſoever, by applying the pipes K and M accordingly; and it has alſo much advantage over every other kind of pump, as the fluid pumped is kept in conſtant motion, both in the ſuction and aſcending pipes. This machine may be fixed either in a hozizontal or vertical direction.

Fig. 3, 4, 5 and 6, (Plate V.) repreſent the parts of the machine in perſpective.

Fig. 7 (Plate VI.) and 8 (Plate VII.) repreſent a ſection and plan of another method of conſtructing the rotative engine, where the ſliders are ſtationed in the periphery of the outer cylinder, and the water, ſteam, or other fluid, paſſes firſt into the ſmaller or inner cylinder, previous to its producing its effect in the channel or groove as in the other example. A is the end of a hollow ſmaller cylinder, placed in the centre of the larger cylinder B; the cylinder A is fixed on its axis or ſpindle C, as in the ſection. DD is the channel or groove, formed between the outer ſurface of the cylinder A and the inner ſurface of the cylinder B; to the cylinder A is fixed a wing or fan E of a projection ſufficient to fill and act in the channel DD as a piſton, when A is turned round by the axis or ſpindle C, ſo as to ſweep the contents of the channel; or, when any force is applied on one ſide of its ſurface, it will cauſe the cylinder A, and the axis or ſpindle C, to be turned round. The cylinder A is left open at both its ends, which paſs through the plates FF into the caps or domical hoods GG, and is fitted water-tight in the junctions. In or about the middle of the cylinder A is a chamber of partition, which divides the upper end from the lower; in the upper end or cavity is cut an aperture, communicating with the channel D, cloſe to the ſide of the wing or fan E; there is likewiſe another aperture cut between the lower cavity of the cylinder A and the channel D, on the contrary ſide of the wing or fan E. HH are two ſliders ſtationed at oppoſite points in the periphery of the outer cylinder B, where there are cells projected, as at II, to to receive them, and allow their motion. Thefe fliders flide with their ends in grooves made in the plates FF, fhewn by the dotted lines in the fec-tion at FF. Motion is communicated to the fli-ders HH by the fmall fpindles KK, paffing through ftuffing-boxes in the ufual way. Thefe fliders are alternately opened and fhut by half the rotation of the inner cylinder, by means of a wheel, with an excentric groove, fixed on the axis or fpindle CC, as at LL in wheel M. (See fection and dotted lines in plan.) In the excentric groove LL move two friction-wheels, which being join-ed to the fliders and arms NN, the fliders HH are opened and fhut by the motion of the axis C turning round, fo that one of the fliders HH are opened and fhut againft the cylinder A, whilft the other is opening to let the wing or fan pafs, which is again fhut before the paffive flider begins its motion. The machine being thus complete, fuppofe that at the pipe O a current of water, fteam, or other fluid having force, was admitted into the cap or hood G, whilft the machine is in the pofition as in the plan, it would immediately

 fall

fall into the upper cavity of the cylinder A, and, paſſing through the aperture into the channel D, would preſs againſt the wing or fan E, on the one ſide, and againſt one of the ſliders H H, on the other; which ſlider, not giving way, would cauſe the wing or fan E to recede, and turn round the cylinder A, with its axis C; which axis, turning the wheel M with the groove LL, would cauſe the oppoſite ſlider to begin its motion; ſo that by the time the wing or fan E reaches the ſtation of the ſlider it is totally drawn back into its cell, ſo as to permit the wing or fan E to paſs without interruption; and by the continued motion of the machine, the ſlider is again ſhut, before that ſlider on which the fluid is preſſing begins to move; ſo that when the firſt ſlider, againſt which the water or other fluid is ſtill preſſing, is opened, the preſſure is then the ſame between the other ſlider and the wing or fan E; and the ſpent water, contained between the two ſliders, immediately ruſhes through the lower aperture into the bottom cavity of the cylinder A, and into the cap or lower hood G, and is carried

off

off by the pipe Q; which pipe Q, being continued down the diftance of 32 feet, would caufe, by the preffure of the atmofphere on the water in the pipe O, a force on the wing or fan E, equal to the fame altitude added to the pipe O, provided O is always kept full from the fountain-head: thus an uniform rotation will be maintained, as in the former example. This machine has alfo, in like manner, all the known properties of a pump, when a power is applied to the axis C.

Fig. 9, 10, 11, 12 (Plate VI.) and 13, 14, 15, (Plate VII.) reprefent the parts of the latter machine in perfpective.

Fig. 16 reprefents another method of conftruction, which, in fome cafes, will have the preference to the two already defcribed. A is a fmaller wheel or cylinder, armed with crofs fliders, as in Fig. 1, fixed in the larger one B, but, inftead of its axis being ftationed in the centre of B, as in Fig. 1, it is moved as much excentric as to caufe the periphery of A to rub againft the fide of B, as at C; this caufes the channel or groove DDD to be formed of the fhape which appears

appears in the figure. The inner ſurface of the wheel or ring B is not perfectly cylindrical, but is a curve, of ſuch a ſhape as would be deſcribed by the points of the ſliders E and F being of equal length in the revolution of the wheel A; or, in other words, of ſuch a ſhape as would occaſion all the four points of the ſaid ſliders to be in conſtant contact therewith. The dotted lines GG ſhew two grooves or cavities, through which the water, ſteam, or other fluid, contained between the point C and either of the apertures of the pipes H and I, paſſes into either of the ſaid pipes; which water, ſteam, or other fluid, would otherwiſe be pinned up by the ſlider, and ſtop the motion of the machine when turned in either direction. This machine poſſeſſes the ſame poperties as thoſe before deſcribed.

Fig. 1

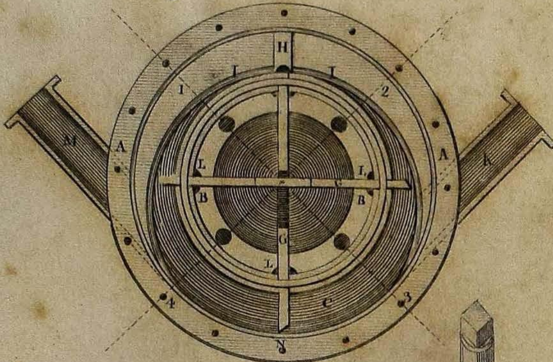


Fig. 2

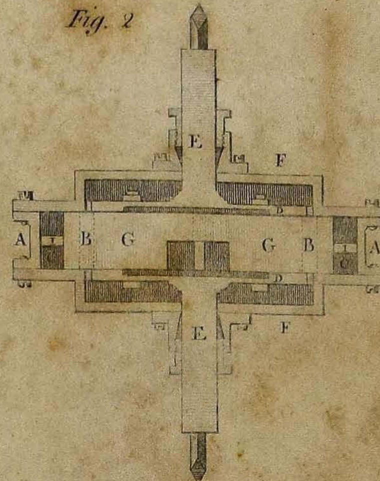


Fig. 3

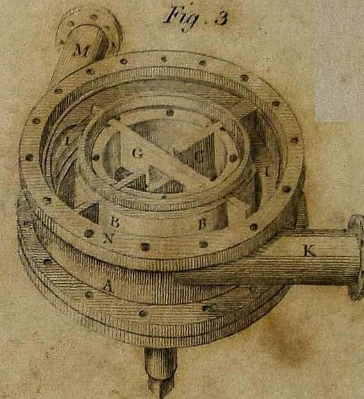


Fig. 4

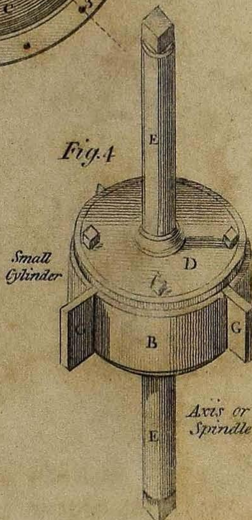


Fig. 5

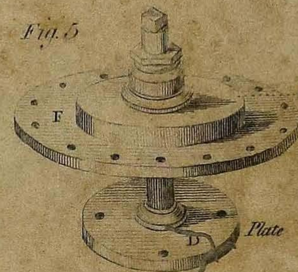
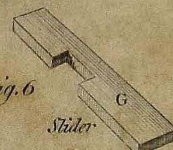


Fig. 6



Cap

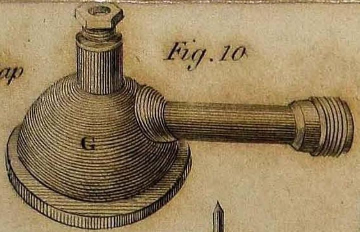


Fig. 10

Fig. 9

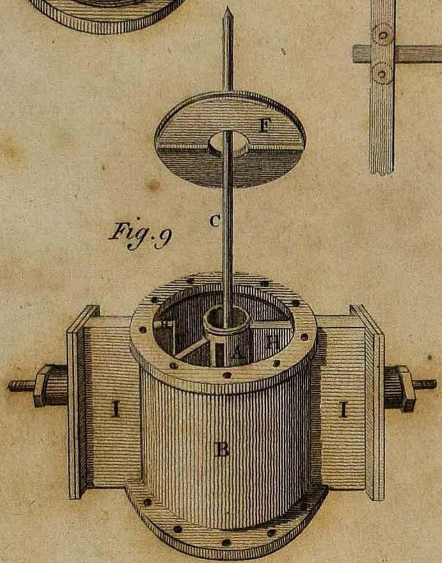


Fig. 12

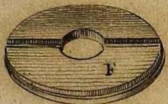


Plate and Groove for slider

Fig. 7

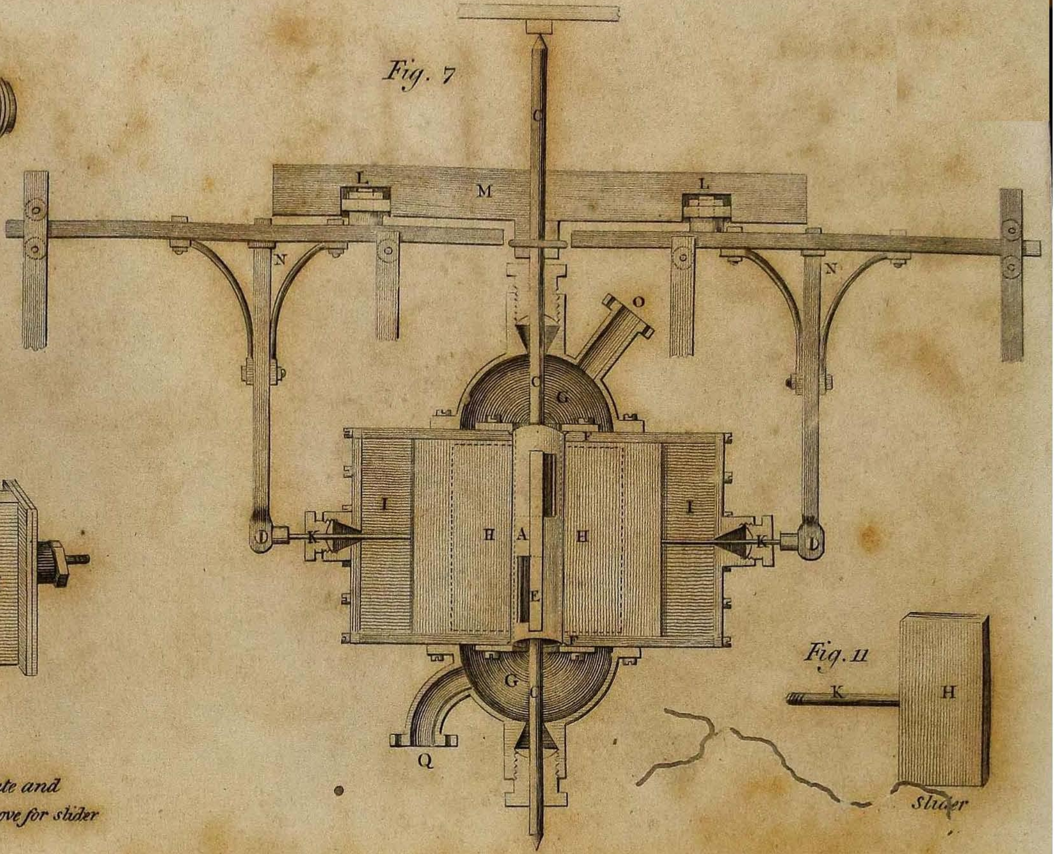


Fig. 11

Slider

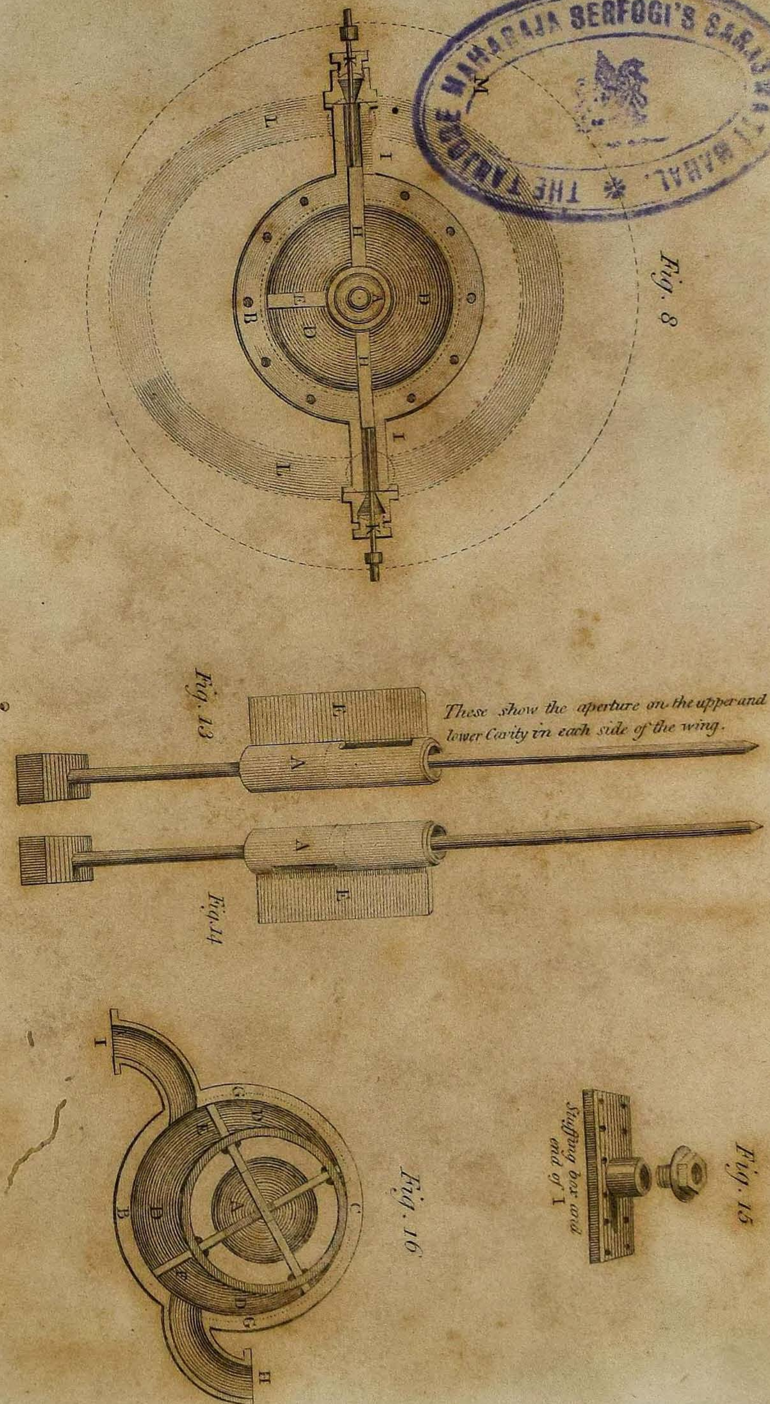


Fig. 8
Fig. 13
Fig. 14
These show the aperture on the upper and lower Cavity in each side of the wing.
Fig. 15
Stuffing box and end of I
Fig. 16

XII. Specification of the Patent granted to Mr. FRANCIS FREDERICK ECKHARDT, of Sloane-ſtreet, Chelſea; for his Method of preparing linen and cotton Cloths with a Paſte, ſo as to form a ſmooth and regular Surface, and yet leave the Cloth of a pliable Quality, for the Purpoſe of receiving a Coat of water-ſize Colours; upon which are afterwards printed Ornaments in fine Silver, and Gold, or Colours, in different Patterns, ſo as to reſemble Damaſk, Lace, and various ſilk Stuffs; which, being afterwards varniſhed, may be waſhed with Water without Injury; to be uſed for Hangings, and other Furniture Rooms.

Dated April 30, 1793.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that I the ſaid Francis Frede-

rick

rick Eckhardt, in purſuance of the ſaid proviſo in the ſaid letters patent, do hereby deſcribe and aſcertain the nature of the ſaid invention, and in what manner the ſame is to be performed as follows; that is to ſay, prepare a paſte with flour, ſtarch, or any of the ingredients with which paſte is or can be made with water or milk; when the paſte is made, mix with it a ſufficient quantity of wax, ſo as to preſerve the linen, cotton, or cloth intended to be uſed, of a pliant or flexible quality. Then ſtrain the linen, cotton, or cloth, upon a frame, and fill the pores or interſtices with the above paſte or compoſition; this is to be done ſo as to render the ſurface as ſmooth as poſſible. When the linen or cloth is completely dry, lay on a proper coat of water-colours, mixed with gum or ſize, according to the nature of the colour intended to be uſed; this being dry muſt be well ſized over, and, when again dry, varniſhed over with any of the various ſorts of varniſh which will reſiſt water, as often as it ſhall be found neceſſary, according to the nature of the colour uſed. If it ſhould be wiſhed that ornaments in ſilver, gold, or colours, to reſemble

damaſk

damaſk lace, or any of the various ſilk ſtuffs, ſhould be printed upon the linen or cloth, then, after the coat of water-colours has been laid on, and is dry, gold ſize, or any of the other compoſitions that will anſwer the ſame purpoſe, muſt be laid, with a printing block or a bruſh, on thoſe parts of the linen or cloth, upon which the ornaments are intended to be placed. Before the ſize or compoſition is completely dry, gild or ſilver it with gold or ſilver leaves, ſo as to deſcribe the ornaments; this being done, ſize it over once or twice, as occaſion may require; and, when thoroughly dry, varniſh it over with any of the varniſhes, in the manner above mentioned. In witneſs whereof, &c.

XIII. Specification of the Patent granted to Mr. FRANCIS FREDERICK ECKHARDT, of Sloane-ſtreet, Chelſea; for his Method of preparing and printing Paper in different Patterns, and ſilvering it over with fine ſilver Leaves, ſo as to reſemble Damaſk, Lace, and various ſilk Stuffs; to be uſed for Hangings, and other Furniture for Rooms.

Dated April 30, 1793.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that I the ſaid Francis Frederick Eckhardt, in purſuance of the ſaid proviſo in the ſaid letters patent, do hereby deſcribe and aſcertain afcertain the nature of the faid invention, and in h at manner the fame is to be performed, as follows; that is to fay, when the paper is coloured in the ordinary courfe, fize it properly with a fize of ifinglafs, parchment, or common fize, fo as to bear an oil, or a varnifh gold fize. This being dry, lay, with a printing block or a brufh, on thofe parts where the ornaments are intended to appear, gold fize, or any of the other compofitions that will anfwer the fame purpofe; when the gold fize, or compofition, is nearly dry, lay on real fine filver leaves, and then fize the paper well two or three times, and, when dry, varnifh it over with any of the various forts of varnifh which will refift damp. In witnefs whereof, &c.

XIV. Deſcription of a ſhort Pendulum to vibrate Seconds; and of a Nautical Watch. Extracted from the Specification of a Patent granted to Mr. Robert Leslie, No. 13, Alderſgate-ſtreet, London; for ſundry Improvements in Clocks and Watches.

WITH THREE PLATES.

Description of the Pendulum.

AA (Fig. 1, Plate VIII.) repreſent two weights, which may be made of any form or ſize. B is a bar which connects them, and which is ſuſpended by two ſprings CC, the upper end of which paſs through the bar D, in the ſame manner that pendulums of common clocks are ſuſpended to the clock; the bar D is ſcrewed to the back plate of the clock, and the ſprings CC are moved

moved nearer together, or farther apart, by the ſcrew E, which has one end cut with a right hand, and the other with a left hand, ſcrew.

This pendulum can be applied to a clock of any ſize, and with any ſcapement; it receives a horizontal motion from the clock, by applying the fork or the pallet arbour to one of the ſprings CC, or to a wire fixed in the bar B for that purpoſe, and is prevented from having any other motion than a horizontal circular one by the ſmall ſteel pin in the ſpring F; which ſpring has one end faſtened to the bottom of the clock-caſe, and the pin at the other end goes into a conic hole in the bottom of the bar B.

To regulate the clock faſter, the ſprings CC are moved farther apart; and ſlower, the contrary, or nearer together: and if the ſcrew E, and that part of the bar B which is between the ſprings CC, are of braſs, and the reſt of iron, the properties of the compound, or gridiron pendulum, will reſult.

The advantages that this pendulum has, over all ſuch as vibrate twice or more in a ſecond, are,

Firſt,

Firſt, it has but one half as much friction in the ſcapement.

Secondly, but one half the reſiſtance of air.

Thirdly, the ſame clock will keep in motion one of four times the weight.

And fourthly, its great convenience, being applicable to clocks, or time-pieces, of any ſize or height, from three inches upwards; ſo that any ſmall portable clock, or time-piece, on this conſtruction, will both beat and ſhew the ſeconds as diſtinctly as one of the largeſt ſize.

Description of the Nautical Watch.

As the dial, and mode of giving motion to the balance, are the only things in which this watch differs from others, a deſcription of the other parts will be unneceſſary.

Fig. 2, (Plate VIII.) ſhews the poſition of the great wheel, and two centre pinions; 80 the wheel, 10 and 10 the two pinions.

Fig. 3, the dial, which has two circles for the hours and minutes, one for the ſeconds, and one for the day of the month, tide, or any other purpoſe.

Fig.

Fig. 4 and 5, a method of giving motion to the balance without any friction. It can be done with any ſcapement; the drawing repreſents a horizontal one, though neither the common wheel or cylinder; the ſame letters refer to Fig. 4, and 5.

A is the wheel; BB, the two edges of the ſuppoſed cylinder, which the teeth of the wheel act on in a common way; C, an arm or lever, faſtened on one end of the cylinder, with the end turned up, and paſſing through a hole, cut through the frame plate D; there is a ſmall hole in the end of the lever, which receives the pendulum or balance ſpring, at the diſtance of about one turn from its outward end, where it is made faſt by a pin. The inward end of the ſpring is faſtened to a collet on the arbour of the balance, in the common way, and the outward end to a ſtud in the plate; ſo that, by giving motion to the lever, the outward turn of the ſpring receives the ſame motion which runs through every turn of it to the centre, and there, being faſtened to the balance, gives it motion alſo; and, though the motion of the lever is not one ſixth of a

circle,

circle, the motion of the balance will be more than one whole turn, as it receives the impulſe entirely from the action or elaſticity of the pendulum or balance ſpring, in which there is no friction; and the balance arbour not having any kind of pallet to be acted on, by any wheel of the watch, has no friction any where but on its own pivots; ſo that, if the holes are jeweled, a ſmall movement, with a weak main ſpring, will give a very heavy balance one turn and a half motion: the watch may be regulated by applying a curb to the outward turn of the ſpring in the uſual way.

The advantages that this mode of giving mo tion to the balance over all others, are,

Firſt, that it receives the impulſe without any friction whatever.

Secondly, that as the wheel has no connection with the balance arbour, bankings of any kind are not neceſſary; for, if the balance ſhould turn twice, or more, round, it cannot produce any bad effect; neither can giving the ſpring a ſet, by any extraordinary motion, ever put the watch out of beat.

Thirdly,

Fig. 1

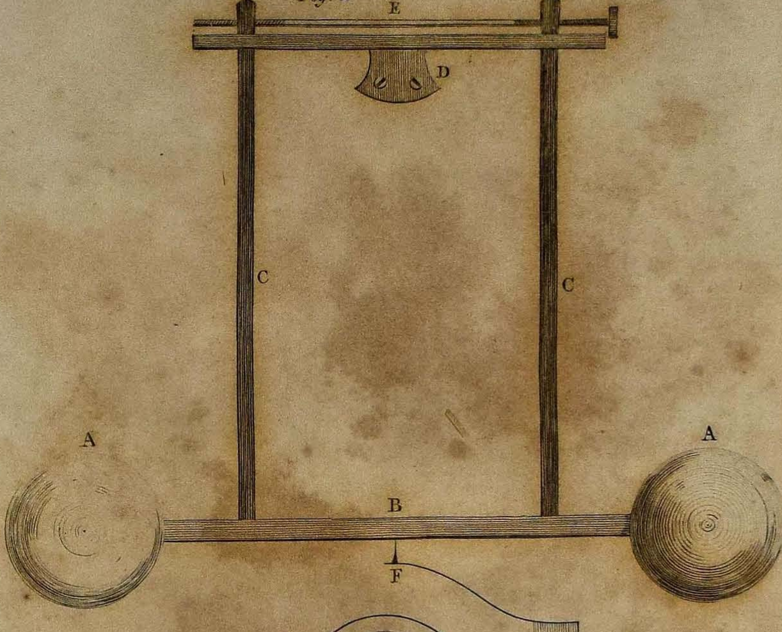


Fig. 4

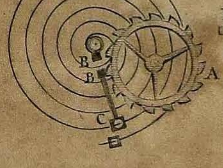


Fig. 5

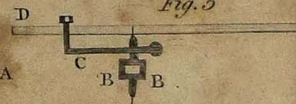
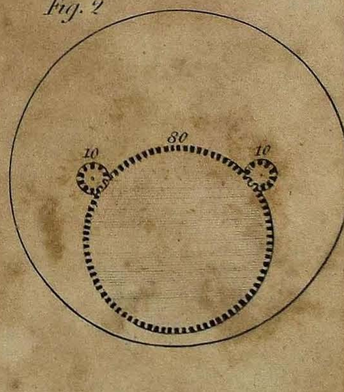


Fig. 3

Fig. 2



Thirdly, the bad effects arising in other watches, from being placed in different positions, or carried with different sides up, (which causes the weight of the balance to bring the pallet and the wheel that acts on it nearer together, or farther apart, and consequently produces a greater or less impulse,) are intirely done away, as the wheel has not the least connection with the balance, or its arbour.

The dial is particularly constructed for convenience, as it has two distinct circles for hours and minutes, with indexes to each; either of which may be moved or set to any particular time, without affecting the other. So that if one is set to the time of the place sailed from, and not altered during the voyage, and the other set to the time of the place of every observation, the difference of longitude will be seen at one view, by allowing one degree for every four minutes; for example, suppose five hours difference between London and Philadelphia, and the watch set to the time of Philadelphia and brought to London, the indexes will stand as in the drawing, those on the left hand shewing the time of Philadelphia, and those on the right that of London.

An index for ſhewing the time of the tide may be placed under that which ſhews the hour on the right-hand ſide, or (as before mentioned) on the lowermoſt ſmall circle; which will point upwards at high water; downwards at low water; to the right at half-ebb; and to the left at half-flood. And, notwithſtanding the complicated appearance of the plan, if it is examined, it will be found ſo ſimple as not in the leaſt to clog the going of the watch, or ſubject it to any inconvenience.

XV. Of the Gut-tie in Oxen and Calves, with its Cure, and the Method of preventing it in the Caſtration of Calves.

From the General View of the Agriculture of the County of Hereford; drawn up, for the Conſideration of the Board of Agriculture, by Mr. JOHN CLARK, of Builth, Breconſhire.

THE excellency of the Herefordſhire breed of neat cattle is ſo univerſally acknowledged, that it was

was with no ſmall degree of concern I learned that many of them were ſubjected to a premature death, in conſequence of the unſkilfulneſs of the perſons who perform the operation of caſtration on the male calves. The diſtemper is here called the gut-tie; when it has once ſeized an ox it is conſidered as incurable, and many hundreds have fallen victims to this dreadful malady. Having heard that Mr. Harris, ſenior, farmer at Wickton, near Leominſter, had been almoſt univerſally ſucceſsful in the cure of it, and being farther informed, that the mode of cure was a myſtery known only to that gentleman, I waited upon him; and, at my moſt earneſt requeſt, he has, in conformity to that liberality which always accompanies ſuperior talents, laid open the whole, for the benefit of ſociety, in the following moſt valuable account.

To Mr. Clark, Builth.

Sir,

As I underſtand that the honourable Board of Agriculture wiſhes to make public every kind of inſtruction that may be of benefit to the farmer, and to ſociety in general, I have taken the liberty of ſending you an account of the cauſe and cure of the gut-tie in oxen, a complaint which is very common in this neighbourhood. As I have never ſeen this complaint treated of by any perſon, you have my permiſſion to make whatever uſe of it you pleaſe. I ſhall only add, that I am neither an ox-leech, nor a profeſſional man, but a Herefordſhire farmer, and your very humble ſervant,

JOSEPH HARRIS.

The ſymptoms of the gut-tie are the ſame as thoſe of an incurable colic, *volvulus*, or mortification of the bowels. The beaſt affected with this complaint will kick at its belly, lie down, and groan ; it has alſo a total ſtoppage in its bowels, (except blood and mucus, which it will void in large quantities,) and a violent fever, &c. To diſtinguiſh, with certainty, the gut-tie from the colic, &c. the hand and harm of the operator muſt be oiled, and introduced into the anus, through the rectum, beyond the os pubis, turning the hand

hand down to the tranſverſe and oblique muſcles, where the veſſels of the teſticles enter the abdomen. There the ſtring will be found united to the muſcles, and is eaſily traced to the ſtricture, by the hand, without pain to the beaſt.

This ſtricture, or gut-tie, as it is called, is occaſioned by an erroneous method of caſtrating the calves, which the breeders practiſe throughout Herefordſhire, and is as follows: they open the *ſcrotum*, take hold of the teſticles with their teeth, and tear them out with violence; by which means all the veſſels thereto belonging are ruptured. The *vaſa deferentia*, entering by the holes of the tranſverſe and oblique muſcles into the abdomen, paſs over the ureters in acute angles; at which turning, by their great length and elaſtic force, the peritoneum is ruptured; the *vaſa deferentia* are ſevered from the teſticles, and ſpringing back form a kind of bow from the urethra, where they are united, over the ureters, to the tranſverſe and oblique muſcles, and there again unite, where they firſt entered the abdomen; the part of the gut that is tied is the jejunum, at its turning from the left ſide to the right, and again from the right

right to the left, forming right angles under the kidney, and attached to the duplicature of the peritoneum, to which it was united, where the rupture happened. There the bow of the gut hangs over the bow of the *vaſa deferentia*, which, by a ſudden motion, or turn of the beaſt, form a hitch or tie of the ſtring round the bow of the gut, (filled with air,) ſimilar to what a carter makes on his cart line. This cauſes a ſtoppage in the bowels, and brings on a mortification, which, in two days, or four at moſt, proves fatal.

To this accident is the beaſt, when caſtrated as above, liable from the day that he was caſtrated till the time of his being ſlaughtered. I have cut them for the gut-tie from the age of three months to nine years. The only method of cure that can be ſafely ventured upon is, to make a perpendicular inciſion, four inches under the third vertebra of the loins, on the left ſide, over the paunch or ſtomach, and introduce the arm to find the part affected; if poſſible, keep the beaſt ſtanding by the help of proper aſſiſtants. The knife I make uſe of to ſever the ſtring is in the form of a large fiſh-hook, with an edge on the concave ſide; it is fixed

fixed to a ring, which fits the middle finger, which finger crooks round the back of the knife, the end of the thumb being placed on its edge. The inftrument, by being thus held in the hand, is fecured from wounding the furrounding inteftines; with it I divide the ftring or ftrings, and bring out one or both, as circumftances require. Here it is to be obferved, that great care muft be taken, by the operator, not to wound or divide the ureters, which would be certain death. I then few up the divided lips of the peritoneum very clofe, with a furgeon's needle threaded with ftrong thread, eight or ten double, fufficiently waxed; I alfo few up the fkin, leaving a vacancy at the top and bottom of the wound, fufficiently wide to introduce a tent of furgeon's tow, fpread with common digeftive and traumatic balfam; covering the incifion with a plafter made of the whites of eggs and wheat flour. The wound, thus treated, and dreffed every day, will be well in a fortnight. The medicine I give to remove the ftoppage in the three ftomachs, occafioned by the tie, and to carry off the fever, is, four ounces of Glauber's falt, two ounces of cream of tartar, and one

ounce

ounce of ſena, infuſed in two pounds of boiling water, adding half a pound of olive-oil, and working it off with plenty of gruel, mixed with a large quantity of infuſion of mallows and elder-bark. I adminiſter the gruel and infuſion for at leaſt two or three days, by which time the beaſt will be well, will eat his provender, and chew the cud, and will for ever be relieved, and remain ſafe from this fatal diſorder.

The following ſimple and eaſy method of caſtration will effectually prevent the gut-tie. Open the ſcrotum, looſen out the teſticles, and tie the ſeveral veſſels with a waxed thread or ſilk; or ſear them with a hot iron, to prevent their bleeding, as in the common way of cutting colts. This method can never diſplace the veſſels of the teſticles, bladder, kidneys, or inteſtines; all of which remain covered or attached to the peritoneum, or lining of the abdomen of the beaſt, which renders it impoſſible that there ſhould ever be a ſtricture or tie on the gut.

XVI. On the Converſion of Animal Muſcle into a Subſtance much reſembling Spermaceti. By GEORGE SMITH GIBBES, B. A. of Magdalen College, Oxford.

From the TRANSACTIONS of the ROYAL SOCIETY of LONDON.

THE celebrated Sir Thomas Brown, in his very learned and curious treatiſe, intituled, *Hydriotaphia*, aſſures us that he has found a ſoap-like ſubſtance in an hydropical body. His words are as follow, viz. "In an hydropical body, ten years buried "in a church-yard, we met with a fat concre-"tion, where the nitre of the earth, and the ſalt "and lixivious liquor of the body, had coagu-"lated large lumps of fat into the conſiſtence of "the hardeſt Caſtile ſoap, whereof part remain-"eth with us."

 Lord

Lord Bacon, in his work intituled *Sylva Sylvarum*, alfo mentions this curious circumftance: "You may turn (almoft) all flefh into a fatty "fubftance, if you take flefh and cut it into "pieces, and put the pieces into a glafs covered "with parchment, and fo let the glafs ftand fix "or feven hours in boiling water. It may be an "experiment of profit for making greafe or fat "for many ufes; but then it muft be of fuch "flefh as is not edible, as horfes, dogs, bears, "foxes, badgers, &c."

Animal mufcle having loft its living principle has been generally fuppofed to undergo, when expofed either to the action of air or water, that kind of decompofition only which is known by the name of the putrefactive fermentation. Since the difcovery of the bodies in the *Cimetiere des Innocens* at Paris, this fubject has been more attended to; and a fubftance, much refembling fpermaceti, is now known to be formed by combinations which the animal flefh and water take.

If you put flefh under water, and let it ftay fome time, it will get very offenfive, and the putrefactive

trefactive fermentation will, in some measure, most assuredly take place. This seems to have been the reason why the substance remaining in the water had not been more accurately examined; it being imagined that, as this decomposition had commenced, the whole wnuld be changed in the same manner. It would appear strange if the same substance, exposed to the action of two such different bodies as air and water, should undergo precisely the same change. That it doet not, has been lately proved by many experiments; and that the putrefactive fermentation is not at all necessary, in the formation of this fatty matter, I think some of the following experiments will shew.

After having seen some of the matter found in the *Cimetiere des Innocens* at Paris, I concluded that, in some situations, the same kind of substance might be easily found; accordingly I examined some of the macerating tubs belonging to anatomical schools in town, and I found that in most of them the flesh was nearly changed into this kind of fat. By the indulgence of Dr. Pegge, the anatomical profeffor in Oxford, I was permitted to examine the receptacle in which the bodies are depofited, after he has finifhed lecturing on them. This place is a hole dug in the ground to the depth of about thirteen or fourteen feet, and, to remove all offenfive fmell, a little ftream is turned through it. I found, on firft looking into it, that the flefh was quite white, and, on drawing up the firft piece, I found it changed in the manner before defcribed. From this place I have procured at leaft twelve pounds weight of a fubftance equal in every refpect to fpermaceti.

Having feen many fpecimens of different animals, which had been changed under fomewhat different circumftances, that is, where fome had been buried in a dampifh ground, fome in wet ground, and fome even in water itfelf, I began to fufpect that I might bring about the fame change in a fhort time, at leaft that I might determine the time neceffary for it: with this view a piece of the leaneft part of a rump of beef was confined in a box full of holes, which, being tied to a tree near a river, was fuffered to float in it. On taking this

this up from time to time, I perceived that it gradually got whiter and whiter; and at the end of a month it was perfectly, to appearance, changed to a mafs of fatty matter. From fome circumftances I am induced to believe that it is fooner converted in running water than when it is perfectly at reft; for, when this beef was expofed to the water in the river, a piece of mutton was placed in a refervoir of water, and I perceived that though the mutton was expofed for a longer time than the beef, yet it was not fo much changed.

Finding that this fubftance was fo formed, and that I could procure large quantities of it, I tried fome experiments to purify it; for this purpofe I took feveral pieces of it and melted them, but I found, though they were brought into a clofer union, that the fœtid fmell was as bad as before. After trying fome unfuccefsful experiments, it occurred to me that if I could add a fubftance to it which would unite with the offenfive parts, and not with the fat, I might then get it pure; accordingly I poured fome nitrous acid upon it

which

which immediately had the desired effect: a waxy smell was perceived, and, on separating and melting it, I got it nearly pure. The nitrous acid turns it yellow, but, by submitting it to the action of oxygenated muriatic acid, I have got it quite white and pure. In the beginning of last June I buried a cow, in a place where, from the rising of a river to supply a mill twice a day, it was submitted to the action of a running water. On taking this cow up in December, I found that where the water was constantly running over it, there it was changed into a fatty substance; but, where the water which had acted on the meat could not pass off, there a very disagreeable smell was sensible, and the flesh was not so much changed. A piece of this cow, that was perfectly lean, was stuck through with a stick, and fastened to the bottom of the river; this piece was perfectly changed into a fat matter, and had lost its offensive smell.

I have brought about this change in a much shorter time, in the following manner: I took three lean pieces of mutton, and poured on them the three mineral acids, and I perceived that at the end of three days each was much altered; that in the nitrous acid was much foftened, and, on feparating the acid from it, I found it to be in exactly the fame ftate with that which I had before got from the water; that in the muriatic acid was not in that time fo much altered; the vitriolic acid had turned the other black.

From thefe experiments, it appears to me that it is not at all neceffary that the putrefactive fermentation fhould take place; on the contrary, that it takes away a great deal of the flefh which might ferve for the formation of a greater quantity of this waxy fubftance.

XVII. On the Dry-rot in Timber. In a Letter from ROBERT BATSON, Efq. of Limehoufe, to the Society for the Encouragement of Arts, Manufactures, and Commerce; from whofe Tranfactions it is extracted.

THE Society for the Encouragement of Arts, Manufactures, and Commerce, continuing to offer a premium for difcovering the caufe of the dry-rot in timber, and difclofing a certain method of prevention, I beg leave to lay before them an account of a method I have put in practice, and which at prefent appears to me to have fully fucceeded.

The dry-rot having taken place in one of my parlours, in fuch a manner as to require the pulling down part of the wainfcot every third year, and perceiving that it arofe from a damp ftagnated air, and from the moifture of the earth, I determined,

mined, in the month of June, 1783, to build a narrow clofet next the wall through which the damp came to the parlour, which had the defired effect; but, though it put a total ftop to the rot in the parlour, the evil foon appeared in the clofet; fungi of a yellow colour arofe, to a great degree, in various parts of it. In the autumn of the year 1786, the clofet was locked up about ten weeks; on opening it, numerous fungi were obferved about the lower part of it, and a white mould was fpread by a plant refembling a vine or fea-weed, and the whole of the infide, china, &c. was covered with a fine powder of the colour of brick-duft. It being then cleaned out, I foon perceived (what indeed I did not expect) that the evil had impregnated the wood fo far as to run through every fhelf therein, and the brackets that fupported them; it had alfo feized upon, and deftroyed, a movable board for breaking fugar on. I therefore, in the beginning of the year 1787, determined to ftrip the whole clofet of lining and floor, and not leave a particle of the wood behind; and alfo to dig and take away about two feet of the earth in depth, and leave the walls to dry, ſo as to deſtroy the roots or ſeeds of the evil. When, by time, and the admiſſion of air, and good bruſhing, it had become ſufficiently dry and cleanſed, I filled it, of ſufficient height for my joiſts, with anchor-ſmiths' aſhes; knowing that no vegetable would grow in them. My joiſts being ſawed off to their proper lengths, and fully prepared, they and their plates were well charred, and laid upon the aſhes; particular directions being given that not any ſcantling or board might be cut or planed in the place, leſt any duſt or ſhavings might drop among the aſhes. My flooring-boards being very dry, I cauſed them to be laid cloſe, to prevent the dirt getting down, which I thought in a courſe of time might bring on vegetation.

The framing for lining the cloſet was then fixed up, having all the lower pannels let in to be faſtened with buttons only; that, in caſe any vegetation ſhould ariſe, the pannels might with eaſe be taken out to examine them.

This having now been done upwards of ſix years, and ne vegetation or damp appearing, the whole of the pannels and floor remaining in the

ſame

ſame ſtate as when firſt put in, I ſhall have a ſatisfaction in taking part of the floor up, if the ſociety think proper to appoint a committee to examine the place.

If what I have produced meets the approbation of the ſociety, I wiſh it made public under their ſanction, that as full a trial as poſſible may be made of it; and if, at a proper diſtance of time, it proves of general utility, any honorary token of the Society's approbation will be received with much ſatisfaction by me.

I think it may be highly neceſſary, in ſome ſituations, to take out a greater depth of earth; and where aſhes can be had from a foundery they are fully equal to thoſe from anchor-ſmiths, but by no means depend upon houſe-aſhes. I am, &c.

ROBERT BATSON.

In conſequence of the foregoing letter, a committee was appointed to examine and report the ſtate of the cloſet, who met on the 15th of May, 1794; the wainſcot being taken down, and the flooring-boards taken up, they were all found entirely free from any appearance of the rot; and, from all the circumſtances then obſerved, it was the opinion of the committee, that the method adviſed by Mr. Batſon, when fully and completely put in execution, appeared to have anſwered every intention mentioned in his letter; and this opinion ſeemed the more juſtly founded, as two pieces of wood (yellow fir) which had been driven into the wall as plugs, without being previouſly *charred*, were affected with the rot.

XVIII. Continuation of Mr. HENRY's Conſiderations relative to the Nature of Wool, Silk, and Cotton, as Objects of the Art of Dying, &c.

(FROM P. 60.)

SILK, when taken from the cone, is covered with a kind of varniſh, which makes it feel rough and hard to the touch, tarniſhes its whiteneſs, and is is generally ſaid to be of ſuch a nature as to be neither ſoluble in water, nor in ſpirit of wine. It has been thought that the only ſolvent for this ſubſtance is a ſolution of alkaline ſalt; and this is commonly applied in the form of ſoap. The ſoap ſhould always be of the beſt quality; for, inferior ſoaps, eſpecially thoſe made with animal fat, are not only leſs powerful in their action, but are apt to ſtain or diſcolour the ſilk. The ſilk in this operation loſes about one fourth of its weight. The matter ſeparated from it is highly putreſcent, for, if a hank of ſilk which has been thus treated be not waſhed, after the operation, it will in a few days grow hot, ſtink, and be covered with ſmall white worms, which feed on the ſoapy and glutinous matter remaining in the ſilk. The liquor in which it has been boiled alſo ſoon putrefies, and becomes uſeleſs. Could this animal matter, ſays M. Macquer, be precipitated from the ſoap, before putrefaction takes place, the ſoap might be recovered, and thus a conſiderable ſaving made to the dyer *.

* Macquer, Art de la Teinture en Soire.

The

The ufe of the beft foaps has been recommended; but even thefe are fufpected of being detrimental to the whitenefs of the filk; and Chinefe filk, which exceeds the European in luftre, is faid to be prepared without foap. The French Academy therefore, fome years ago, offered a prize for the difcovery of a method of cleaning filk without foap; the prize was obtained by M. Rigaut, whofe mode was to ufe a flender alkaline folution inftead of foap.

But Monf. l'Abbé Cullomb * has lately gone farther, and has actually diffolved in water the varnifh of filk, which has always been fuppofed to be of that oleo-refinous kind as not to be acted on even by fpirit of wine. He expofed a quantity of raw filk to the action of boiling-water for nine hours, and found it freed from the varnifh, with the lofs of one fourth of its weight.

Though the filk by thefe means acquire a confiderable degree of whitenefs, if intended to receive fome of the moft brilliant colours a farther operation is requifite. This confifts in expofing

* Journal de Phyfique, Part II. Vol. XXIX.

the ſilk to the fumes of burning ſulphur, ſo confined in a ſtove that none ſhall eſcape, but the whole be applied to the material intended to be whitened: of the rationale of this operation Mr. Delaval has given a very ingenious explanation *.

But, though thus rendered more fit for exhibiting the brilliant colouring, the attraction of the ſilk for colouring matter is rather diminiſhed than increaſed; the raw or unſcoured ſilk being more eaſily and permanently dyed than that which has paſſed the above deſcribed proceſs.

Cotton and linen are prepared for the purpoſes of dying by being boiled in ſolutions of alkaline ſalts, and afterwards expoſed to the air, and the ſun's rays, in the bleach field. Linen, containing much oily and reſinous matter, requires a ſtrong ſolution of alkaline ſalt, and that they be in a cauſtic ſtate; but cotton not having any reſinous matter, and not much ſuperabundant oil, the milder alkalies are more beneficially employed for the bleaching of it †.

This

* Mancheſter Memoirs, Vol. II. p. 2.

† The new mode of bleaching by means of the dephlogiſticated marine acid, which has been introduced into our manufactures

This bleaching, or ſteeping of the alkaline leys, leaves in the cotton, however well waſhed, ſome earthy matter, which, being unequally diſtributed, would, when the cotton is to be dyed, render the application of the colour unequal. This, therefore, is to be removed by ſteeping in a dilute vitriolic acid, which is capable of diſſolving and carrying off the earth. But this acid is alſo to be carefully removed by waſhing the cloth in water; otherwiſe, as it becomes dry, the acid, being gradually concentrated by the evaporation of the water, will attack and corrode the cotton.

The intention of theſe previous preparations ſeems to be two-fold: the firſt is, to free the material to be dyed from any extraneous matter, which might, by its want of attraction for water, prevent the abſorption of the colouring-liquor; for, we find that unbleached ſtuffs do not imbibe

nufactures ſince the reading of this paper, promiſes to be of great utility to them; not only by ſhortening the time required for the proceſs, which has been generally extended from one to two months, and may now be reduced to a few hours, but alſo by ſending up the goods in a ſtate much better adapted to the ſubſequent proceſſes.

water

water with near ſo much avidity as thoſe that have been bleached. The ſecond is, that the yarn or cloth may be rendered whiter, and, by reflecting the rays of light more copiouſly, enable the colouring-matter to exhibit more brilliant tints; to theſe a third attention has been added, viz. to enlarge or dilate the pores of the ſubſtance.

But, for ſome particular purpoſes, cotton requires a different and more complex preparation. In the proceſs for dying the Turkey or Adrianople red it is boiled, and repeatedly ſteeped, in mixtures of mineral alkali oil, and animal excrement; and, though theſe operations have been conſidered as only anſwering the above-deſcribed purpoſes, I truſt I ſhall be able to make it appear, in the ſequel of this paper, that important additions are thus made to the cotton, whereby its attraction for colouring-matter is increaſed.

Having thus conſidered the natures of the different ſubjects of dying, and the various preparations neceſſary to render them fit for the reception of colouring-matter in general, let us next proceed to ſome deſcription of the colouring-ſubſtances which are employed in dying.

Theſe are divided into two claſſes; viz. thoſe which are themſelves poſſeſſed of colour; and thoſe which, poſſeſſing no colour in themſelves, alter the power of the former to tranſmit the various rays of light, thereby enabling them to exhibit colours different from thoſe which they would naturally exhibit.

When I ſay that ſubſtances do themſelves poſſeſs colour, I only mean that they poſſeſs the power of tranſmitting particular rays of light, ſo as to produce, by the action of theſe rays on the retina, the idea of certain colours.

Though the primitive colours into which a ray of light may be divided are ſeven, yet the original colours produced by dyers are no more than five; viz. blue, red, yellow, brown, and black. From theſe, perhaps, the two laſt may be excluded as compounds; all the other ſhades, of various denominations, are formed by different combinations of theſe original colours.

The ſubſtances which do themſelves contain colouring-matter, and are uſed in dying, are chiefly of the vegetable, ſome of the animal, and in a few inſtances of the mineral, kingdom. The

laſt

laſt conſiſt of metallic calces, and chiefly thoſe of iron and copper.

Of the two former *, moſt of their component parts, in which the colouring matter reſides, ſuch as their mucilage, their gum, and the ſalts which they contain, are ſoluble in water, as, by means of theſe ſalts, are alſo their oily parts; to theſe the French writers have given the general name of extractive ſoapy matter. Other conſtituent parts of vegetables are not ſoluble in water, viz. ſome of their oily, their reſinous, and their earthy parts.

Yet we ſhould be deceived, as M. Macquer juſtly obſerves, if we were to expect to make a perfect ſeparation, by means of water, of the extractive ſoapy matter from the other parts. For, a portion of that matter is defended from the action of the water, by the reſinous and oily ſubſtances; while, on the other hand, theſe are partially diſſolved, being rendered capable of uniting to the water, by means of the mucilaginous parts.

* Macquer, Dictionnaire de Chymie.

The colouring animal and vegetable drugs, of the *materia tinctoria*, have been formed by chemiſtry into three diviſions *.

First. Thoſe ſubſtances which, together with extractive, contain ſome reſinous, and alſo ſome portion of earthy, matter in their compoſition; and the colouring-principle having a ſtrong attraction to the earthy, and this to the ſubſtance to be dyed, a ſeparation from the water is eaſily effected, and the colour is capable of being applied, and of adhering in a durable manner, without the intervention of any medium. Of this tribe are galls, walnut-rinds, the root of the tree ſumach, and alder-bark; theſe are called root-colours, as being the foundation of others.

Secondly. Other articles of the *materia tinctoria* conſiſt of materials whoſe parts are either wholly extractive, or, though containing ſome reſinous matter, are capable of being diſſolved in water alone; and, being deficient in the earthy principle contained in the articles of the former diviſion, require that an earth be previouſly in-

* Macquer, Dictionnaire de Chymie.

troduced

troduced into the pores or interſtices of the ſubſtances intended to be dyed, to form a baſis to which the colour may adhere. Without this medium, the attraction of that ſubſtance, to the colouring-matter, would be ſo weak as either not to be able to ſeparate it from the water, or, if ſeparated, to retain and prevent it being rediſſolved by the water, when aided by mechanical means, or by the addition of certain ſubſtances which increaſe its ſolvent powers, even in a ſmall degree *.

* Many of theſe colouring-bodies, as well as thoſe of the firſt diviſion, alſo contain a principle, known by the appellation of the aſtringent principle, which greatly contributes to their fixity, and has much effect in ſeparating the earthy parts of the ſalt employed to afford the above-mentioned baſis. Under this deſcription are comprehended cochineal, madder, weld, querciton-bark, and ſeveral other drugs. But other articles of this diviſion ſeem to be either deficient in this principle, or elſe to poſſeſs it of ſo volatile a nature that it readily eſcapes, and carries along with it the colouring-matter, to which it has a cloſe attachment. Of the nature of this principle we ſhall hereafter give a more particular detail.

Thirdly.

Thirdly. Another claſs conſiſts of principles ſo prevalently reſinous, that we are obliged to promote their ſolution in water by fermentation, or by the addition of ſome ſubſtance which may act on the reſinous particles. For this purpoſe, alkaline ſalts, or quicklime, are employed; and by their means we extract the colouring-matter of ſome bodies, ſuch as indigo, archil, ſafflower, and arnatto. Theſe alſo attach themſelves to the cloth, without the intervention of an earthy medium.

But the degree of fixity is various, in the different articles of the *materia tinctoria* belonging to all thoſe diviſions. Some of them belong to the leſs or falſe dye, as it is called, and are liable to be injured, and eaen deſtroyed, by the action of the ſun's rays, air, water, and alkaline or acid liquors. The ingredients of the good dye, on the contrary, in a great meaſure withſtand the influence of theſe agents. The former are more eaſily managed, are cheaper, and are more brilliant; but the latter make amends for their other defects, by their ſolidity and permanency.

The colouring-matter itſelf is formed, perhaps, in a great meaſure, of the inflammable, in ſome

caſes

cafes united to the aftringent, principle. The identity of light and phlogifton, or at leaft that the one is a modification of the other, appears to be pretty clearly proved. Plants totally excluded from the fun's light acquire no colour: and flowers are obferved, *cæteris paribus*, to poffefs the moft beautiful tints in thofe climates where they enjoy the influence of that luminary the moft liberally. This matter, therefore, muft of itfelf be very fugitive, and as phlogiftic bodies act on, and diffolve, each other very powerfully, we are hence enabled to account for the deftructive effects of folar light on colour, when applied to the dead fibre, from its diffolving the phlogifton, in the fame manner, according to Mr. Delaval, as fpirit of wine diffolves camphor *.

The acids alfo act on, and deftroy, colouring-matter, in proportion to their attraction for phlogifton. Thus, nitrous acid is highly and inftantaneoufly deftructive to many colours; but is exceeded in power by the dephlogifticated marine acid. This very active fubftance is the

* Manchefter Memoirs, Vol. II.

ftrongeft

ſtrongeſt teſt of all others for the goodneſs of dyes; for thoſe that can withſtand its action will endure every other hardſhip without injury.

Again, ſome chemiſts have conſidered iron as the colouring-matter of vegetables, as it certainly is, in many inſtances, of minerals. But this theory does not neceſſarily exclude phlogiſton: for, it is ſuppoſed that the various colours which plants exhibit may depend on the various ſtates of *phlogiſtication* in which the iron exiſts. Thus iron when diſſolved in vitriolic acid is green: apply ſuch a degree of heat as may drive off a part of the remaining inflammable principle and the acid, it becomes yellow; and, on carrying the proceſs ſtill farther, it deſcends to red, and purple. It muſt be allowed that iron enters, as a component part, into moſt plants, and that its calces are capable of exhibiting great variety of colours; but ſtill it is to phlogiſton, or light, that we are to look up as the real cauſe of colour; this being the active, whilſt the material calces can, at moſt, be regarded as the paſſive, principle.

Since the formation of the antiphlogiſtian theory indeed, by which the exiſtence of phlogiſton

is

is denied, the various colours of plants have been accounted for, from the different proportions of dephlogifticated air they may retain. Plants, when expofed to the actions of the fun's rays, have their water decompofed, and part with this pure air; yielding it in proportion to the quantity of light they receive, which, joining with it, gives it elafticity: but plants kept in the dark throw out none of this air, and are white. Thofe of the fame kind, expofed to a weak light, will have fome of the air feparated, and have a faint degree of colour; and thofe which undergo the action of a ftrong light will exhibit vivid tints. But, though we allow of the dephlogifticated air, as producing whitenefs, yet we may alfo acknowledge the effect of phlogifton, in producing colour; and, in fact, the antiphlogiftians are obliged to admit of inflammable gas, as a fubftitute for it; and to acknowledge, that this gas, which they fuppofe to be the other conftituent part of water, is the principle of colour *.

* Journal de Phyfique, tom. XXVI. p. 1.

The colourless ingredients used in dying consist of alkaline, acid, nitrous, earthy, and metallic, salts; which contribute either to extract the colouring-matter from other substances which contain it, or, by attenuating or incrassating its particles, to cause the colour to ascend or descend, according to the prismatic range. Thus, acids raise the blue colour of vegetable juices to indigo, violet, red, and yellow; while alkalis reduce the tints, thus raised, to violet, indigo, blue, and, on a farther addition, to green.

In the subsequent part of this paper, we shall proceed to consider the nature of the several bases; endeavour to deduce a theory of dying; and particularly to account for the action of the substances employed in the preparation for the Turkey red, and in the other parts of that process.

PART SECOND.

In the former part of this memoir it must have been evident, that the processes which have been already described are founded in chemical principles;

principles; and that a knowledge of chemiſtry muſt conſtantly be advantageous to thoſe who have the direction of ſuch operations, and ſerve to expedite improvements in them. In thoſe which remain for deſcription, the hermetic art is equally uſeful. The whole buſineſs of dying is, indeed, ſo truly a chemical proceſs, or rather a combination of ſeveral chemical proceſſes, that I am convinced the invention, or at leaſt the principal improvements of the fundamental parts, muſt have proceeded from men ſkilled in chemiſtry. We have ſeen that the Egyptians were even acquainted with the more complicated kind of dying, or *callico-printing*; and this knowledge was not confined to them, but was poſſeſſed by other Eaſtern nations. From the Eaſt alſo proceeded, *to us*, chemiſtry itſelf; and it is highly probable that the art was of great antiquity, in that part of the globe, and had arrived at a degree of perfection of which we have at preſent no ſuitable ideas. To have invented the proceſs of printing, in the manner deſcribed by Pliny, the inhabitants of India muſt probably have known how to prepare alum *; they muſt have been acquainted with the manner of diſſolving lead in the vegetable acid; they muſt at leaſt have been acquainted with the component parts of theſe ſalts; and they muſt have had a knowledge of double elective attractions.

In our diviſion of the various colouring-ſubſtances, of the animal and vegetable kinds, we took notice that there are ſome, viz. thoſe of the third diviſion, which, not having of themſelves a ſufficient attraction for the cloth, require to have an earthy ſubſtance applied, as an intermedium. The requiſites in this earth are, that it ſhould have a ſtrong attraction for the material to be dyed, and alſo for the colouring-principle; and, in many caſes, that it ſhould poſſeſs perfect whiteneſs, for the purpoſe of reflecting the rays of light, ſo as to enable the tinging-matter to exhibit its peculiar colour with the greater brilliancy. If, to theſe properties be added, that, though ſoluble in acids, its ſolubility ſhould not be too eaſy, and that it ſhould even be capable of form-

* The factitious ſalt which is now called alum was firſt diſcovered in the Eaſtern countries; but when, where, and by what means, is unknown.

Bergman's Eſſays, vol. I. p. 339. Eng. tranſl.

ing

ing inſoluble compounds with ſome other ſubſtances, which may be occaſionally added to it for that purpoſe, we have perhaps a complete deſcription of ſuch a baſis, or, as it is commonly called, a mordant.

This is a term that appears to have been firſt introduced by the French dyers, who, apprehending that the intention of paſſing the ſubſtances which were to be dyed through certain ſaline liquors, the name of which they did not underſtand, was to corrode ſomething that oppoſed the entrance of the colouring-principle, and to enlarge the pores of the ſubſtances, gave to the liquors the appellation of mordants. A term which, as conveying a wrong idea, it is to be wiſhed were rejected; I ſhall therefore take the liberty to change the word *mordant* for *baſis*; adding an epithet occaſionally, deſcriptive of the body from which it is obtained. The ſubſtances principally uſed to afford the white baſis for colouring-matter are, alum, and ſolutions of tin in different acids, but generally in marine acid, or in a mixture of marine and nitrous acid, commonly known by the name of *aqua regia*.

TO BE CONTINUED IN OUR NEXT.

XIX.

XIX. On the Method of making Alum by the direct Combination of its conſtituent Principles; by M. CHAPTAL, of the Royal Society of Montpellier.

From the MEMOIRS of the ACADEMY of SCIENCES of PARIS.

ALUM is produced by the combination of vitriolic acid with alumine, or pure clay.

This combination is formed either by nature or by art.

In the firſt caſe it is almoſt always the reſult of the decompoſition of pyritical ſchiſtus; in the ſecond, it is made by the direct combination of vitriolic acid with alumine.

The firſt effect of the decompoſition of the pyritical ſchiſtus is the forming of vitriolic acid; the ſecond is the combination of that acid with thoſe metals and earths which form the baſis of the ſchiſtus, from which reſult vitriols of iron, of lime, of alumine, of magneſia, &c.

The

The courſe of operations employed in the alum-manufactories is intended merely to haſten the decompoſition of the ſchiſtus, to extract the alum, and to diſengage it from the other ſalts which are mixed with it.

The great variety of uſes to which alum is applied renders it one of the moſt precious ſubſtances employed in the arts; but good mines of alum are rare, and our great kingdom procures from foreign parts almoſt all the alum it makes uſe of*.

It was therefore of great conſequence to endeavour, by all poſſible means, to make alum; and ſufficiently cheap to ſtand in competition with thoſe manufactories where it is only extracted from the earths which contain it; both theſe ends appear to have been anſwered in ſome places.

All the known proceſſes for making alum conſiſt, in general, in impregnating clay with vitriolic acid, and in facilitating the combination of the

* In conſequence of my analyſis, my advice, and my proceſſes, an eſtabliſhment for making alum has been formed at the mines of Saint George, a league from Milhau. I hope that this example will be followed.

mixture,

mixture, by expofing it to a moderate heat. M. Sage has given us a very exact defcription of the procefs made ufe of at Javelle, a particular detail of which may be feen in his works. But this procefs, although varied in a great number of different manners, has always appeared to me to be extenfive and troublefome; and not capable of being followed, to any advantage, in our province, where foreign alum at prefent (1789) fells only for from fixteen to twenty-five *livres* the hundred weight. That what I have faid above is true I am convinced, by having manufactured alum, in the large way, for the fpace of fifteen months; and any one may acquire the fame conviction, without the fame rifk, merely by computing, at the loweft price, the coft of the earth, that of the acid, the expence of labour, and, in a general way, all other particulars which a manufacturer brings into fuch calculations.

I was therefore obliged to feek for fome more œconomical and more fimple manner of proceeding, in doing which my refearches were founded upon the following principles.

The vitriolic acid made ufe of is the principle which contributes moft to the coft of the alum;

alum; this acid (ſaid I to myſelf) is only a mixture of water with the vapour produced by the combuſtion of ſaltpetre and ſulphur; let us expoſe our earths, when prepared, to the action of this vapour; the effect of the acid will ſurely be then more ſtriking, becauſe, in the ſtate of vapour, its effects are infinitely greater than when it is in a liquid ſtate *. It was, however, neceſſary to ſubmit theſe conjectures to the teſt of experiment; and that I have done. Clays of every kind, prepared in every different manner, and preſented in all poſſible forms, were expoſed to the vapour of ſulphur, in rooms lined with lead. Theſe experiments were attended with various reſults, of which I ſhall have occaſion to ſpeak in the courſe of this account; at preſent it is ſufficient for my purpoſe to obſerve, that the ſame

* The vapour which is decompoſed upon the ſides of rooms lined with lead, indicates only from 45 to 50 degrees, becauſe that vapour is weakened by being combined with the water of the atmoſphere. But if this ſame vapour is received in dry veſſels, at the inſtant of its being diſengaged, it is condenſed, in the form of ill-defined cryſtals, on the ſides of the veſſels, by being artificially cooled; and it becomes liquid as ſoon as the external air, more or leſs charged with water, is ſuffered to enter the veſſels.

experiments were varied and repeated, until I had acquired principles sufficiently sure and fixed to go to work in the large way; and to determine me to establish one of the largest manufactories of the kind. My establishment has been, for the space of two years, in a state of great activity; and I think my principles have now been sufficiently proved, to enable me to offer them with some degree of confidence.

I shall divide what I have to say upon this subject into three parts. In the first I shall speak of the construction of the place in which the mixture of sulphur and saltpetre is to be burnt. In the second, I shall consider the choice of the earths, and manner of preparing them. In the third, I shall make known what experience has taught me respecting the phenomena presented by the earths exposed to the aforesaid vapour; respecting the length of time which it is proper to leave them exposed to it; and respecting the manner of managing them while in the rooms in which they are exposed.

First. Our rooms lined with lead are very proper for the use above spoken of, the vapours of vitriolic acid having very little action upon lead; those of the nitrous acid, which are formed and disengage difengage themfelves as foon as the rooms are opened to be aired, have more action upon that metal, but, when its furface becomes corroded, there is formed upon it a layer of white calx, which, in the manner of a varnifh, protects the metal to which it adheres. But lead is heavy and expenfive, and, for thofe reafons, not very eligible for large and extenfive eftablifhments. Thefe confiderations prompted me to feek for fome kind of cement, which fhould not be fenfibly acted upon by the acid in a ftate of vapour; which fhould not grow foft by a heat of from 40 to 50 degrees of Reaumur; (122 to 144½ of Fahrenheit;) and which fhould be fo fmooth that no cracks or crevices fhould appear in it after being laid on. To fulfil all thefe conditions was no eafy tafk; but, in order that I might be able to make all neceffary experiments, I caufed a room to be built of wood, fupported by pillars of ftone, at the height of five feet from the earth, and entirely detached from all other buildings, that it might be expofed to a more ftrict examination. This room is thirty feet long, twelve wide, and fix high; and I have, in fucceffion, lined the infide of it with all the cements from which (according to experiments made upon them in a ſmall way) I had reaſon to hope for ſucceſs. I then burnt the uſual mixture of ſulphur and ſaltpetre in it for the ſpace of one or two months; at the end of that time I took away the product of the combuſtion, and I attentively examined the ſtate of the cement, with which the inſide of the room was covered. Sometimes I found it all cracked and broken; at others that it had been melted, and had run upon the ground; it was often ſeparated from the wood, though it had been very carefully applied with a bruſh; ſtill more often, the oil, which ran about the edges of the cement, diſſolved it, and became coloured by it. Whichever of theſe events took place, I never failed to ſcrape off the cement, and ſubſtitute another in its place, which I ſuppoſed might be free from the defects I had juſt witneſſed. In ſhort, after a courſe of experiments which laſted from twelve to fifteen months, I ſucceeded in finding a compoſition which appeared to me to poſſeſs many advantages over all others; the cement which I then applied to my room having exiſted for the ſpace of three years without having received any ſenſible damage,

mage, though the room has been conſtantly employed for making oil of vitriol. The only fault I have obſerved in it is, that it is rather too eaſily affected by heat; but this inconvenience may be removed by burning the compoſition on the outſide of the room, and managing it in ſuch a manner that the heat in the inſide ſhall never exceed 45 degrees of Reaumur (133 of Fahrenheit) *.

In conſequence of the reſult of my experiments, I reſolved to ſet on foot a more conſider-

* This cement is compoſed of equal parts of roſin, turpentine, and wax. Theſe three ſubſtances are melted together in a pot; and, when all the volatile oil which cauſes the mixture to riſe is diſſipated, it is to be applied boiling-hot, with a bruſh. The number of uſes to which this cement may be applied is very great; it may be employed to line the caſks uſed on-board a ſhip; the water, or victuals kept in them, would not be ſo ſubject to become putrid; even the ſhips themſelves might be coated with it. This cement is preferable to tar in many reſpects, it is not ſo ſubject to crack, it is leſs ſticky, is more ſimple, and has a ſmoother ſurface. A board ſix feet long, and eighteen inches wide, covered with this cement, was kept in water for nineteen months; it had not imbibed any water, nor was the coating at all damaged. If it ſhould be required to render this cement more conſiſtent, it may be done by the addition of powdered bricks.

able eſtabliſhment for making alum; the building I conſtructed for that purpoſe has been in conſtant uſe during two years.

The room in which the mixture of ſulphur and ſaltpetre is burnt is forty-eight feet long, forty-four wide, and twenty-ſeven high at the higheſt part. The walls of the ſides are of common maſonry, and are covered internally with a thick coating of white plaſter; the floor is paved with bricks, bedded in mortar formed of a mixture of calcined and freſh clay. Upon this firſt pavement is laid a ſecond, in order to croſs and cover the joints which are formed by the bricks of the firſt: and the bricks of this ſecond pavement are bedded in a layer of my cement, which is uſed hot, in the way of mortar.

The roof of this room is of wood, but the beams are very near to each other; they have longitudinal grooves from end to end, into which the boards are fitted, ſo as entirely to fill up the ſpace between the beams; in this way the whole of this large piece of timber work is put together, without a ſingle nail.

This

This room, conſtructed as aforeſaid, was lined with my cement; three or four layers of which were ſucceſſively applied, in order to efface the little holes and cracks which are always formed in the firſt layer, and to leave the ſurface perfectly ſmooth and poliſhed. I alſo took particular care to apply the firſt layer as hot as poſſible, that the wood, the plaſter, and the bricks, may be well impregnated with it; when the cement is applied in this manner, it enters, a certain way, into the texture of theſe ſubſtances, and, as it were, incorporates with them. This operation requires ſo much care, is ſo very eſſential, and the conſequences of its being ill-performed are ſo injurious, that the execution of it muſt not be truſted to one who does it merely for hire; and it will perhaps be thought aſtoniſhing that eight months of conſtant labour were barely ſufficient to complete this work. I firſt applied the cement upon the inner ſurface of the roof, becauſe I was always apprehenſive that the influence of heat and cold, and the changes in the degrees of moiſture and dryneſs, might cauſe the wood-work to warp, and in that caſe I ſhould

have

have time to judge of its ſtate, and apply a remedy. It was not long before my ſuſpicions on that head were confirmed; as, after a ſpace of three or four months, I obſerved cracks and crevices beginning to form, to an alarming degree. I then reſolved to take off the tiles of the roof, (which were laid immediately upon the wood-work of my room,) and to apply a layer of cement over the whole external ſurface of the wood. By this means I placed all the wood-work of the room between two layers of cement, thereby preventing the wood from imbibing any moiſture. I alſo repaired the cement within, and the roof has now exiſted for two years and three months in ſo entire and perfect a ſtate as to be truly aſtoniſhing.

This cement has ſo much the advantage over lead, with reſpect to expence, that the inſide of this immenſe room coſt me only from ſix to ſeven thouſand *livres*; whereas it is very eaſy to ſhew, by calculation, that the value of the lead, requiſite to cover all the ſurfaces, would amount to from eight to nine hundred thouſand *livres*.

TO BE CONCLUDED IN OUR NEXT.

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REPERTORY
OF
ARTS AND MANUFACTURES.

NUMBER IX.

Printed by NICHOLS and SON, Red-Lion-Paſſage, Fleet-Street, London.

XX. Specification of the Patent granted to Mr. JOHN DANIEL BELFOUR, of Elſineur, in the Kingdom of Denmark; for his new-invented Machine for making and manufacturing Ropes and Cordage.

Dated March 3, 1793.

WITH THREE PLATES.

TO all to whom theſe preſents ſhall come, &c. NOW THEREFORE KNOW YE, that I the ſaid John Daniel Belfour do by this inſtrument under my hand and ſeal, in purſuance of ſuch proviſo in the ſaid recited letters patent contained, and in compliance therewith, declare that the plans or drawings annexed to this inftrument, and the defcription and references herein after contained, do particularly defcribe and afcertain the nature of my faid invention, for which fuch letters patent were granted to me as aforefaid, and in what manner the fame is to be performed; premifing, and wifhing it to be particularly underftood, that the fize and dimenfions of the machines, and their component parts, which are herein defcribed, are taken from thofe which I myfelf have ufed, and from which the annexed drawings are made, but that the machines may be made of different fizes if required. The effect intended to be produced by the machine invented by me, and for which this patent is taken out, is to improve the manufacture of ropes and cordage, by making every yarn employed in the compofition thereof bear its proper and equal proportion of the ftrefs: in order to do this it is neceffary that every yarn fhould, at the time of its being twifted into the rope, be kept tight, to prevent its being fqueezed or puckered up into the infide of the ftrand, as is too much the cafe in ropes made upon the old principle;

principle; and to keep them thus tight, in the operation intended by this machinery, every yarn is to be wound upon a feparate reel, which reel is fo conftructed as not to yield or render out the yarn wound upon it, until fuch yarn is, in the operation of twifting, called forth to contribute its affiftance and proportion in forming the ftrand. This is the end propofed to be anfwered by all the machinery mentioned in this fpecification, in which all the other parts are fubordinate to the great machine reprefented in the drawing annexed, and marked with the letter A. (Plate IX. Fig. 1. and Plate X.) which letter is fixed upon the upper rail of the great frame of the machine. A great part of the effect intended to be produced confifts in winding the yarns regularly upon the reels, and to that end a confiderable part of the machinery hereafter defcribed is particularly applied, becaufe, when the yarns are fo wound on the reels, thofe reels will yield or deliver the yarns off the great machine A then ftanding ftill. This machine or frame contains the reels, marked B, on one of which reels a part of every rope-yarn is to be wound, the other ends of fuch yarn being faftened to the winch or handle that twiſts the ſtrands. This frame may be made larger or ſmaller, according to the quantity of reels intended to be placed in it, which quantity of reels depends on the will of the manufacturer, agreeable to the ſize of the rope intended to be made, as each rope-yarn muſt have a ſeparate reel for itſelf. I have found it neceſſary, in making one ſtrand of a twenty-two-inch cable, to have the frame made very ſtrong, of oak timber ſix inches ſquare, to enable it to counteract the great ſtrain it has to bear during the twiſting of ſuch a ſtrand; and, for the convenience of moving the frame, four rollers ſhould be inſerted, two under each ſide of the bottom of the frame, for it to move on; which rollers may be made of wood or metal, and ſhould be proportionate in ſize and ſtrength to the dimenſions of the frame itſelf. On the fore part of the frame there is to be placed, as appears in the drawing, a grate-work of wood and iron, marked C, which moves from ſide to ſide on two rollers, marked D, which are fixed in the lower part of the great frame A; and the grate-work is guided on the top by two rollers, alſo marked D, fixed in the upper

part

part of the great frame A. The uſe of this grate-work is to lead or guide the yarns to the ſeparate reels, on which they are to be wound, and to prevent the yarns from getting between the reels, and alſo to fill the reels with yarns properly from ſide to ſide. To produce theſe effects this grate-work is moved backwards and forwards, by a great wheel fixed on the right ſide of the great frame A, reckoning when a perſon ſtands with his back to the frame, and which wheel is marked E. This wheel is of a ſingular conſtruction, and may be made of braſs, iron, or any other hard metal, as is hereafter more fully deſcribed. This wheel is turned by one of the ſpindles on which the annexed drawing is made, the wheel is turned by the ſeventh ſpindle from the bottom, marked F, and that ſpindle is alſo turned by the general handle G, which handle, at the ſame time, turns all or as many of the ſpindles hereafter deſcribed as the manufacturer chooſes to ſet in motion, according to the ſize of the rope he intends to make. The number of reels which I have uſed in making one ſtrand, or one ninth part, of a twenty-two-inch

inch cable, has been two hundred and ninety-ſeven; which I have placed in the great frame A on eleven ſpindles, each ſpindle containing twenty-ſeven reels, and the height of the great frame A, thus filled with two hundred and ninety-ſeven reels, will be ſeven feet ſix inches, and the breadth eleven feet: where a great number of ſpindles are introduced, the ſize of the frame muſt be increaſed in proportion. The ſpindles on which the reels are fixed (four of which ſpindles are marked H) are made of round iron bars, of an inch and a quarter in diameter, and in length according to the ſize of the great frame A. They are inſerted, at the farthermoſt or right-hand end, into the great frame A, and paſs through the frame at the other or left-hand, reckoning as aforeſaid, into a plate of iron as repreſented in the drawing, and marked I; to each ſpindle is fixed a ſmall handle, marked K, which handle ſerves to turn the ſpindles round, for the purpoſe of turning the reels on which the yarns are wound. Theſe ſpindles ſhould be made of iron; the reels upon which the yarns are wound may be made of wood, iron, braſs, or other metal, but I have found

found them beſt and moſt durable as follows: the barrel of the reel ſhould be of wood turned, and ſhould be in length four inches, and in diameter three inches; a hole muſt be bored through the centre ſufficiently large for the ſpindles, marked F, to go through, ſo that the reel may turn round eaſily on the ſpindles; and on each end of the barrel of the reel, to form the two ends of each reel, an iron plate ſhould be fixed, about one eighth of an inch thick, and ſix inches in diameter, ſo as to make the height of the ends of the reels ſix inches. In order that the reels, after a ſufficient quantity of yarn is wound upon them, may be confined to their own ſpindles, ſo as neither to be fixed too faſt nor moved too eaſily, I have introduced four ſprings into each reel, which ſprings are marked L, (Plate IX. Fig. 2.) and ſhould be made of iron or ſteel, about two inches and a half in length, one quarter of an inch in breadth, and one eighth of an inch thick in the middle, and ſmaller towards each end: two of theſe ſprings are fixed into each end of the barrel of the ſaid reel in the inſide; one end of each ſpring is fixed faſt into the barrel of the reel, the

other

other end is movable, and is governed by a ſcrew marked M, which, by being turned towards the right, cloſes the two ends, and thereby fixes the reel faſter to the ſpindle, or, being turned the other way, opens the two ends, thereby allowing the reel to move more freely; a drawing of the inſide of one of the ends of one of the reels is included among the drawings annexed. At the diſtance of four inches from the right-hand end of each ſpindle, reckoning as aforeſaid, and of nine inches from the left, upon each ſpindle is placed a ſcrew-nut, for the purpoſe of ſcrewing all the reels on their ſpindles cloſe together, or giving them greater liberty, and alſo for keeping the reels in their proper places; and, to give effect to theſe nuts, each end of each ſpindle muſt be made wormed, ſo as to articulate with the ſcrew or worm in the inſide of each nut. The nuts are deſcribed by the letter O, and may be made of iron, braſs, or other hard metal, but I have found thoſe of braſs the beſt; they ſhould be made in the ſhape of  and about four inches diameter, ſo as to be moved by the hand, without a key, or any other inſtrument. To prevent the ſpindles from

from bending, or breaking, or giving way, during the operation of twiſting the ſtrand, I have fixed the ſtandard P, which ſhould ſtand perpendicularly, and as near as poſſible in the middle of the great frame A, and be faſtened into the upper and lower parts of the great frame A. This ſtandard ſhould have holes in it, at proper diſtances, ſufficiently large for each ſpindle to go through, which ſtandard I recommend to be made of iron, three inches broad and half an inch thick; placed edgeways as near in the centre of the machine as can be; its height of courſe muſt depend on the height of the great frame A. It ſhould be inſerted into the top and bottom rails of the great frame, or fixed by nails or ſcrews, or in any other manner the manufacturer chuſes, ſo as to make it faſt. To prevent the wheels from carrying each other round, there ſhould be placed between every two reels, upon the ſpindle, a round piece of braſs with a hole through it, ſo large as to let it paſs freely round the ſpindle without being confined to it, three inches in diameter, one eighth of an inch thick at that part which is neareſt the ſpindle, and reduced gradually ſmaller, to about half its thicknefs, at the other edges; this piece may be made of iron, or any other hard metal, but I am of opinion brafs will anfwer the purpofe beft. The handles defcribed by the letter K, which are fixed on thofe ends of the fpindles that come through the great frame A, for the purpofe of turning the fpindles round, are made of iron, about ten inches long, and a little curved outwards, that they may pafs each other; and each handle may be turned feparately, or all together by the iron plate I, through which plate are holes, fufficiently large to receive the end of each handle, and which plate may be taken off or kept on at pleafure, by removing the fcrews which fix it to the upper and lower of the fmaller handles K, which fcrews may be made of iron or any other hard metal. The handles K fhould be about half an inch in diameter, and may be made either round or fquare; and, at that end of the handle where the fpindle is introduced, a fquare or other hole muft be made, for the fpindle to go through, which may be faftened by a pin or fcrew, or riveted. The plate I, through which the ends of the fmall handles K pafs, fhould be made

made of iron, and be about one inch and a half broad, and a quarter of an inch thick; its length muſt depend upon the number of ſpindles there are to be turned by it: the ſmaller handles marked K, may be made in the form of the handle of a corn or coffee mill. The ſize of the frame, in which the grate-work of wood and iron marked C is fixed, muſt depend on the ſize of the great frame A; it ſhould ſtand perpendicular, and its breadth and height muſt be leſs than the breadth and height of the frame A, becauſe it muſt move backwards and forwards in the front of the frame A, and it ſhould be leſs in breadth than the breadth of the inſide, or clear of the frame A, by the length of one of the reels; and lower than the clear of the height of the frame A, ſo as to work freely upon and under the four rollers before deſcribed. The frame of the grate-work C ſhould be made of oak wood, about three inches ſquare; from the top to the bottom of this frame, in a perpendicular direction, ſhould be fixed as many upright bars of iron as there are reels on each ſpindle. Theſe upright bars are marked Q, and ſhould be diſtant from each other about three inches; they

 ſhould

ſhould be about an inch broad, one quarter of an inch thick, and ſtand with their flat ſides towards the reels, being fixed to the frame C by nails or ſcrews; through which bars muſt be as many holes proportioned on each bar, according to the whole number of reels on the machine, the lower part of which holes muſt be level with the upper part of the barrel of the reel, and as large in height as the ſides of the reels are from the upper part of the barrel to the edge of the plate at the end of the reel, and ſufficiently large in breadth to admit a common rope yarn to paſs through them with a rough knot upon it. In order to confine theſe bars in proper places, it is neceſſary to have two or more croſs bars of wood or metal, marked R, which may be made ſtronger or weaker according to the ſize of the machine; I have found them ſufficient when made of oak wood three inches ſquare. The rollers D, on which the frame or grate-work C moves at the bottom, and which keep it in its place at the top, may be made of wood or metal, and ſhould be fixed on pins to the great frame A, having grooves in the centre, which fit on the upper and lower part of the

the frame C; and on the right-hand ſide of the ſaid frame is fixed a connecting-iron, marked S, for the purpoſe of communicating to the frame C the motion given by the wheel E; which iron S muſt be faſtened to the frame of the grate-work C, at about one third of the height from the bottom on the right-hand ſide, ſo as to connect it with the wheel E. The length of the iron S, from the ſide of the frame C on which it is to be fixed, ſhould be about twelve inches, and one inch ſquare, having on the back part of it, towards the wheel E, two projecting arms about three inches in length, one at the end, and the other near the centre; on theſe two arms the ſide plates T, which are fixed on the great wheel E, operate as the wheel E goes round, thereby giving the grate-work the neceſſary motion, to ſlide the frame C from right to left, and back again, in order to fill the reels with yarns equally, as before mentioned. The plates marked T, on each ſide of the great wheel E, ſhould be made of iron or ſteel, and ſhould be fixed upon the great wheel E about one inch within his circumference; their thickneſs ſhould be about half an inch, their breadth,

breadth, in the broadeſt part, ſhould be equal to the length of the body of one of the reels on which the yarns are wound, tapering gradually towards each end till they become level with the ſurface of the great wheel E, on which they are fixed; their length muſt depend on the ſize of the great wheel E, which is to be regulated by the magnitude of the machine. On a machine, capable of containing the quantity of reels ſufficient for making one ſtrand of a twenty-two inch cable, the great wheel E ſhould be two feet in diameter and about half an inch thick, which wheel ſhould be of iron, and it may be either open or ſolid on its circumference; it muſt be divided into teeth, at diſtances proper for receiving thoſe fixed on the end of the ſeventh ſpindle from the bottom before mentioned, which protrudes through the end of the frame A to act upon the great wheel E, ſo that it may receive motion ſufficient to cauſe the grate-work C to move from ſide to ſide a ſpace equal to the thickneſs of a common rope yarn each time the reels on which the yarns are wound go once round; by which means the reels can be properly filled, and conſequently the reels need

need not be any larger than to hold the quantity of yarn which is twiſted up in making the firſt ſtrand of a rope; for example, ſuppoſe in the common method of making ropes one ſixth part of the yarns is twiſted up in the operation of making the firſt ſtrand, (ſay of yarns one hundred and eighty fathoms long,) then on this machine muſt be wound thirty fathoms of each yarn, ſo that (inſtead of a ſledge moving forwards, as in the common way, as the ſtrand is twiſted) this machine is fixed faſt, and, as the ſtrand is twiſted from the oppoſite end of the yarns, each reel moves round and delivers its yarn faſter or ſlower according to the circle which each yarn occupies in the ſtrand; whereby a very conſiderable ſaving in the yarn will be found, by the quantity left on the reels of thoſe yarns which lie in the inſide parts of the ſtrand. A rope thus made, by each yarn being kept tight from one end of the ſtrand to the other in the twiſting, will not only receive a very conſiderable degree of additional ſtrength, but will be much leſs liable to ſtretch; and it will at the ſame time, from its compactneſs, keep the water out much better than a rope made on the old

principle;

principle; it will wear longer, and be leſs ſubject to what is called *meg*, or to break in the partial manner called by ſeamen *ſtranding*, which means one ſtrand giving way before the other; and, from the proceſs I have made, all ropes from the circumference of two inches upwards receive more than one fourth part of additional ſtrength from this proceſs; which ſtrength increaſes as the ropes are made larger, ſo that I apprehend a twelve-inch cable, made after this manner, will anſwer all the purpoſes of one of fifteen inches made in the common way, independent of the ſaving in the materials. The wheel E, ſo frequently mentioned, is placed on the ſide of the great frame A, on a round bolt or ſpindle of iron, marked V, about eight inches long and one inch in diameter, upon which bolt or ſpindle the wheel turns round; and, in order to uſe the wheel E, ſo as to move the grate-work C from ſide to ſide, (in caſe the ſeventh ſpindle ſhould be broken, or not be wanted to be uſed,) on the outer end of the barrel or nave of the wheel E may be fixed a handle, to turn it without the uſe of the teeth on the projecting part of the ſeventh ſpindle. On the back of the left-

hand

hand ſide of the great frame A, through which the ends of each ſpindle come, it is neceſſary to have a hook or ſtop, for the purpoſe of faſtening each handle, after a ſufficient quantity of yarn is wound on the reels, ſo that the ſpindles may remain immovable during the operation of twiſting the ſtrands, while the reels work perfectly free and independent of each other round the ſpindle. It is alſo neceſſary to fix on each reel a piece of line or leather, faſt at both ends, the bite of which is to be put through the holes of the grate-work in the uprights marked Q, for the convenience and diſpatch of faſtening the yarns thereto; which line or leather ſhould be of ſuch length as to be conveniently reached; (ſay from two to three feet;) and, in order to have them always handy after the ſpare yarn is taken from them, a bolt, or piece of wood, may be put through the bites of thoſe which the ſize of the rope may not require to be uſed, to prevent them from being drawn through the grate-work, and thereby creating confuſion among the reels. At the back ends of the lower parts of the great frame A ſhould be fixed ſtraps or bolts, for the purpoſe of faſtening it, to prevent its moving

 forward

forward during the operation of twiſting the ſtrands; and, if it ſhould be thought neceſſary, for the better ſtrengthening and ſecuring the ſpindles, more than one of the upright ſtandards P may be uſed; for, if that is done, it will render a proportionably greater number of the nuts O neceſſary for regulating the ſituation of the reels on the ſpindles.

The above is the explanation of the conſtruction and effects of the principal parts of the machinery uſed in this operation: what follows relates to the detached parts of the machinery which are neceſſary, according to my plan, to complete the whole. The machine which I call the ſeparating machine (ſee Plate XI. Fig. 1 and 2) is for the purpoſe of keeping each yarn free and ſeparate from the others, during the operation of twiſting the ſtrands; and there may be one of theſe ſeparating-machines for every fifteen or twenty fathoms of yarn to be twiſted, at the option of the manufacturer. It is to ſtand looſe, for the convenience of being moved when neceſſary, and its ſize muſt depend on the ſize of the great machine A; but, for the ſtrand of a twenty-two inch cable, I found it neceſſary to have its breadth three feet, and its height four feet ſix inches. The ſtandards or ſides, marked *a*, may be made of wood, four inches broad and two inches thick; the reſt of the frame in due proportion. In the inſide of both the ſtandards or ſides *a* muſt be a groove, two inches broad and three quarters of an inch deep, from the top to within two inches of the bottom of the ſtandard, to admit the frame *b* to be ſlid up and down if thought neceſſary; and the two ſtandards *a* may alſo, if thought proper, be connected, at half their height from the bottom, by a hinge, ſo that they may fall down outwards, in order to give more room in the rope-walk; and, when in uſe, theſe ſides may be kept faſt by a ſmall hook, bolt, or pin, at each ſide. The frame *b* muſt be made to fit the groove in the ſtandard *a*, and be half its height, into the bottom of which frame ſhould be inſerted, and fixed, bars of wood or metal, marked *c*, but I prefer wood on account of its being lighter. Each of theſe bars ſhould be as high as the frame *b*, and about one inch ſquare, having a ſpace betwixt each, of about one quarter of an inch. The frame *b* ſhould be open at the top, like the teeth of a comb, for convenience of admitting the yarns to be dropped in, without the trouble of receiving them through; and, to facilitate the doing of this, on one ſide of the bars there ſhould be as many ſmall bolts or rods, made of round iron, about one eighth of an inch diameter, marked *d*, as there are ſpindles in the great machine A, ſo that each yarn may be ſeparated from the other: and theſe rods are to be put through bored holes in the three upright parts of the frame *b*, marked *e*. On the end of each rod ſhould be a ſmall knob or head, and upon the rods, immediately within their knobs or heads, muſt be placed a plate *f*, with as many holes in it as there are rods, through one of which holes each rod is to paſs, which plate I find beſt made of iron; it ſhould be ſo long as to take in the ends of each rod, and of ſufficient ſtrength to bear the rods being all drawn out at once if required; upon which plate may be placed handles, large enough to receive a man's hand, in order to draw out the plate and rods all at once. Theſe rods ſhould be at equal diſtances, according to the ſize of the frame, as they are intended to keep the yarns from falling upon or mingling with each other;

other; if they are at the diſtance of one inch it will be found ſufficient to prevent confuſion. The reaſon why theſe rods ſhould be thus looſe is for diſpatch; for example, before the rope-maker begins to work, all the rods are to be drawn out of the machine, and as the men or boys employed carry the yarn along they are to drop the yarns between the bars *c*; as ſoon as the yarn is put between every bar, the lowermoſt rod is to be put into its place, after which the next row of yarns is to be put in, then the ſecond rod, and ſo on till the whole number of yarns required to be uſed ſhall be dropped in. The uſe of the plate *f* is as follows; when the twiſting of the ſtrand is begun, and the top minor (an inſtrument uſed in twiſting, the nature and uſe of which is herein after deſcribed) approaches towards the machine, fig. 1, one of the workmen is to draw all the rods out at once, by which means the yarns are entirely free of the machine, and no impediment is occaſioned by the operation; he is then to draw out the pin *g*, which keeps the frame *b* in its place, whereby that frame falls to the bottom, in the grooves, as before deſcribed, and, if occaſion requires, he is to unhook or looſen the hooks

hooks *i*, by which means the upper part of the ſtandards *a* falls down outwards, and thereby gives more room in the rope-walk. According to the length of the rope intended to be made, more than one of theſe ſeparating machines are to be uſed in the ſame manner; I find by experience, that one ſeparating-machine at every fifteen fathom is ſufficient, but the number ſhould be proportioned to the diſtance each yarn is kept from the other, becauſe the farther the yarns are ſeparated from each other the fewer of thoſe ſeparating-machines are required. To prevent the ſtrand from being twiſted too quick, I have introduced an inſtrument which I call the top minor, marked U, (Pl. XI. Fig. 3 and 4) which is inſerted between the yarns, and keeps each yarn ſeparate from the reſt; it moving along as the ſtrand is twiſted. The top minor U ſhould be made of ſtrong tough wood, which I have found beſt of elm or oak, and its ſhape and uſe are as follows. In ſhape it reſembles a ſugar-loaf, but is not ſo piqued at the ſmall end, but at the broad end exactly of the ſame form as *per* drawing U; round the broad end ſhould be fixed a hoop of iron, which is to be let in level with

with the wood, which hoop muſt be made according to the ſize of the top. To this hoop ſhould be fixed ſmall projecting pieces of iron, their length about two inches, their breadth about one inch, and their thickneſs in the middle about one eighth of an inch, and ſomething ſmaller towards each edge: they ſhould ſtand at the diſtance from each other of one quarter of an inch, or more if poſſible to be allowed, which muſt depend on the ſize of the rope to be made, otherwiſe in making the ſtrands of a great cable its ſize will be encreaſed ſo as to render it cumberſome to uſe; for example, a top minor of about nine inches diameter at the broad end, will be of a ſize ſufficient for the twiſting a number of yarns to make a ſtrand of a twelve-inch cable, whereas to make a twenty-two inch cable it would require one of twenty-four or twenty-ſix inches diameter; and, when the whole quantity of cavities between the ſpikes of the top minor are not wanted, the yarns can be placed between every ſecond or third, ſo as to render but few of theſe top minors neceſſary in a rope walk. Its length ſhould be the ſame as the diameter at the broad end, and it ſhould decline

away

away towards the ſmall end. At one fifth of its length from the broad end ſhould be fixed, either into or through it, two handles, for the purpoſe of guiding it as the ſtrand is twiſted, by which means it may be impelled forward or kept back, ſo as to cauſe the ſtrand to be twiſted harder or more open, at the option of the workmen, and the reaſon of its being ſo ſtunt (as I call it) at the ſmall end is, that it may not jam among the yarns: and, from its ſhape, and being greaſed before it is placed among them, it will be found to require very little aſſiſtance, but will move forward as the ſtrand is twiſted. If, in making the ſtrand of a large rope, it is thought too large or cumberſome to be governed by hand, it may eaſily be fixed on a ſmall ſledge, to relieve the workman, which ſledge, if neceſſary, can have a ſmall winch in it, upon which winch a rope may be uſed, faſtened to the oppoſite end of the rope-walk, to heave the ſledge, and the top minor along with it, forward as wanted. Various other methods may be ſubſtituted for the purpoſe of preventing the ſtrand from twiſting, until it has received that poſition the workman wiſhes; ſuch as pieces of wood with holes bored in them;

ſmall

ſmall machines divided in a ſimilar manner, or ſomething like the ſeparating-machine before deſcribed ; or by the external application of a ring, or other circular inſtrument, or any other ſhape, ſo as to preſs upon the ſtrand, and prevent its receiving an improper twiſt, to ſerve the purpoſe or intention of the top minor ; for, unleſs the ſtrand is regulated in the twiſt, and kept exactly in the poſition in which it is to remain, the good effects propoſed by this invention will be in a great degree defeated; but it is not of any conſequence in what manner it is regulated, ſo long as that point is accompliſhed. The reaſon why I prefer the top minor as here deſcribed, and marked U, to any other mode, is, that it may be put among the yarns, and thereby ſave conſiderable trouble, and, when it is done with, it can be eaſily taken out again. The length of the handles to be affixed to the top minor may be optional, from one to two feet and a half, and they may either be fixed into it, or run through it, and ſhould be of iron, two inches and a half in breadth, half an inch thick in the middle, and rather thinner towards the edge. To prevent the ſtrand, when it is twiſted, from untwiſting again, I have found it neceſſary to have a contrivance which I call *nippers*, marked W, (Pl. XI. Fig. 3.) which are to be ſcrewed faſt on that end of each ſtrand which terminates at the great machine A, after the ſtrand has received its proper twiſt, and before it is looſened from the great machine, and placed on the great winch commonly uſed for the purpoſe of twiſting the three ſtrands into one; and theſe will alſo ſerve to conduct the ſtrands exactly towards the great winch, ſo as to prevent one ſtrand being longer than the other; they ſhould be made of iron, ſufficiently ſtrong to bear the ſtrain that may be requiſite, which is no more than to hold the ſtrands tight after twiſting. In the bite of theſe nippers the ſtrands muſt be fixed faſt by a ſcrew, and the nippers muſt be properly ſecured in the frame; as ſoon as one ſtrand is fixed on the great winch, the ſledge with the nippers may be ſlipped under the next ſtrand; and, when that is fixed, to the third. The thickneſs of the nippers, in the ſhank, ſhould be about one inch in diameter, and the hole of the ſledge, through which they are fixed, ſufficiently large to admit their being turned round

round with eaſe; their ſhape ſhould be as *per* letter W, and they may be fixed into the upper or croſs bar of the ſledge, or the fore part of the great winch, (at the diſtance of ſix, nine, or twelve inches from the ſhanks of the ſame,) heretofore uſed in twiſting the three ſtrands into one; but, the nearer they are fixed, the ſhorter the neck need be to convey the ſtrand to the winch. The jaw X may be made to open ſufficiently to receive one ſtrand of the largeſt rope, as it may be ſcrewed together ſo as to confine the ſmalleſt, and it may be made either round or ſquare. In order to facilitate the general work, as each yarn muſt be placed ſeparately on a reel on the great machine A, it would be better to have a great number of whole yarns wound on ſeparate reels, diſtinct from thoſe which are placed on thoſe ſpindles, always ready for uſe; the yarns may be wound on theſe reels by boys, women, or old men, as ſoon as the yarns have gone through the tar, and are ſufficiently dry. The ſize of theſe diſtinct or ſpare reels muſt depend on the length of the yarn, and they ſhould be made of light wood, with a hole through each ſufficiently large to receive a bolt, on which they can run round with eaſe, at one end of which bolt there ſhould be a handle fixed; and, as the reels are put on one by one, there ſhould be a ſmall braſs or iron ring put between each, ſo as to prevent one reel from pulling the other round, ſimilar to thoſe between the reels on the ſpindles in the great machine A. The uſe of theſe reels, with the yarns thus wound, will be eaſily perceived to be to facilitate the winding the yarns from them, on to the reels or the ſpindles in A, and the number of them muſt be proportionate to the ſize of the rope intended to be made, and the ſtrength of thoſe who are to carry them; and, when the intended quantity of reels is put on the bolt, another handle may be eaſily put on the other end of it, to keep the reels on, and make it more convenient to carry. When the number of reels is ſo placed, the end of each yarn muſt be faſtened to the bite of the cords, or leather ſtraps, fixed on the reels in the great machine A; then the intended quantity of yarn, from the other reels on the bolt, muſt be wound on the reels of the great machine A, while thoſe who bear the reels on the bolt walk on gradually, towards the upper end of the

rope-

rope-walk, permitting the reels to run round and quit the yarns as they go. When the reels, on the great machine A, have received as much yarn as is intended to be put on them, let the other ends of the yarn be faftened to the twifting winch, as ufual, at the oppofite end of the rope-walk. It will always be advifable, in winding the yarns on to the reels, in the machine A, to begin with the lower rows of thofe reels, on account of placing or dropping the yarns properly into the feparating machine; and it will be alfo advifable to wind on to the reels, in the machine A, as many yarns at one time as there are reels on one fpindle, because, a whole fpindle of reels being turned by one handle, time and labour will both be faved. In order to place the yarns in the feparating-machine with the greateft eafe, the conductor, marked Y, (Pl. XI. Fig. 4.) will be found ufeful, and it may be made of wood, of a fufficient length to admit fmall pins to be fixed into it, at the diftance of about one quater of an inch from each other, between which the yarns may be placed, as foon as they are wound on the reels upon the machine A; and two boys can, with the conductor borne

between

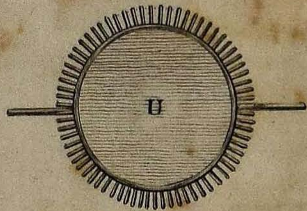
between them, follow thofe who carry the yarn along, and by that means the yarns will be placed much fooner, and more regularly, in the fepara-ting-machine. As few rope-makers have occafion to make cables larger than eighteen inches diameter, the generality of them will, in my opinion, find a machine that will contain two hundred reels, for making one ftrand, large enough, but this will in fome meafure depend on the thicknefs of the yarns. It will be proper to have three of thefe machines, becaufe then all the three ftrands of a cable may be twifted at one time, and thereby greater regularity effected. Thofe who make no larger than a fixteen-inch cable in diameter, will find a machine that contains one hundred and fixty reels large enough, allowing always for the different thicknefs of yarns; but, when a twenty-two-inch cable is to be made, it will be neceffary to have the quantity I have mentioned in the former part of this fpecification, viz. two hundred and ninety-feven reels; although, by this improved method of laying the yarns together, by which each yarn is made to bear an equal ftrain, I am fully perfuaded that an eighteen-inch cable will

will be found to anſwer all the purpoſes of one of twenty-two inches made in the common way; and there will be a ſaving of a conſiderable quantity of the yarns, which will be found left on the reels; which, in the uſual mode of twiſting, would have been all wound up into the ſtrands, and which in a large cable will amount to a very important quantity; or, if it ſhould ſtill be wiſhed to uſe cables and ropes of the ſame dimenſions as hitherto, a prodigious encreaſe of ſtrength, compactneſs, and durability, will be found in ſtrands twiſted by this machine. The ropes made by this machine ſhould be wrought by ſteady and well-practiſed workmen, and, when they come to lay the three ſtrands into one, they ſhould endeavour, by all means in their power, to turn at both ends of the rope-walk with an equal motion, ſo that no more twiſt may be taken into the firſt ſtrands than when the top minor paſſes through them; for, by any conſiderable alteration in twiſting, either too ſlow or too quick, part of the improvement intended by this proceſs may be defeated; for, if twiſted too quick at the end towards which the top approaches, the outſide yarns will receive more ſtrain on them than they

they ought to have, and, if too ſlow, the inſide yarns will be affected in a ſimilar manner. Therefore it is neceſſary to be attentive to this part of the proceſs, and as the ſledge, through which they twiſt the ſtrands, as well as the machine A, both ſtand faſt during the laying the yarns into ſtrands, it may not be amiſs to have a ſmall bell over each with a line fixed to it, and conducted along the top of the rope-walk, within reach, to give notice to the men at the other end when to ſtop. Every part of the manufacturing of cordage and ropes in general may be executed in the manner hitherto practiſed, except this of twiſting the yarns into the firſt ſtrands, whether for the purpoſe of making what are commonly called *water-laid ropes*, or *ſhroud-laid ropes*; and the hemp may be dreſt, and the yarn ſpun and tarred, in the uſual manner. In making ſmaller ropes three ſtrands can be made on one machine, according to the number of the yarns which may be required. It muſt alſo be obſerved, that in twiſting the ſtrands there muſt be a top minor for each, all of which ſhould be carried along at one time, equal to each other, that the three ſtrands may have an equal texture. In witneſs whereof, &c.

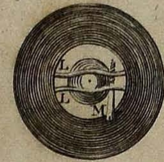
XXI.

Fig. 3.



Broadest end of the top minor

Fig. 2.



View of one of the Reels in the inside, under the outer plate, or end

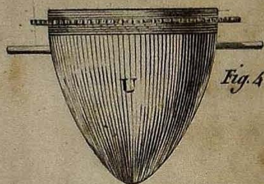


Fig. 4.

Side of the top minor

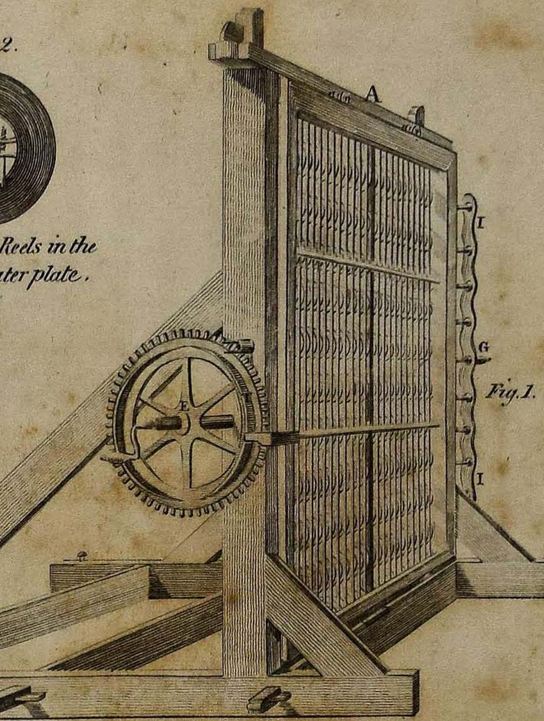
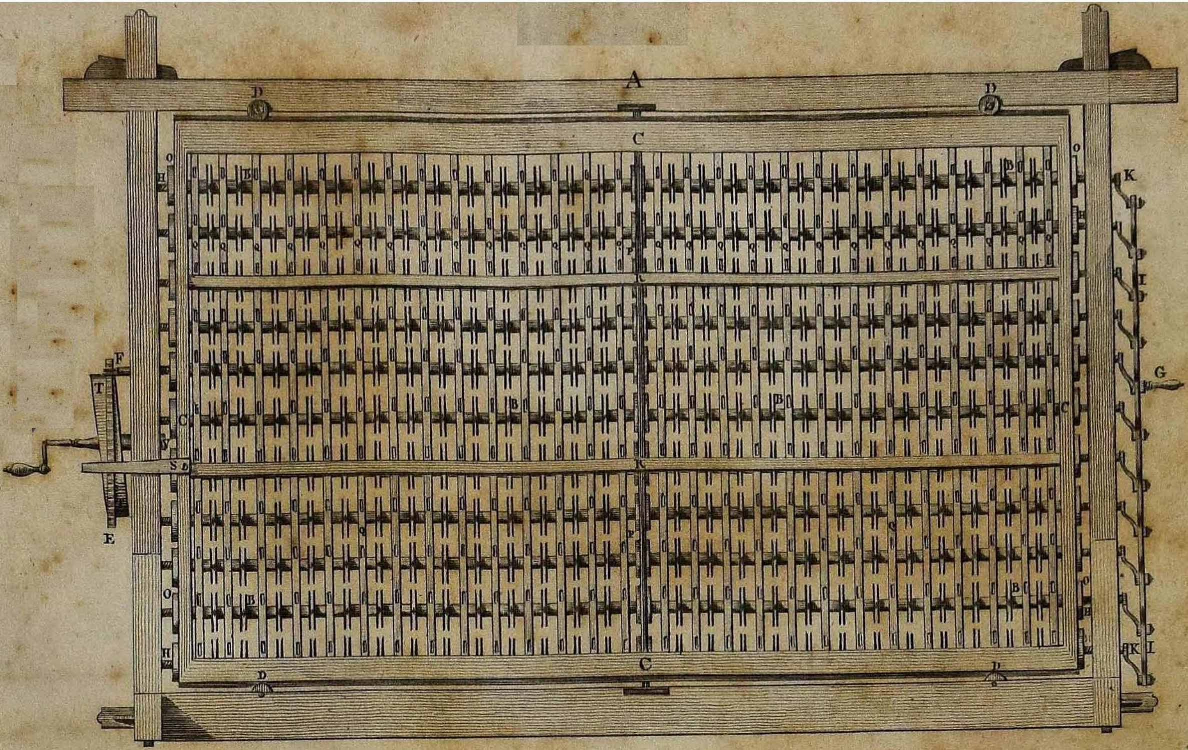


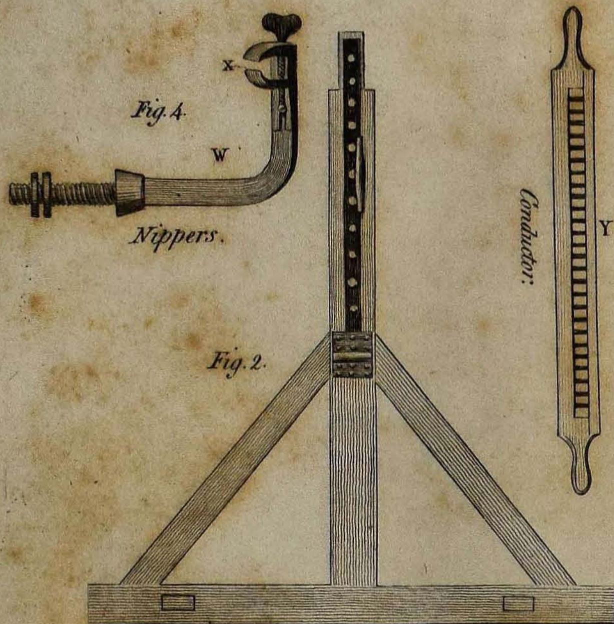
Fig. 1.

Perspective of the great Machine.



Front view of the great Machine, with the gratework C. Six only of the Reels are mark-ed B, four of the Spindles are marked H, and four of the Nuts marked O; but all the rest of the above parts are to be considered as described by the same Letter.

Fig. 4.



Nippers.

Fig. 3.

Conductor.

Fig. 2.

End view of the separating Machine.

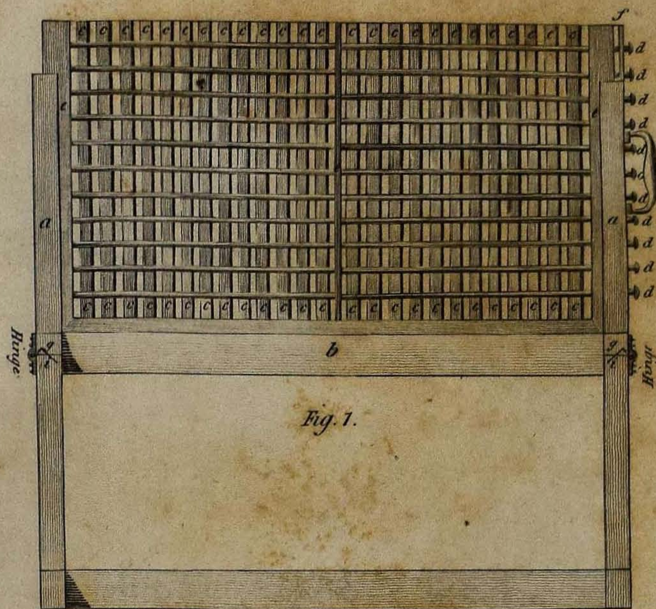


Fig. 1.

Front view of the separating Machine.

XXI. Specification of the Patent granted to Mr. WILLIAM JAYNE, of Sheffield, in the County of York, Confectioner; for his Invention of a Compofition, or Mixture, for keeping and preferving perfectly found, for the Space of two Years at the leaft, the Eggs of Hens, Turkeys, Geefe, and Ducks.

Dated Feb. 8, 1791.

TO all to whom thefe prefents fhall come, &c. NOW KNOW YE that, in compliance with the faid provifo, I the faid William Jayne do hereby declare, that my faid invention is defcribed in manner following; that is to fay, take and put into a tub or veffel one bufhel, Winchefter-meafure, of quick lime, thirty-two ounces of falt, eight ounces of cream of tartar, and mix the ſame together, with as much water as will reduce the compoſition, or mixture, to that conſiſtence that it will cauſe an egg, put into it, to ſwim with its top juſt above the liquid; then put, and keep, the eggs therein, which will preſerve them perfectly ſound for the ſpace of two years at the leaſt. In witneſs whereof, &c.

XXII. Specification of the Patent granted to George Glenny, of Bromley-Hill, in the County of Kent, Eſq. for his Method of obtaining from Wood Aſhes a greater Quantity than uſual of Pot and Pearl Aſhes.

Dated April 2, 1791.

To all to whom theſe preſents ſhall come, &c. Now know ye that, in compliance with the

the ſaid proviſo, I the ſaid George Glenny do hereby declare, that the method or invention uſed by me, for obtaining from wood aſhes a greatly ſuperior quantity of pot and pearl aſhes than has hitherto been obtained, is as follows: namely, that the common aſhes produced by burning wood muſt be completely calcined in a furnace; and, if a ſmall proportion of lime be ſifted among the wood aſhes, before they are put into the calcining furnace, it will prevent them from vitrifying; but, if they are at times ſtirred with an iron rake, or other proper inſtrument, during the proceſs of calcination, that will anſwer the purpoſe of adding the lime; and when the aſhes are calcined into a fine powder the uſual method may be purſued, but it is better to boil them in large veſſels, eſpecially in froſty weather. In witneſs whereof, &c.

XXIII. Deſcription of a Sea Gage, for the Purpoſe of ſounding in Currents, and great Depths of Water; by JOHN CHARNOCK, Eſq.

WITH A PLATE.

A VARIETY of machines have, at different periods, been invented for the purpoſe of aſcertaining and meaſuring, without a line, depths of water which, in conſequence of currents and other cauſes, might be unfathomable by the method commonly practiſed by ſea-faring perſons. The moſt eminent of theſe is that contrived in the laſt century by Dr. Hook, but even this is ſo far from being accurate, that it might probably betray the ſeamen into greater evils than would be occaſioned by the total want of a ſounding-lead. The utility of a machine conſtructed ſo as to be capable of pointing

pointing out, with *certainty*, the depth of water, in ſuch caſe, muſt be obvious to all.

The machine of which the plate is hereunto annexed was invented ſome years ago, by a very ingenious artiſt of the name of Greenſtreet, now employed under the board of ordnance. As ſoon as it was completed, he ſubmitted it to the inſpection of the ſociety for the encouragement of arts, &c.; the committee, feeling themſelves only the treaſurers of their ſociety, with a laudable attention to frugality, guarding againſt impoſition, declined giving him any premium till he had undertaken a diſtant voyage, and made a ſeries of experiments with the machine; theſe ſtipulations ſuiting neither the convenience nor the finances of the inventor, he took his machine home. About ſeven years ago I was informed of it by a friend who had accidentally ſeen it, and as I had juſt before contrived an inſtrument which I hoped might anſwer the ſame purpoſe, but which, on trial, proved very uncertain, I immediately went to Mr. Greenſtreet, who very readily diſpoſed of his machine to me.

To the long piece of wood A (Plate XII. Fig. 1 and 2.) is attached the hollow trunk B, in which is fitted a wooden ſpiral worm, or endleſs ſcrew, C, (Fig. 2.) which fills the trunk ſo completely as ſcarcely to admit of any water paſſing between it and the ſides of the cavity. On the axis of this worm is continued one of braſs, D, which turns the large wheel E, which wheel is graduated in thirty-ſix diviſions, expreſſing ſix fathoms, or thirty-ſix feet; being the diſtance the machine deſcends while that wheel makes one revolution. On its axis is a ſmall pin, which, each time the wheel makes one revolution, moves forward the ſecond wheel F one tooth. This ſecond wheel has thirty ſix teeth, one revolution of it therefore expreſſes a depth of two hundred and ſixteen fathoms; the axis of it is furniſhed with a pin, like that of the firſt, and every revolution of it moves forward the third wheel G one tooth; which third wheel has forty-one teeth, conſequently a complete revolution of that wheel will meaſure a perpendicular depth of ten miles fifty ſix fathoms. H and I are two indexes, which point out

the

the depth the machine has defcended, and keep the two wheels from varying.

When this machine was firft invented it was found to be incorrect, owing to the water preffing improperly on the fpiral worm, or meafurer; and the hood K, which is called the regulator, was added, to admit water to the worm in that direction. The angle it fhould form with the fide of the trunk was varied, until actual experiment fuccefsfully pointed out the proper one. To the end of the machine is fufpended a weight D, (Fig. 1.) which, when it touches the bottom, difengages itfelf, and the fpring M, being by that means releafed, (as in Fig. 2.) forces the check N into the tooth of the large wheel E, and ftops the farther motion of the wheel-work. The machine, having loft the weight which occafioned its defcent, immediately rifes, being affifted by the buoy O, which is attached to the upper end.

The only real objection that can be made to the general ufe of this machine is, that the fhip muft be hove to, when it is ufed, and a boat hoifted out, in order to take it up. In all the experi-

experiments I have hitherto made, I have ever found it critically exact; they have, it is true, been made only in ſmall depths, but which were previouſly aſcertained, with the greateſt accuracy, by the uſual method. The experiments made in the moſt rapid currents have been equally ſucceſsful; the perpendicular depth only being marked, though the machine paſſed obliquely through the water.

Fig. 2. is repreſenred on a ſcale of about an inch to a foot.

I have endeavoured to be as clear and conciſe as poſſible, in this deſcription of the machine, and if the ingenious inventor derives an honour from it, or the public any advantage, my end is fully anſwered.

Fig. 1

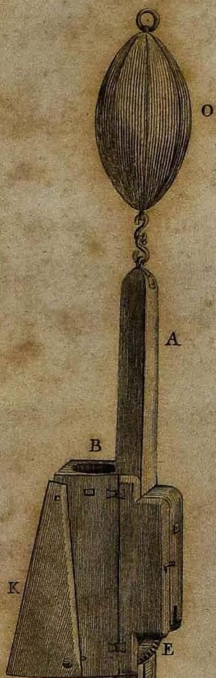
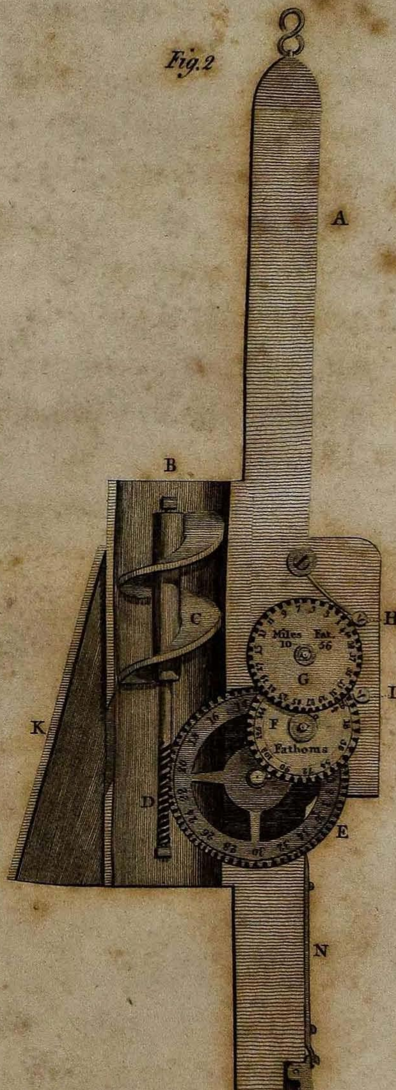


Fig. 2



XXIV. Account of the Method of making the Otter of Roses, as it is prepared in the East Indies; by Donald Monro, M. D. of London.

From the Transactions of the Royal Society of Edinburgh.

I HAD the following receipt for making the otter of roses, as it is prepared in the East Indies, from Major Mackenzie, of Coull, in the County of Rose, who told me he got the account from an officer of his corps, who was up in the country where it is prepared, and assisted in making it himself.

Take a very large glazed earthen or stone jar, or a large clean wooden cask; fill it with the leaves of the flowers of roses, very well picked, and freed from all seeds and stalks; pour on them as much pure spring water as will cover them, and ſet the veſſel in the ſun, in the morning at ſun-riſe, and let it ſtand till the evening, then take it into the houſe for the night; expoſe it, in this manner, for ſix or ſeven ſucceſſive days, and, at the end of the third or fourth day, a number of particles, of a fine yellow oily matter, will float on the ſurface, which, in two or three days more, will gather into a ſcum, which is the otter of roſes. This is taken up by ſome cotton, tied to the end of a piece of ſtick, and ſqueezed with the finger and thumb into a ſmall phial, which is immediately well ſtopped; and this is repeated for ſome ſucceſſive evenings, or while any of this fine eſſential oil riſes to the ſurface of the water.

N. B. I have been informed that ſome few drops of this eſſential oil have been, more than once, collected by diſtillation, in the ſame manner as the eſſential oils of other plants, here in London.

The following receipt for making *Attar*, or *Otter*, of Roſes differs ſo much from the foregoing, that we thought it would not be improper to inſert both.

XXV.

XXV. The Proceſs of making *Attar*, or eſſential Oil, of Roſes; by Lieutenant-Colonel POLIER.

From the TRANSACTIONS of the SOCIETY inſtituted in BENGAL.

THE *attar* is obtained from roſes by ſimple diſtillation, and the following is the mode in which I have made it.

A quantity of freſh roſes, for example forty pounds, is put into a ſtill, with ſixty pounds of water; the roſes being left as they are, with their calyxes, but with the ſtems cut cloſe. The maſs is then well mixed together with the hands, and a gentle fire is made under the ſtill; when the water begins to grow hot, and fumes to riſe, the cap of the ſtill is put on, and the pipe fixed; the chinks are then well luted with paſte, and cold water is put into the refrigeratory at top; the receiver is alſo adapted at the end of the pipe, and the fire is continued under the ſtill, neither too violent nor too weak. When the impregnated water begins to come over, and the ſtill is very hot, the fire is leſſened by gentle degrees, and the diſtillation continued till thirty pounds of water are come over, which is generally done in about four or five hours. This roſe-water is to be poured again on a freſh quantity (forty pounds) of roſes, and from fifteen to twenty pounds of water are to be drawn by diſtillation, following the ſame proceſs as before; the roſe-water thus made, and cohobated, will be found, if the roſes were good and freſh, and the diſtillation carefully performed, highly ſcented with the roſes. It is then poured into pans, either of earthenware or of tinned metal, and left expoſed to the freſh air for the night. The *attar*, or eſſence, will be found in the morning, congealed, and ſwimming, on the top of the water; this is to be carefully ſeparated and collected, either with a thin ſhell or a ſkimmer, and poured into a phial.

When a certain quantity has been thus obtained, the water and fœces muſt be ſeparated from the clear eſſence, which, with reſpect to the firſt, will not be difficult to do, as the eſſence congeals

with

with a ſlight cold, and the water may then be made to run off. If, after that, the eſſence is kept fluid by heat, the fœces will ſubſide, and may be ſeparated; but, if the operation has been neatly performed, there will be little or none. The fœces are as highly perfumed as the eſſence, and may be kept, after as much of the eſſence has been ſkimmed from the roſe-water as could be. The remaining water ſhould be uſed for freſh diſtillations, inſtead of common water, at leaſt as far as it will go.

The above is the whole proceſs of making genuine *attar* of roſes. But, as the roſes of this country (Lucknow) give but a very ſmall quantity of eſſence, and it is in high eſteem, various ways have been thought of to augment the quantity, though at the expence of the quality. In this country it is uſual to add to the roſes, when put in the ſtill, a quantity of ſandal-wood raſpings, (ſome add more, ſome leſs,) from one to five *tolahs*, or half-ounces. The ſandal contains a deal of eſſential oil, which comes over freely in common diſtillation, and, mixing with the roſe-water and eſſence, becomes highly impregnated with their perfume.

fume. The impofition, however, cannot be concealed; the effential oil of fandal will not congeal in common cold, and its fmell cannot be kept under, but will predominate, in fpite of every art. In Cafhemire they feldom ufe fandal to adulterate the *attar*, but I have been informed that, to encreafe the quantity, they diftil with the rofes a fweet-fcented grafs, which does not communicate any unpleafant fcent, and gives the *attar* a high clear green colour: this effence alfo does not congeal in a flight cold, as that of rofes.

Many other ways of adulteration have been practifed, but all fo grofs and palpable that I fhall fay nothing of them. The quantity of effential oil to be obtained from the rofes is very precarious and uncertain, as it depends not only on the fkill of the diftiller, but alfo on the quality of the rofes, and the favorablenefs of the feafon. Even in Europe, where the chemifts are fo perfect in their bufinefs, fome, as Tachenius, obtained only half an ounce of oil from one hundred pounds of rofes. Homberg obtained one ounce from the fame quantity; and Hoffman above two ounces. (The rofes, in thofe inftances, were ſtripped of their calyxes, and only their leaves uſed.) In this country nothing like either quantity can be had; to obtain four *maſhas* (about one drachm and a half) from eighty pounds, which deducting the calyxes, comes to ſomething leſs than three drachms *per* hundred weight of thoſe leaves, the ſeaſon muſt be very favorable, and the operation carefully performed. In the preſent year (1787) I had only ſixteen *tolahs* of *attar* from fifty-four *maunds*, twenty-three *ſeers*, of roſes, produced from a field of thirty-three *biggahs*, or eleven Engliſh acres; which comes to about two drachms *per* hundred pounds.

The colour of the *attar* of roſes is no criterion of its goodneſs or country. I have had, this year, *attar* of a fine emerald green, of a bright yellow, and of a reddiſh hue, from the ſame ground, and obtained by the ſame proceſs; only from roſes collected on different days.

The calyxes do not at all diminiſh the quality of the *attar*, nor impart any green colour to it; though perhaps they may augment the quantity.

XXVI. Continuation of Mr. HENRY's Confiderations relative to the Nature of Wool, Silk, and Cotton, as Objects of the Art of Dying.

(From Page 133.)

ALUM, being a cheap fubftance, is moft commonly ufed. It confifts of vitriolic acid, pure clay *, or argillaceous earth, and water. According to Bergman, one hundred parts of cryftalized alum contain thirty-eight of vitriolic acid, eighteen of clay, and forty-four of water. The clay is generally fuperfaturated with acid; this is proved by the phenomena produced on the addition of mild vegetable fixed alkali. On the firft portions of alkali being added, a fmall portion of the earth precipitates from thofe parts of the alum with which the alkali comes in contact; and, as

* The conftituent parts of common clay are agillaceous, mixed with filiceous, earth, in various proportions. Pure argillaceous earth is only obtainable from alum.

pure

pure clay has an attraction for aërial acid, the effervescence produced is at first small; but presently the remaining free acid, attacking this precipitate, rediffolves it, and an effervescence appears, occasioned by the discharge of the aërial acid from the clay. This precipitation, followed by rediffolution, and a discharge of gas, continues till the acid be perfectly saturated; the precipitation then goes on regularly, and the earth is no longer diffolved anew, except the alkali be continued to be added after the precipitation is fully accomplished; nor does any effervescence follow when fresh portions of alkali are added.

These are the appearances when mild or aërated vegetable alkali is used, but, if the pure or caustic alkali be employed, the precipitation takes place more slowly; and, if the pure alkali continue to be added after the precipitation is effected, the earth will be rediffolved.

This earth has a strong attraction for colouring matter, particularly for such as forms the red and yellow colours; insomuch that, if a solution of alum be poured into water deeply tinged with madder or weld, the earth will quit its acid to

 unite

unite without the colouring particles of theſe ſubſtances, and form with them a precipitate or laque; from which it cannot be ſeparated, either by the action of water, or ſpirit of wine, and is not totally deſtroyed even by that of fire.

Marine ſalt of tin, and that formed by *aqua regia*, have for their baſis the white earth of that metal, which has alſo a ſtrong attraction for colouring matter, and is, in ſome caſes, preferred to that of alum. When united to the colouring matter of cochineal, it forms a beautiful pigment, well known by the name of carmine. If the addition of theſe ſaline ſubſtances, to the coloured liquors, be ſufficiently long continued, and under proper circumſtances, the whole of the colouring matter will be precipitated, and the water be left colourleſs *.

Tin is not the only metal which affords baſes for colouring ſubſtances; lead, biſmuth, and zinc, alſo afford earths, or calces, which attract colouring matter; but the two firſt have defects which render them leſs eligible. The calx of zinc may perhaps be uſefully employed; but ſhould firſt be

* Macquer, Dictionnaire de Chymie.

thoroughly purified from the iron which it generally contains.

Theſe all form baſes for the more brilliant reds and yellows: for the laſt, the calx of copper is alſo employed, having a ſtrong attraction for the colouring matter of weld. Salts containing iron furniſh a baſis which, with the aſtringent matter of vegetables, produces a black dye.

When alum is uſed to ſupply a baſis for the dying of wool, it is the practice to join with it either crude tartar or its purified cryſtals, in the proportion of five ounces of alum to one of tartar. This laſt ſubſtance we know conſiſts of an alkaline vegetable ſalt, ſuperſaturated with a peculiar acid, which bears its name. The ſuperabundant vitriolic acid of the alum will decompoſe a part of the tartar, by attaching itſelf to the alkali, and thus the quantity of free tartareous acid is increaſed, which has no properties injurious to the cloth.

In the aluming of ſilk no tartar is employed; for, the ſilk, in the previous preparation, being impregnated with alkaline or ſoapy matter, the ſuperabundant acid will be neutralized by it. In this procefs, when the tubs have been long ufed, a very confiderable incruftation is formed on their fides; which the dyers, finding no injury from it, fuffer to accumulate. Some of the foap ufed for the fcouring adheres to the filk, notwithftanding the wafhing it undergoes; and the alkali of the foap, uniting with the acid of the alum, fome of its earth is precipitated, joins with the detached oil, and forms the incrufting fubftance; the undecompofed alum, and the vitriolated tartar, perhaps alfo, in part, entering into the combination *.

Cotton requires a ftill different treatment: as the vitriolic acid is injurious to cotton, and it is neceffary that the aluminous folutions fhould be well dried on it before it be wafhed, the acid, being concentrated by the evaporation of the water, would corrode the cotton. It is therefore proper to faturate the fuperabundant acid, previous to the aluming of the cotton; and for this purpofe one-fixth or one-eighth of pearl afhes is to be added.

* Macquer, Art de la Teinture de Soie.

But

But the aluminous liquor ufed by the printers is prepared in a different manner: to three pounds of alum, diffolved in a gallon of hot water, a pound and half of fugar of lead is added; the mixture is ftirred together for a confiderable time, and the agitation repeated often, during two or three days; when a few ounces of whiting are to be added gradually, as a ftrong effervefcence enfues. On adding the fugar of lead to the alum, a double elective attraction produces two decompofitions, and two new compounds: the vitriolic acid forfakes the earth of alum, to unite with the calx of lead of the *faccharum faturni*; and this new falt, poffeffing very little folubility, falls to the bottom of the veffel, in form of a white precipitate. The earth of alum, being left at liberty, and in fo minutely divided a ftate, is attacked, in the act of precipitation, and diffolved by the acetous acid, which, having quitted the lead, is ready to form this new union: and thus, a very foluble falt being the product, it remains diffolved in the water, and, when thickened with gum, is applied by means of blocks to the cloth. The piece being afterwards dried in a hot ftove, the

the vinegar, which, as the cloth dries, becomes highly concentrated, and very volatile, * not having a ſtrong attachment to the aluminous earth, flies off, and leaves the earth upon the cloth ready to receive the colouring matter: and herein conſiſts the advantage of the change of the vitriolic for the acetous acid.

Thus we ſee that the printer's liquor for the red and yellow colours is not, as thoſe artiſts generally imagine, a mixture of alum and ſugar of lead, but merely an acetated argill, or aluminous earth, combined with vinegar. The addition of whiting is intended only to neutralize the ſuperabundant acid, and would perhaps be better made to the alum, before the mixture of the ſugar of lead; for, as that acid immediately precipitates ſome of the lead, without furniſhing the acetous acid with aluminous earth in return, a

* The vinegar, by its union to the calx of lead, ſeems to have acquired ſome new properties; for, on ſeparating it from the lead, by diſtillation, it always contains ſome portion of ether. When the cloth has become dry in the hot ſtove, Mr. Charles Taylor has obſerved flaſhes of electric light darting from its ſurface.

waſte of the *ſaccharum ſaturni* is the conſequence, which might be prevented by the mode now recommended.

The ſolutions of tin, and of the other white metals, ſhould be as perfectly ſaturated as poſſible; otherwiſe, not only the ſuperabundant acid will injure the cloth, but the calx will not ſo readily precipitate, to form the white baſis. In the dying of wood the ſolution of tin is mixed with the decoction of cochineal, and falls, in the form of carmine, on the cloth; but ſilk has in vain been attempted to be dyed ſcarlet in this mode. M. Macquer has however accompliſhed this *deſideratum*, by firſt fully impregnating the ſilk with the ſolution, before he proceeded to the dying. By this means M. Macquer declares that he has produced ſcarlet, though not equal to that dyed on wool, yet ſufficiently beautiful, and ſuperior to the ſcarlet formed by a mixture of ſafflower and arnatto. And, he adds, that an eminent manufacturer at Lyons had ſucceeded in dying great variety of colours on ſilk, by applying the tin baſis after the ſame manner *.

* Macquer, Dictionnaire de Chymie, 2d edit.

If

If a ſcarlet could be dyed without the uſe of nitrous acid, the tin baſis might be employed for this purpoſe on cotton; but the acid being requiſite for the production of this beautiful colour, and being highly corroſive to cotton, this baſis is prevented from being applied to that ſubſtance. But, if this metallic earth has any preference to alum, for other colours on cotton, it might be procured united to acetous acid, by a proceſs which I have lately diſcovered, ſomewhat ſimilar to that for making the printer's liquor; viz. by adding to a ſolution of tin, in marine acid, a ſolution of ſugar of lead. The marine acid will unite with the lead, and precipitate as *plumbum corneum*, and the vegetable acid will unite with the tin, with which it could not eaſily be ſaturated by any other mode; for, the acetous acid has very little power to diſſolve tin in its metallic form.

The cupreous baſis may be obtained from blue vitriol, and from verdegris, or acetated copper. It is ſeldom uſed by itſelf, but generally in conjunction with alum.

The martial basis, where wool and silk is concerned, is obtained from green vitriol or copperas; but this basis is best procured, for cotton, from a solution of iron in acetous acid, or even, as it should seem, in the astringent principle: for, a solution of iron is used by the dyers of cotton, with great success, which is formed by stratifying old iron with alder bark, and digesting them in water.

It may also be worthy of remark, that cotton, having but a weak attraction for colouring matter, requires that it should be presented under every advantage; and the Dijon Acadademicians having proved that the mineral acids are destructive of the astringent principle, in which the colouring matter of those substances requiring a basis seems to reside, this property, added to others, may be a reason for their rejection, and for the preference given to the acetous acid.

Having thus given an account of the various preparations that are generally used for wool, silk, and cotton, and of the basis applied for the reception of the colouring matter, let us next take a view of the *particular* preparatory operations

 practised

practiſed in the proceſs for dying the Adrianople or Turkey red, on cotton; and to theſe alſo add a detail of the proceſs itſelf. It is proper to premiſe, that all the wooden veſſels employed ſhould be made of deal, or of ſome white wood, free from aſtringent matter; and that the moſt convenient quantity for operating on, in proportion to the ingredients uſed in the ſeveral operations, is ſixty-ſix pounds of cotton.

From ſixty pounds of Alicant barilla, a ley is drawn, by means of ſoft water, amounting to ſixty gallons; and then, by pouring on of freſh water, a ſecond ley is formed, meaſuring forty gallons: after this, a third ley is alſo extracted from the ſame barilla, the quantity of which ſhould be about fifty-two gallons.

A liquor is alſo prepared, conſiſting of four gallons of ſheep's dung, collected after it has been excreted from the animal, and before it has been expoſed to rain, diſſolved in twenty gallons of water, and ſtrained through a hair-ſieve, to ſeparate from it the groſſer parts.

Theſe preparatory meaſures being taken, the firſt operation conſiſts in adding nine pounds of Gallipoli

Gallipoli oil to eight gallons of the ſecond barilla liquor; this forms a kind of ſoap, to which are to be added twenty-four gallons of the firſt barilla liquor, twelve gallons of the dung-liquor, and forty-eight gallons of ſoft water. Into this liquor, when nearly of a ſcalding heat, the cotton is to be put; room being made for it, by taking out about twenty gallons of the liquor, which is to be gradually returned into the pan, in proportion to the waſte by evaporation; and the whole is to be kept boiling during five hours. After which the cotton is taken out of the pan, ſuſpended over it to drain, and then well wrung, waſhed in clear water, and hung on ſmooth poles to dry, either in the open air, or in a ſtove, but the former is to be preferred if the weather be fair.

The liquor wrung out of the cotton is to be preſerved, together with the remainder in the pan, for a future operation; and, at this time, ſixteen gallons of ſoft water are to be added to the dung-liquor.

The ſecond operation conſiſts in pouring three pounds and a half of Gallipoli oil into a bucket containing four gallons of the ſecond barilla liquor, and adding this mixture to ſix gallons of the firſt barilla liquor, and four gallons of dung liquor. Of this compoſition two or three gallons are to be put into a tub, and in it about a pound and a quarter of the cotton is to be well ſoaked, and afterwards wrung, but not too cloſely, over a tub kept for that purpoſe. A ſimilar portion of cotton is then to be treated in the ſame way; and ſo on, till the whole has paſſed through the mixture; adding about a pint, or three half pints, of liquor, on the immerſion of every freſh parcel of cotton. The cotton is then to be thoroughly dried; which it muſt alſo be after the ſubſequent operations; and theſe are to be conducted in the ſame manner, with reſpect to the manipulations, as the preſent one.

In the third operation, the liquor which had been wrung out of the cotton is to be poured back into the tub in which the ſoaking has been performed; and to this are to be added, of Gallipoli oil three pounds and a half, and of the ſecond barilla liquor, dung-liquor, and firſt barilla liquor, four gallons each. After this operation,

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the dung-liquor is to be ſtrengthened, by the addition of about two handfuls of ſheep's dung, diluted with a little water.

The fourth operation is ſimilar to the third: the liquor which remains is to be ſet aſide, for the purpoſe of mixing with the reſiduary liquor after the eighth operation; to be uſed for other cotton, in any ſubſequent proceſs.

The dung-liquor is omitted in the fifth operation; and the mixture employed in the three following operations is called the *white* liquor, to diſtinguiſh it from that uſed in the three preceding parts of the proceſs, which, from the colour imparted by the dung, is named the *green* liquor.

The ſame quantity of oil as before is to be mixed in a bucket with four gallons of the ſecond barilla liquor, and poured into a tub, where are to be added to it, three gallons more of the ſame liquor, and four gallons of the firſt barilla ley.

About four gallons of this liquor remain after the wringing, and theſe are to be added, in the ſixth operation, to the ſame quantity of oil, firſt mixed with four gallons of the ſecond ley, and then with two gallons (more or leſs, in proportion to the quantity of white liquor remaining after the

preceding

preceding operation) of the ſame ley, and four gallons of the firſt.

In the ſeventh operation, the quantities of all the ingredients are the ſame as in the ſixth. The reſiduum of the white liquor, after the three laſt operations, will be about eight gallons, and is to be preſerved, to be uſed in the fourteenth operation.

The eighth operation conſiſts in heating the third barilla liquor, amounting to fifty-two gallons, to about the warmth of new milk, removing it, when thus warmed, from the copper to a tub, immerſing the whole of the cotton therein, and ſuffering it to remain for twelve hours, or longer. It is then to be taken out, and laid on a cloth, ſpread on four or five ſticks placed acroſs a large tub, into which the liquor drains, as it runs from the cotton. The cotton is then to be well wrung, and afterwards thoroughly waſhed, that no looſe oil may remain, which would be injurious to the next operation.

The wringing tub and peg are now to be well waſhed, and a freſh ſet of poles uſed; for, if any oil were to come into contact with the cotton, in the next parts of the proceſs, it would receive a blackiſh tinge in the dying.

The

The galling forms the ninth operation. Sixteen pounds of galls, or, if the blue galls be ufed, a fomewhat fmaller portion, are put into twenty-four gallons of water, nearly boiling. The liquor is then brought to boil, and the ebullition continued for fifteen minutes; but, as foon as the boiling commences, the fire fhould be withdrawn, as the heat already received will keep it up for a fufficient time, and the galls will not fettle if it be too violent. The liquor is to be carried to the wringing-tub, in the quantity of three or four gallons at a time, according as it is foaked up by the cotton, till one half of it has been thus employed; and the cotton is to be worked in it, as hot as poffible, by means of a ftick paffed through the fkains. After this it is to be dried, either wholly or in part, in the open air; if it cannot be thus completed, as rain would, in this ftate, and efpecially as the cotton approaches to drynefs, be highly prejudicial, the drying muft be finifhed in a ftove. The liquor which has been wrung out is to be added to the remaining half in the copper.

TO BE CONCLUDED IN OUR NEXT.

XXVII.

XXVII. Conclufion of M. CHAPTAL's Paper, on the Method of making Alum by the direct Combination of its conftituent Principles.

(FROM P. 144.)

SECONDLY. In chufing and preparing the earths, certain precautions are neceffary, which I think it right to point out, in order that all thofe who may wifh to follow my method, may proceed with certainty: this preliminary knowledge is particularly indifpenfable in great enterprizes, becaufe in them every experiment is of importance.

The moft pure clays are the beft; not becaufe the formation of the alum is more fpeedy, but becaufe it is more eafily extracted, and more pure. When coloured clays are made ufe of, whether grey, black, or yellow, (all of which in general owe their colour to impregnations of iron,) they

more

more quickly ſhew ſigns of efflorefcence, and appear, at firſt, as if they would furniſh more alum than others; but theſe firſt appearances are deceitful, and the vitriol of iron, which it is neceſſary they ſhould be deprived of, brings on a train of troubleſome and expenſive operations.

When clays which have a ſlight mixture of marl in them are made uſe of, ſuch as thoſe which are found almoſt every where in our province, the alum appears to form in a very ſhort time; but the vitriol of lime, or ſelenite, which may be extracted from the mixture, injures the cryſtallization. I have obſerved, in this laſt caſe, that the cryſtals have not the ſame conſiſtence, they crumble between the fingers, and their particles diffuſe themſelves in water before they diſſolve in it; this kind is rejected by the dyers.

It is therefore proper to chuſe a white and pure clay; I found one of this kind at *Cornillon*, in the dioceſe of *Uſés*, and, of all which I have tried, this appears to me to be the moſt advantageous.

When we want to diſpoſe it to combine with the vitriolic acid, it muſt be firſt calcined; this

 calcination

calcination ſhould be moderate, and equal in all parts of the lay; to accompliſh theſe two purpoſes, it is abſolutely neceſſary that the conſtruction of the furnace ſhould concur with the manner in which the clay is diſpoſed. The furnace I make uſe of for this purpoſe is nine feet in height, and ſeven in diameter; it may be conſidered as a portion of a cylinder vaulted at each end, *i. e.* rounded in the form of a cap at the top, and at the bottom; theſe caps have many holes pierced through them, that the flame may be diſperſed, in an equal manner, throughout the whole ſpace of the furnace.

The preparation I make uſe of to the earths conſiſts in beating them well, and wetting them with water, ſo as to be able to form them into balls of five or ſix inches in diameter: with theſe balls the furnace is to be filled, and, as theſe ſpherical boides touch only at certain points, they leave intervals which form a kind of flues, by means of which the heat is equally conveyed to the whole maſs. The firſt effect of the flame is to render the balls of clay of a black colour, but this

this colour difappears as foon as the mafs is ftrongly heated, and then I ftop the fire *.

Thirdly. The balls when taken out of the furnace are to be beat to powder, or at leaft bruifed, and in that ftate I expofe them to the vapour of vitriolic acid, in the room already defcribed. A layer of them is placed upon the floor, and at the end of fome days the calcined pieces of thefe earths appear to crack and fplit; like incruftations of pure alum are foon after perceived in the crevices; and fometimes there are alfo cryftals, formed by the union of feveral layers placed one upon the other †.

* By a fimilar procefs I calcine ferruginous clays, and form with them *pozzolanas*, which may with advantage be ufed in the place of thofe which we procure at a great expence from Italy.

† By forming proper partitions at the bottom of thefe rooms, we may expofe iron, alumine, copper, and water, to the action of the vapour, and confequently make, at the fame time, vitriol of iron, of copper, of alumine, and vitriolic acid. I have formed all thefe falts in the fame room, and at the fame time; but I obferved that the dry vapour did not eafily combine with the copper, and that it was alfo advantageous to wet the iron, to facilitate its diffolution.

When an efflorefcence is formed all over the earths, and unequivocal figns of the formation of alum appear through their whole texture, I take them out of the room, and place them under an open fhed, as much expofed to the air as poffible, that the earths may be more thoroughly penetrated by the acid, and that the fuperfluous acid may by that means be diffipated.

When that is done the earths are carried away in large tubs, and water is poured upon them to lixiviate them, according to the method commonly followed in all manufactories of this kind ; the ley is evaporated in leaden caldrons, and fet to cryftallize.

In all manufactories of alum it is ufual to make ufe of alkalies, to faturate the fuperabundant acid which the leys almoft always contain. Thefe fubftances alfo ferve to affift the cryftallization, as without their help we obtain only a granulated precipitate or mafs, which exhibits no appearance of cryftals. I have even obferved, that when alum is made to cryftallize without this addition of alkaline falts, the cryftals are neither fo hard nor fo heavy as they generally are.

It

It is obſerved, by the celebrated Bergman, that in order to ſaturate the ſuperfluous acid of the aluminous leys, it is ſufficient to boil clay in them. This proceſs appears ſimple and œconomical, and, on both thoſe accounts, worthy to be followed, but I am convinced that it is not a practicable one. If the acid-ley be boiled with clay, either baked or raw, the diſſolution takes place but very ſlowly, and only in conſequence of violent ebullition; if the ley be filtered, after it appears to be ſaturated, it lets fall, upon cooling, a great part of the clay which it had diſſolved; if, while it is in this ſtate, the diſſolution be concentrated, the clay ſeparates, and forms a precipitate which entirely prevents all cryſtallization; this has happened to me in numerous experiments. But when, inſtead of making uſe of an aluminous earth with an exceſs of acid, we diſſolve alum in water, and add to the ſolution ſome drops of acid, this acid may be ſaturated, and we may obtain, by evaporation, very fine cryſtals of alum, but mixed and confounded with the clay which is precipitated, and the quantity of alum is not in-

creaſed

creaſed by this operation. Theſe experiments ſeem to demonſtrate that the acid ley diſſolves the earth of alum only as a diſſolution of alum, and not in conſequence of the ſuperfluous acid which it contains.

I ſhall ſay no more reſpecting the advantages reſulting from this method of making alum; I ſhall only obſerve that, by uſing the vitriolic acid in the ſtate of vapour, thoſe tedious, troubleſome, and expenſive operations, by which that acid is concentrated and rectified, are avoided; and that, by following this proceſs, it is eaſy to eſtabliſh a ſufficient number of manufactories to ſupply the arts with a very valuable material, which we have hitherto been obliged to procure from foreign countries.

XXVIII.

XXVIII. Proceſs to deprive Treacle of its diſagreeable Taſte, and to render it capable of being employed for many Purpoſes, inſtead of Sugar.

FROM THE *ANNALES DE CHIMIE.*

THE high price of refined ſugar deprives a great number of perſons of a wholeſome aliment to which they have been accuſtomed ; among the methods which have been propoſed to compenſate the loſs of ſugar, the uſe of purified treacle is one of the leaſt expenſive. The following is a proceſs given by the M. Cadet (Devaux) in the *Feuille du Cultivateur*, founded upon experiments made by Mr. Lowitz, of Peterſburgh.

Take of treacle,	-	-	24 pounds.
—— of water	-	-	24 pounds.
—— of charcoal, thoroughly burnt,			6 pounds.

Bruiſe

Bruiſe the charcoal groſſly, mix the three ſubſtances in a caldron, and let the mixture boil gently upon a clear wood-fire: after it has boiled for half an hour, pour the liquor through a ſtraining-bag, and then replace it upon the fire, that the ſuperfluous water may be evaporated, and that the treacle may be brought to its original conſiſtence.

There is little or no loſs by this operation, as twenty-four pounds of treacle give nearly the ſame quantity of ſyrup.

This proceſs has been repeated in the large way, and has ſucceeded; the treacle is ſenſibly ameliorated, ſo that it may be uſed for many diſhes, nevertheleſs thoſe with milk, and the fine or aromatic *liqueurs*, are not near ſo good as with ſugar.

ERRATUM.

Page 166, line 15, for Pl. XI. read Pl. IX.

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Red Lion Paſſage, Fleet-ſtreet.

REPERTORY
OF
ARTS AND MANUFACTURES.

NUMBER X.

XXIX. Specification of the Patent granted to Meſſrs. HENRY WRIGHT and JOHN HAWKSLEY, of Arnold, in the County of Nottingham, Worſted Manufacturers; for their Invention of certain Machinery for combing and preparing of Wool, Cotton, Silk, Flax, Hemp, and Mohair, for the Purpoſe of Spinning.

WITH TWO PLATES.

Dated June 8, 1793.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the

 ſaid

ſaid proviſo, we the ſaid Henry Wright and John Hawkſley, do hereby deſcribe and aſcertain the nature of our ſaid invention, and the manner in which the ſame is to be performed, as well by the figures or delineations of the machinery, as by the deſcription or explanation ſet forth; that is to ſay, Fig. 1. A, (Plate XIII.) is an upright ſhaft, revolving about forty times a minute; B B, a pair of wheels, of equal number of teeth or cogs; C, a pinion with nine cogs; D, a wheel with ſeventy-one cogs; (both the pinion E and wheel F to riſe or fall according to the length of the wool;) G, a wheel with forty-one cogs; H, a wheel with thirty-two cogs, giving motion to the comb-wheel I, which has three rows of comb-teeth on each arm; K, combing cylinder, with three rows of teeth, to be either horizontal, as drawn, or perpendicular; L, a wheel with one hundred and forty-four cogs; M, a pinion with ſixteen cogs; O, a worm, working into the wheel N; N, a wheel on the upright ſhaft to the feeding-frame wheels A A in Figure 2; S, a pinion working into a wheel to be put on the end of the rollers or wheels A A in Figure 2;

P P, two wheels, of equal numbers, to turn the long cogged wheels Q Q, which wheels are to draw the wool from the cylinder K; R R, two rollers, to conduct the wool into a can or baſket. Fig. 2. Feeding-frame. A A, two long cogged wheels, working in pinion S in Fig. 1; B B B, three rollers, round which a linen cloth is making conſtant revolutions, to conduct the wool forward to the wheels A A; C, a roller, round which a linen cloth is wrapped, with wool ſpread on it, the end of which paſſes over roller D, and down to roller E; where, having at D conducted and got quit of its wool, it wraps itſelf up again, and ſo on in ſucceſſion with others by which it is replaced; F F F, three pulleys, by which the rollers receive their motions with bands or cords; GG, the two linen cloths above-mentioned; HH, two rollers, the bottom one, revolving by the pulley F, cauſes the two upper ones to revolve alſo, the roller E conſequently wraps up the cloth, and that above it is meant to be of a ſufficient weight to prevent its riſing up, and to preſs upon it ſufficiently to make it revolve. Fig. 3, a fly with bruſhes and rollers, working with ſpiral ſprings, to lay the wool cloſe to the teeth of the cylinder K in Fig. 1, and to be fixed, with a relative motion, over the long cogged wheels Q Q. Fig. 4, a circular bruſh, fixed at the back of the combing cylinder K, (Fig. 1,) revolving quick to take the *noils* off the teeth, and cloſe to it is fixed a row of teeth, to take the *noils* off the bruſh as it revolves, and to be cleared occaſionally as they fill. Fig. 5, (Plate XIV.) is another combing-machine, either as a preparer, or finiſher, or both. A, a ſtraight range of combs in three compartments, A, B, C; connected together by a hook or catch at the top, as at D D, and moving in a ſlide or groove, and made to remove or take off after they have paſſed the long cogged wheels E E, when they will have got quit of the wool; F, a rack which has a very ſlow ſliding motion, and is moved by the pinion G; E E, two long cogged wheels, to draw the wool from the comb-teeth, againſt which are to be placed two conducting rollers, for the ſame purpoſe as R R in Fig. 1; H, three rows of comb-teeth. The motion of the ſtraight range of combs A B C, being ſlowly progreſſive

from

Fig. 1

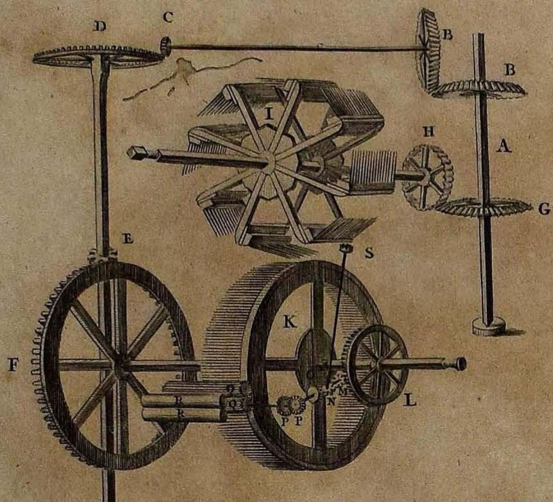


Fig. 3

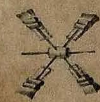


Fig. 4

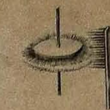


Fig. 2

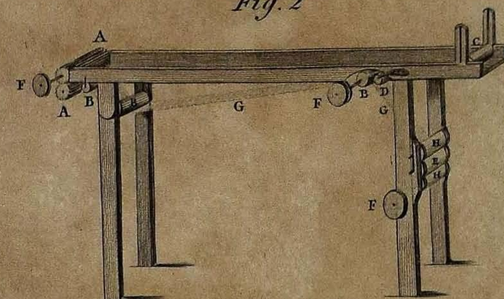
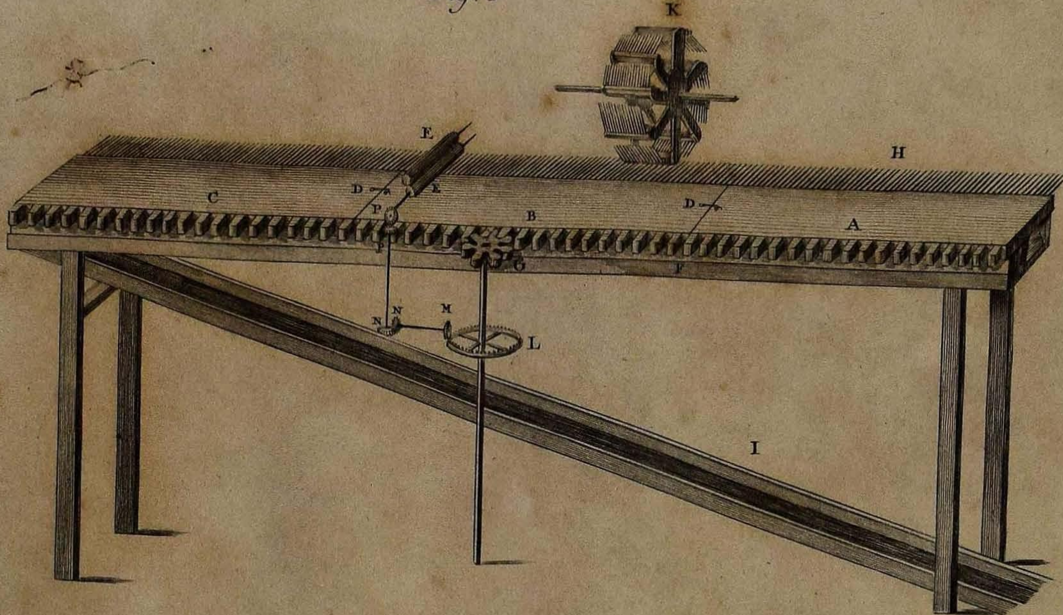


Fig. 5



from A to C, it follows that when the ftraight range of combs has advanced the length of one compartment, that part muft be taken away and difcharged of its *noils*, and then paffed to the other end of the machine, on the inclined plate I, or otherwife, and fixed in the vacancy which will then be at A, and fo on alternately; by which means a perpetual fliver of wool will be produced K is the fame comb-wheel as I in Fig. 1, and moving with the fame velocity. The feeding-frame is the fame as Fig. 2. L, is a wheel with one hundred and forty-four cogs; M, a pinion with fixteen cogs; N N, two wheels with equal numbers of teeth; P P, two wheels with equal numbers of teeth; H, the teeth, drawn horizontally, but alfo to be placed perpendicularly, in cafe of need or choice. In witnefs whereof, &c.

XXX.

XIX. Specification of the Patent granted to Mr. WILLIAM CUNNINGHAM, of the City of Edinburgh, Chemist; for his Method, by which Rags, known by the Name of Grays and Ropes, can be made into Tea-Crown Paper; and Rags, known by the Names of Tea-Crown and Bible-Crown Rags, and Thirds, can be made into Paper called Pot, Small Post, Demy, Royal Inferior, or Papers of similar Qualities; and Rags, denominated Seconds, into Paper called Fine, Imperial, Royal, Super-Royal,

Writing

Writing Royal and Medium, Writing Demy, Thick Poſt, Thin Poſt, Fine Fool's Cap, and all other Papers which have been hitherto reckoned of the fineſt Qualities; and by which Paper can be made from fine Rags of a finer and more beautiful Quality, and Colour, than was ever before manufactured.

Dated Nov. 28, 1794.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that, in compliance with the ſaid proviſo, I, the ſaid William Cunningham, do hereby declare, that my ſaid invention is, and is performed, as follows; that is to ſay, I make a particular alkaline ley, of the proportion of materials as follows, *viz.* I take eight pounds of pearl-aſhes, and ſixty-eight pounds of quick lime, and put them into a veſſel with one hundred and twenty

twenty gallons of pure water; this mixture I stir six times a day for eight days, and then allow it to subside, and, when the water is clear, I run thirty English gallons through a flannel bag, to prevent any particles of the lime, that may remain in the water, from injuring the pulp or rag when it is boiled with the ley in the copper. This proportion of this particular ley is sufficient to boil five stones, of iron weight, of pulp or rag, with the addition of as much water as will make it boil easily; but, before the pulp or rag and water is put into the copper, there must be a false bottom made of wood, bored full of small holes, and fixed to the bottom of the copper, to prevent the stuff from falling down upon the bottom of the copper, which would burn it. The boiling must be continued for three hours and a half; but if the stones, or part of the stones of rags, are very strong, the boiling ought to be continued double that time, or even more, and during the time of boiling it must be frequently stirred. After the boiling operation is over, the contents of the copper must be run into a drainer, and, as soon as it can

be

be lifted, it muſt be put into a waſhing engine for half an hour. It is after this put again into a drainer, and allowed to remain until the water, without preſſure, is drained out of it; but, if the rag or pulp is very coarſe, ſuch as the brown Hamburgh, as much water muſt be allowed to remain as one fourth of its own weight, or perhaps leſs, if the ſtuff ſticks too cloſely together. The ſame quantity muſt be put into a ſteam-cheſt, or any veſſel that will contain gas, but the moſt convenient, for the above quantity, I h ve found to be a ſquare box three feet three inches by twenty-ſeven inches deep; in which there muſt be four or five movable wooden grates, at equal diſtances, to keep the layers of the ſtuff ſeparate. The top of the box muſt be tightly luted down, to prevent the gas from flying off. Into this cheſt or box there is a lead pipe fixed, to be connected with the neck of a retort, which retort may be made of lead, glaſs, or any other material fit for the purpoſe. Into this retort I put the following materials, viz. two pounds of manganeſe, and three pounds and a half of ſea-ſalt, which muſt be well mixed with the hands, ſo as to make the particles adhere to one another as close as possible. The retort I put into a sand-bath, the retort being tubulated; I then lute the end of the aforesaid pipe to the neck of the retort, and also the head. Previous to these materials being put into the retort, I take four pounds of vitriolic or sulphuric acid, and an English quart of water, which I mix gently together, and allow it to stand till it is cool; this cool mixture I pour into the retort, and stir it well with a small stick, to mix the acid and materials together, and then I lute the stopper quite close. From this moment the bleaching power begins to operate, and in this situation the retort is allowed to stand for an hour; after which a gentle heat is applied for three hours, and then increased till the contents are brought to boil. In this situation the retort remains till all the gas is wrought off, which may be in ten or twelve hours. This can be easily ascertained by taking out the stopper; if there is no smell when you bring your head close to the hole of the stopper, the gas is all evaporated, and the retort may then be taken off, and the contents poured out; care being taken that the current of air do not carry the smell of

the

the refiduum againft the perfon employed. The lid of the fteam-cheft is now taken off, and the cheft run full of water, in order to deftroy the faid fmell of the gas in the ftuff, which it will effectually do in about ten minutes. The water is then run off by a plug at the bottom, and the ftuff allowed to drain for a little. It is then again put into the wafhing machine or engine, where it continues three quarters of an hour, and is then run into a drainer, after which it is again put into the copper, with the fame proportion of the ley and water: boil and ftir it as before. After the faid boiling operation is over, the contents are again run into the drainer, and managed in the fame manner as already defcribed; after which it is again put into a fteam-cheft, and the retort fet a going with the materials before mentioned, or with the following materials, as the nature of the rag or ftuff may require, viz. two pounds of fulphuric acid, mixed with an Englifh quart of water, (more or lefs, but this I have found to be the beft proportion,) five pounds of muriate of lime, and two pounds of manganefe. The muriate of lime muft be finely pounded, fifted, and well mixed with the manganefe, before it is put into the retort; and, when the retort is wrought off, the fteam-cheft is again filled with water, to deftroy the fmell of the gas as before, and the pulp, rag, or half ftuff, is then put into the beating engine, and finifhed off for paper. If, from the coarfenefs of the rag, and finenefs of the paper wanted, it appears that the pulp, rag, or half ftuff, is not fufficiently whitened, and the fhows deftroyed, the laft operation muft be again repeated, with either the firft preparation of materials for the retort, or with the laft, as may appear moft advantageous in the opinion of the operator. But if the fhows, pobs, or parts of the ftem of hemp or flax ftill remain ftrong, this third operation muft be conducted in the following manner, viz. put the ftuff again into the copper, with the proportions of the fame ley and water as before, and the boiling muft be continued until they are deftroyed; then prepare the ftuff for the fteam-cheft as formerly, and charge the retorts with the following proportions of materials; take four pounds of fulphuric acid diluted with an Englifh quart and fourth part of water, two pounds of fea-falt, three

pounds

pounds of muriate of lime, two pounds of manganeſe, mix all theſe well together, and ſet the retorts a going as before; when they are wrought off, the ſtuff muſt be managed as in the ſecond operation. If coloured or printed rags are to be made into paper, the half ſtuff muſt be ſubmitted to the action of a weak ſour, made of ſulphuric acid and water, for four hours, and then waſhed before it is put into the copper to be boiled with the ley; this ſour deſtroys the particles of iron contained in printed cloths, which, if allowed to remain, render the bleaching proceſs imperfect. As this, and all chemical proceſſes, may be varied much, and to advantage, by the judgement of the operator, and as I may ſtill from experience make farther improvements, that the public may reap the advantage of them, my operations may be ſeen at all times, at the places where they are carried on. In witneſs whereof, &c.

XXXI. Specification of the Patent granted to Mrs. JOHANNA HEMPEL, of the Parish of St. Luke, Chelsea, Potter; for her Invention of a certain Composition made of Earth and other Materials, and the Means of manufacturing the same into Basins and other Vessels, which, so manufactured, hath the Power of filtering Water, and other Liquids, in a more cheap, easy, and convenient Manner than Water or other Liquids could before then be filtered.

Dated October 16, 1790.

TO all to whom these presents shall come, &c. Now KNOW YE, that, in pursuance of the said proviso, I, the said Johanna Hempel, do declare, that the Nature of my said Invention of the said Com-

Compofition, and of the means of manufacturing the fame as aforefaid, is defcribed and afcertained in manner following; that is to fay, the faid bafins, or other veffels, are or may be made with different compofitions, according to the pleafure of the manufacturer, and alfo according to their fizes, as every compofition will not equally ftand the fire without flying or cracking, which depends on the fize of the bafin or veffel to be made; and the quantity of each article, to be ufed on each occafion, is liable to a variation, the knowledge of which is to be attained only by practice and experience, in as much as the materials do not always poffefs the fame qualities or powers. The bafins, or other veffels, are formed, moulded, thrown, or turned, on a potter's wheel, according to the fhape or fize of the bafins, or other veffels, oval, round, or otherwife, with or without a cover, likewife with or without a rim or border round the edge, whereby the fame may be hung, fuftained, or refted, in or on a frame, or other fuitable or convenient ftand or veffel. The compofition, out of which the bafins, or other veffels, for filtering water, or other liquids, are thrown,

turned,

turned, moulded, or formed, consists in the first instance as follows; to wit, four equal parts, out of nine equal parts, of tobacco-pipe clay; and five equal parts, out of nine equal parts, of coarse sea, river, drift, or pit sand; these two materials, in the above proportions, are sufficient for the purpose of making small basins, and other vessels, to contain a quantity not exceeding one gallon of water, or other liquid; but the composition, when confined to these two materials, and in these proportions, often flies or cracks in the fire, if larger basins, or other vessels, are attempted to be made with it; and therefore, in the second instance, the composition out of which the basins, and other vessels, for filtering water or other liquids, are thrown, turned, moulded, or formed, consists as follows; to wit, of equal parts of tobacco-pipe clay, and coarse sea, river, drift, or pit sand. Or, in the third instance, as follows; that is to say, three equal parts, out of nine equal parts, of tobacco-pipe clay; one equal part, out of nine equal parts, of Stourbridge clay, or clay from the surface of coal-mines, or any other clay of the same quality; one equal part, out of nine equal parts, of Windſor, or other loam, of the ſame quality with Windſor loam; and four equal parts, out of nine equal parts, of coarſe river, ſea, drift, or pit ſand. Or, in the fourth inſtance, as follows: to wit, four equal parts, out of eight equal parts, of tobacco-pipe clay; three equal parts, out of eight equal parts, of coarſe ſea, river, drift, or pit ſand; and one equal part, out of eight equal parts, of that burnt ground clay of which crucibles are made. The baſins, and other veſſels, which are made of the materials, and in the proportions, in the ſecond, third, and fourth inſtances, above mentioned, will ſtand the heat of the fire better than thoſe made of the materials, and in the proportions, in the firſt inſtance above mentioned. And, therefore, the materials in the ſecond, third, and fourth inſtances, are better calculated for the making of larger baſins, and other veſſels, than thoſe in the firſt inſtance are. For all, and every, and each of the above four inſtances, the different parts of the ſaid ſeveral and reſpective compoſitions muſt be worked together, moulded, or formed, as pottery is usually worked, moulded, or formed; and when the vessels are of that degree of dryness which is usual, and well known in the formation of pottery, the whole outside and inside surfaces are shaved or turned off on a potter's wheel, ready for burning; and, when perfectly dry, are burnt or baked in a potter's kiln, as other pottery is usually burnt or baked. But as some of the above sorts of clay and composition differ in quality from each other, the quantities of each sort to be taken or used must, in some measure, be left to the experience and discretion of the maker, to compound them in such proportions as to render the basins, and other vessels, fit for the intended purpose. In witness whereof, &c.

XXXII. Specification of the Patent granted to Mr. ROBERT WELDON, of Litchfield, Engineer; for his Invention of a Machine for conveying Veſſels, or other Weights, from an upper to a lower, or lower to an upper, Level on Canals.

WITH A PLATE.

Dated June 19, 1792.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that I the ſaid Robert Weldon, in compliance with the ſaid proviſo, do hereby declare, that my ſaid invention is deſcribed in the plan, or drawing, hereunto annexed, and particulars thereof hereunder written. In witneſs whereof, &c.

DESCRIPTION OF THE MACHINE.

(See Plate XV.)

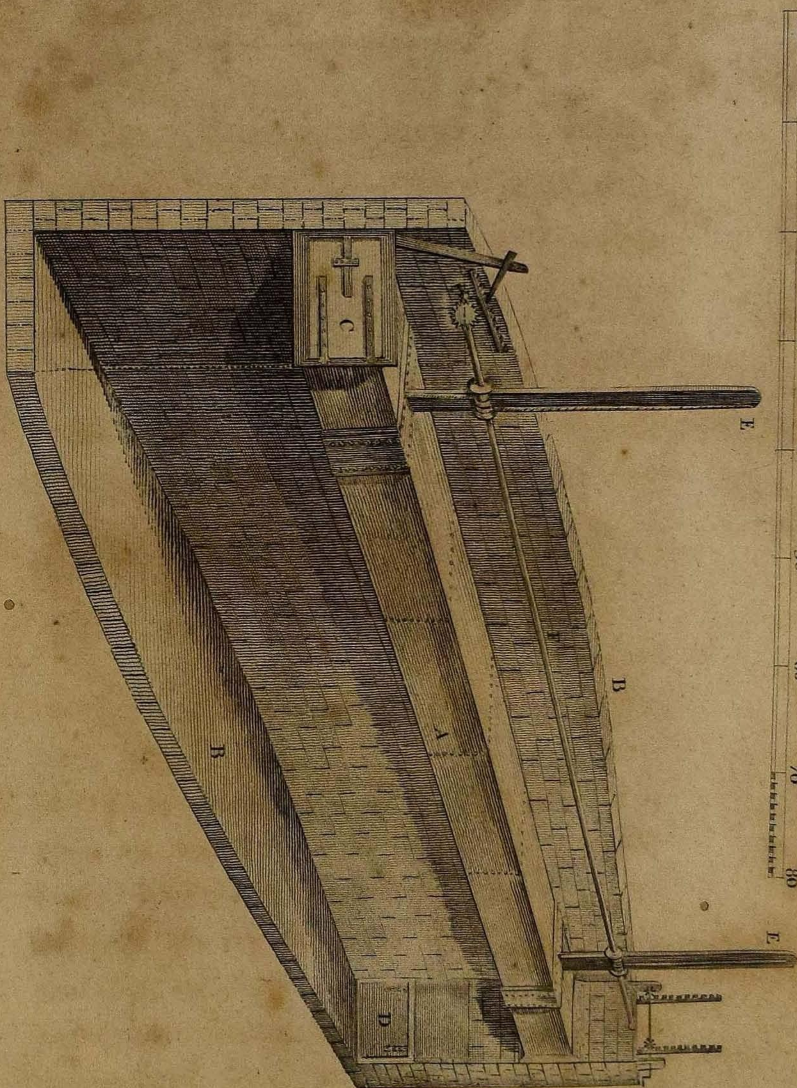
The drawing annexed presents a perspective view of the machine, or conveyance, (by which the conveyance is to be effected,) and of the inside of a cistern partly in which it is immersed; both which may be constructed in the form or shape in the drawing, or otherwise as may best suit the different situations and purpofes required. The machine, A, consists of a trunk, or caiffon, made of copper, iron, wood, or other materials, and of dimensions equal to the reception of veffels, or other large bodies and weights; at each end thereof is a door-way, which the veffel, &c. is to be floated through, into or out of the trunk, and being received therein, and the door then shut over, a given quantity of water to float the veffel, &c. and counterpoife the machine, it may then be easily raised or lowered at pleafure, by means of racks and pinions, or chains and pulleys, (as fhall be found moft convenient,) from one level to another, and the veſſel, &c. be delivered accordingly. B is one ſide, the bottom, and one end, of the lock or pound. C, the door at each end of the trunk. D, an aperture at each end of the lock, one at the upper and the other at the lower level, with a ſliding gate or bolt, moved by racks or chains, to receive the end of the trunk, to which it is to be cloſely fitted at the time the veſſel, &c. is received or delivered. E E are the uprights, to which chains are fixed, and to which pinions alſo may be applied, for the purpoſe of raiſing or lowering the trunk, which, when brought to the aperture of the lock, will be confined there by means of levers; and the machine is farther regulated by means of a pump, an air-pipe, and other apparatus, to be applied as occaſion may require.

XXXIII. Idea of a Dendrometer, or Inftrument for meafuring Diftances by One Obfervation; by WILLIAM PITT, Efq. of Pendeford, near Wolverhampton.

WITH A PLATE.

THE idea of a Dendrometer, or inftrument to meafure diftances by a fingle obfervation, has fometimes been difcuffed, both in converfation and upon paper; and, though the fubject has generally been treated with neglect, and even with a kind of contempt, by found mathematicians, upon an idea of its extravagance and eccentricity, or upon a fuppofition of its being founded upon falfe principles, yet I cannot but ftrongly recommend it to the attention of the ingenious mathematical inftrument-maker, as an article perhaps capable of being brought to a higher degree of perfection than has generally been fuppofed.

The



10
20
30
40
50
60
70
80
C
E
E
A
B
B
B
D

The method of determining diſtances by two obſervations, from either end of a baſe line, is well known to every one in the leaſt degree converſant with plane trigonometry; that of determining ſuch diſtances by one obſervation has been leſs explained and underſtood; and to this I wiſh to call the attention of the ingenious, whoſe local circumſtances of ſituation may enable them to inveſtigate and improve the ſubject.

To determine diſtances by one obſervation, two methods may be propoſed, founded on different principles; the one, on the ſuppoſition of the obſerver being in the centre, and the object in the circumference, of a circle; the other, on the contrary ſuppoſition, of the obſerver being in the circumference, and the object in the centre.

To determine the diſtance of any object on the firſt ſuppoſition, of the obſerver being in the centre, the bulk or dimenſions of ſuch object muſt be known, either by meaſure or eſtimation, and the angle formed by lines drawn to its extremities being taken, by an accurate inſtrument, the diſtance is eaſily calculated; and ſuch calculations may be facilitated by tables, or theorems, adapted to that purpofe. For this method our prefent inftruments, with a nonius, and the whole very accurately divided, are fufficient; the only improvement wanting feems to be, the application of a micrometer to fuch inftruments, to enable the obferver to read his angle with more minute accuracy, by afcertaining not only the degrees and parts of a degree, but alfo the minutes and parts of a minute.

As, in this method, the bulk of inacceffible objects can only be eftimated, the error in diftance will be exactly in the proportion of the error in fuch eftimation: little dependence can therefore be placed on diftances thus afcertained. For the purpofes of furveying, indeed, a ftaff of known length may be held by an affiftant, and the angle, from the eye of the obferver to its two ends, being meafured by an accurate inftrument, with a micrometer fitted to afcertain minutes and parts of a minute, diftances may be thus determined with great accuracy; the application of a micrometer to the theodolite, if it could be depended upon, for thus determining the minute parts of a degree,

gree, (in ſmall angles,) is very much a deſideratum with the practical ſurveyor.

This method of meaſuring diſtances, though plain and ſimple enough, I ſhall juſt beg leave to illuſtrate by an example; ſuppoſe A, Fig. 1, (ſee Plate XVI.) the place of the inſtrument; BC, the aſſiſtant's ſtaff, with a perpendicular pin at D, to enable the aſſiſtant to hold it in its right poſition; now, if the angle B A C could, by the help of a micrometer, be aſcertained to parts of a minute, the diſtance from A to B, or to C, may be, with little trouble, calculated as follows.

Suppoſe the length of the ſtaff B C be 100 inches, or other parts; divide the number 343500 by the minutes contained in the angle A, the quotient will be the diſtance A B, or A C, in the ſame parts.

The number 343500 becomes the dividend in this caſe, becauſe the arch of a circle ſubtending an angle of 3435 minutes, or 57° 15′, is equal in length to the radius, and the object-ſtaff B C is ſuppoſed divided into 100 equal parts.

Thus, ſuppoſe the angle A be 1°, or 60′, then 60)343500(=5725 inches = diſtance A B.

Or,

Or, if the angle A be 60′ $\frac{1}{10}$ then 60.1)343300(= [illegible]3,5 inches.

Hence it appears, that an error of $\frac{1}{10}$ of a minute, in the angle A, would cause an error of 9 inches and a half in the distance AB, or about $\frac{1}{600}$ part of the whole; the accuracy therefore, of thus taking distances, depends upon the accuracy wherewith angles can be ascertained; and the error in distance will bear the same proportion to the actual distance as the error in taking the angle does to the actual angle.

But this method of ascertaining distances cannot be applied to inaccessible objects, and it is moreover subject to the inconvenience of an assistant being obliged to go to the object whose distance is required, (an inconvenience almost equal to the trouble of actual admeasurement,) therefore the perfection of the second method proposed (if attainable) is principally to be desired: namely, that of conceiving the observation made on the circumference of a circle, whose centre is in the object whose distance is to be ascertained: and, none of our instruments now in use being adapted to this mode of observation, a new

con-

conftruction of a mathematical inftrument is therefore propofed, the name intended for which is the *Dendrometer.*

This name is not now ufed for the firft time, it was applied in the fame way by a gentleman who had, as I have been informed, turned his thoughts to this particular fubject, but I do not find that he ever brought his inftrument into ufe, or explained its principles; nor do I underftand that this principle has ever been applied, in practice, for the familiar purpofe of afcertaining terreftrial diftances in furve, [illegible] or otherwife; though the fame principle has been fo generally, and fuccefsfully, applied, in determining the diftance of the heavenly bodies by means of their parallax.

The following principles of conftruction are propofed, which may perhaps be otherwife varied and improved. O, Fig. 2, the object whofe diftance is required; A B C D E the inftrument *in plano*; B C, a telefcope, placed exactly parallel to the fide A E; C E, an arch of a circle, whofe centre is at A, accurately divided from E, in degrees, &c.; A D, an index, movable on the centre A, with a nonius fcale at the end D, gradicated to apply to the divisions of the arch; also with a telescope, to enable the observer to discriminate the object, or any particular part or side thereof, the more accurately. The whole should be mounted on three legs, in the manner of a plain table, or theodolite, and furnished with spirit-tube to adjust it to an horizontal position. The instrument being placed in such position, the telescope BC must be brought upon the object O, or rather upon some particular point or side thereof: which, being there fastened, the index AD must be moved, till its telescope exactly strikes the same point of the object; then the divisions, on the arch ED, mark out the angle DAE; which will be exactly equal to the angle BOA, as is demonstrated in the XV. and XXIX propositions of Euclid, Book I: and, the side BA being already known, the distance BO, or AO, may be easily determined in two different ways, viz. first, by supposing the triangle BOA an isosceles triangle; then multiply the side BA by 3438, as before, and divide the product by the minutes contained in the angle DAE = the angle BOA; the quotient will

be

be the diſtance BO = AO, very nearly; or, ſecondly, by ſuppoſing the triangle ABO right-angled at B, then, as the ſine of the angle found DAE = BOA is to the ſide known BA, ſo is the radius to the ſide AO, or ſo is the ſine of the angle BAO to the ſide BO. To illuſtrate this by an example, ſuppoſe the ſide BA = 1 yard, the angle found DAE = BOA = 0° 15′, then, *per* firſt method 15)3435(= 229 yards = the diſtance BO, or AO. Or, by ſecond method,

As the ſine of the angle found 0° 15′ = 7.6398160
is to the ſide BA = 1 yard = - 0.0000000
So is radius 90° 0′ = - - 10.0000000

yards

To the log. of the ſide AO = 229 = 2.3601840

Or,

As to the ſine of the angle found
0° 15′ = 7.6398160
is to the ſide BA = 1 yard = 0.0000000
So is the ſine of the angle BAO
= 89° 45′ = 9.9999959

yards

To the log. of the ſide BO = 229 = 2.3601799

As

As the perfection of this inftrument depends totally upon its accuracy in taking fmall angles, which accuracy muft depend, for its minute divifions, upon its being fitted with a micrometer; and as the writer of this cannot doubt that the particular mode of doing this muft be familiar to the intelligent inftrument-maker, he cannot but ftrongly recommend it to the attention of the ingenious of that profeffion, as an object which, when perfected, would be a real and confiderable improvement in their art, and an ufeful inftrument to the practical furveyor. Its accuracy would alfo, in fome meafure, depend upon the length of the line B A in the figure; that line might therefore be extended, by the inftrument being conftructed to fold or flide out to a greater length, when in ufe; upon which principle, connected with the application of a micrometer, an accurate and ufeful inftrument might certainly be conftructed. To adjuft fuch inftrument for ufe, let a ftaff be held up at a diftance, in the manner of Fig. 1, exactly equal in length to the diftance of the two telefcopes, and the index A D being brought exactly upon the fide A E, if the two tele-

telescopes accurately ſtrike either end of the ſtaff, the inſtrument is properly adjuſted.

The conſtruction of a ſimilar inſtrument, on the principles of Hadley's quadrant, for naval obſervations, would alſo doubtleſs be an acceptable object in navigation, by enabling the mariner to aſcertain the diſtances of ſhips, capes, and other objects, at a ſingle obſervation; and that, perhaps, with greater accuracy than can be done by any method now in uſe.

For this purpoſe, the following conſtruction is propoſed: A B C D E, Fig. 3, the inſtrument *in plano*; O, the object whoſe diſtance is required; at A, at C, at E, and at 3, are to be fixed ſpeculums, properly framed and fitted, that at 3 having only its lower part quickſilvered, the upper part being left tranſparent, to view the object; the ſpeculum at A being fixed obliquely, ſo that a line A 1, drawn perpendicular to its ſurface, may biſect the angle B A C in equal parts; that at C being perpendicular to the line C 2; thoſe at E and 3 being perpendicular to the index E 3, and that at E being furniſhed with a ſight; the arch D C to be divided from D, in the manner of Hadley's qua-

 drant;

drant: the movement of the index to be meafured, as before, by a micrometer: and, as the length of the line A E would tend to the perfection of the inftrument, it may be conftructed to fold up in the middle, on the line C 2, into lefs compafs, when not in ufe: the inftrument may be adjufted for ufe by holding up a ftaff at a diftance, as before propofed, whofe length is exactly equal to the line A E.

To make an obfervation by this inftrument, it being previoufly properly adjufted, the eye is to be applied at the fight in the fpeculum E, and the face turned toward the object; when the object, being received on the fpeculum A, is reflected into that at C, and again into that at E, and that at 3 on the index: the index being then moved, till the reflected object, in the fpeculum at 3, exactly coincides with the real object, in the tranfparent part of the glafs, the divifions on the arch D 3, fubdivided by the micrometer, will determine the angle D E 3 = the angle A O E; from which the diftance O may be determined as before.

It

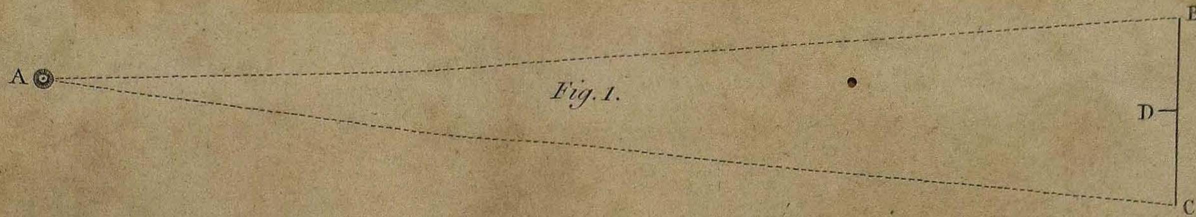


Fig. 1.

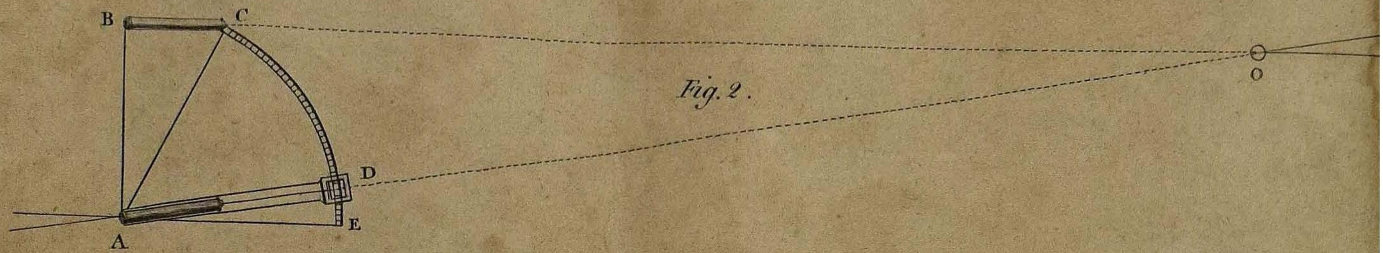


Fig. 2.

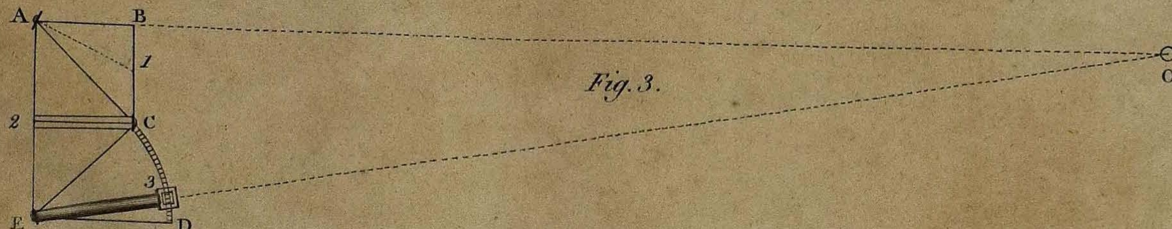


Fig. 3.

It is very probable that this arrangement may be improved, by thoſe who are familiar with the beſt conſtruction of Hadley's quadrant; which the writer of this profeſſes himſelf not to be, farther than its general principle. He has not the leaſt doubt that uſeful practical inſtruments may be conſtructed on the principles here deſcribed; and, upon this idea, cannot but recommend the ſubject to the attention of thoſe concerned in the manufacture of ſimilar inſtruments.

XXXIV. Concluſion of Mr. HENRY's Conſiderations relative to the Nature of Wool, Silk, and Cotton, as Objects of the Art of Dying.

(FROM p. 207.)

FOR the tenth operation, this remaining decoction of galls is to be heated, the thick ſediment at the bottom being previouſly ſeparated by a hair-ſieve, and the cotton again treated as in the ninth operation.

The eleventh operation is the aluming of the cotton. Thirty pounds of Roman alum, finely powdered, are put into sixteen gallons of water, gradually heated, and continually stirred; as soon as it becomes so hot that the operator can just easily bear his hand in it, the fire is to be removed. Six gallons of the first barilla liquor are then to be added by degrees, and the whole agitated till the solution is complete. The cotton is to be placed in the wringing tub, about three gallons of the alum-liquor poured on it, and, in proportion as it is soaked up, more is to be added, till about one half of it is employed. The cotton having been thoroughly worked in the liquor, it is to be well wrung and dried, and the portion which is wrung out is to be returned to the remainder in the pan, and used in the twelfth operation, which is performed exactly in the same manner as the eleventh; after which the dried cotton is to be well washed, by handfuls, in running water, the workman holding in each hand about twenty ounces of cotton, for two minutes. Each portion is then wrung, and separated, washed and wrung again, and laid upon a coarse cloth. The whole is then carried up from the river, wrung a third time, and hung to dry. The cotton will now be ready for the thirteenth operation, in which the colouring-fubftance is applied to it.

The cotton is firft divided into four equal parts, each of which is to be dyed feparately; and thefe are fubdivided into fkains, or parcels, of about a pound and a quarter each. The copper pan is then to be filled with water, within about fix inches of the top, and twenty-fix pounds of Smyrna, or rather of Cyprus, madder added to it. As foon as the water becomes milk-warm, fourteen pounds of fheep's blood, as frefh as it can be procured, are to be ftirred into it. When the liquor is fo warm that the workman can juft bear his hand in it, one fourth part of the cotton is to be put into it, fufpended on fticks, by means of which it is moved backwards and forwards in the pan, every five minutes; and the fkains are to be inverted every ten minutes, fo that they may receive the dye equally in every part; this bufinefs is continued for about fifty minutes. The cotton is then hung on five fticks only, and ſo ſuſpended by ſtrings as to be wholly immerſed in the liquor, which is now made to boil, and continued boiling for forty-five or fifty minutes. A white froth, which about this time appears on the ſurface, is a ſign that the madder is exhauſted of its colouring matter, and that the cotton can receive no benefit, though it will get an injury, from continuing longer in the liquor. It is then to be withdrawn, carried to be well waſhed in the river, or waſh-wheel, and then wrung and dried.

The other three-fourths of the cotton are then to be ſucceſſively dyed in the ſame manner; freſh madder baths being uſed for each parcel.

The fourteenth operation is repreſented as highly eſſential to the ſucceſs of the proceſs; ſhould it be omitted, the colour, it is ſaid, would not only be ſo animated as to loſe much in the ſubſequent operation, but would likewiſe require more time for the enlivening. About eight gallons of the white liquor, which remained after the ſeventh operation, and were directed to be reſerved, are now to be mixed with four gallons of the firſt barilla ley. Two gallons of this mixture

mixture being put into the wringing-tub, the whole of the cotton is to be waſhed in it; adding more liquor in proportion as it is ſoaked up by the cotton, which is afterwards to be wrung and dried.

To this ſucceeds the fifteenth and laſt operation; viz. that of enlivening or reviving the colour. The copper pan being about half filled with water, twenty-eight or thirty gallons of the liquor remaining after the firſt operation are to be added, ſo that the liquor may reach to within ſix inches of the top. When the liquor is nearly boiling, the cotton is to be put in, being previouſly formed into parcels of about two pounds and a half each; nearly four ounces being kept ſeparate, for a purpoſe hereafter to be deſcribed.

The cotton is to be well preſſed down in the pan, and confined by ſticks. The pan is covered with a wooden lid, having a ſmall hole, through which the ſmall portion of cotton, reſerved for that intention, may be occaſionally withdrawn, in order to obſerve the progreſs of the operation; this hole has a movable cover. The lid is then to be ſecured by a ſtrong croſs of wood, with a ſtraight piece over it; and the ſides made cloſe,

ſo

so as to confine the vapours, by laying round the edges of the lid a quantity of damp linen cloth. The fire is then to be raised, so as to make the liquor boil, and the boiling is to be continued for nine hours.

The process is finished by taking the cotton out of the liquor, wringing, and drying it; but the drying is never to be performed either in a stove or in strong sun-shine. The colour will be most brilliant if the cotton be dried in the shade, with a free access of air.

In the third part I shall endeavour to give a theory of dying (so far as *reds* are concerned,) and especially of the process of which we have just given a detail.

PART THIRD.

Nothing can lead more effectually to the improvement of any art than a right understanding of the instruments, or agents, employed in the practice of it. Though long experience may establish a number of facts, yet, if the *theory* of the manner by which they are produced be not understood, misapplications are liable to be made,

similar

ſimilar practices are purſued where the caſes differ eſſentially; and improvements are attempted at hazard, and often on falſe principles.

Though it may not be granted that, in the ſcouring of the ſeveral materials which are to be ſubjected to the art of the dyer, their tubular pores are enlarged, or even diveſted of any matter which inſtructs them, yet it will not be diſputed that the intention of theſe proceſſes is to remove an oily or a reſinous matter which inveſts the fibres, and fills up the interſtices of the filaments; either rendering the material leſs white, or leſſening its attraction for water, and for the colouring-matter intended to be applied. For the more brilliant colours, in order that they may be exhibited in their greateſt luſtre, the ſcouring and bleaching is generally carried to ſuch a degree as only to be ſhort of injuring the texture; and the material always ſuffers a loſs of ſubſtance.

In the preparation for the Turkey red, the caſe ſeems to be different; no bleaching is allowed, and the firſt operation of the proceſs is of a kind that is rather likely to add to the weight than to ſubtract any thing from it. The cotton is boiled in a mixture of barilla, or impure mineral alkali, oil, and animal excrement. Were the sole intention of this operation to scour the copper, or, as the dyers phrase it, to open its pores, would not the barilla alone be more efficacious? And for what reason can we suppose that the sheep's dung, which contains a quantity of foul colouring matter, should be added? We have seen that, in the scouring of silk, when a perfect soap is used, some portion of it adheres, notwithstanding the washing the silk undergoes. The cotton is indeed also well washed after this first operation, but it is most likely that water will not be able to remove the whole substance of this animalized soap; and it seems also probable, that the imperfect soap, or mixture of oil and alkali, together with the dung-liquor, through which the cotton is so often passed, will continue to furnish somewhat to it; for animal substances contain an acid which is separated in various forms. We have already seen that saccharine acid is obtainable from them by means of nitrous acid; the blood affords the Prussian acid, and also phosphoric acid. This last is contained still more abundantly

abundantly in the urine, and in the bones, but we ſhall defer the conſideration of the uſe of animal acid in dying, till we come to treat on the ſubject of baſes.

The idea of animalizing vegetable ſubſtances, to promote their attraction for colouring-matter, occurred to me many years ſince; and the late Sir Torbern Bergman ſeems to have held a ſimilar opinion. We have ſeen, in the abſtract I have given of M. Berthollet's analyſis of animal and vegetable ſubſtances, that wool and ſilk yield much acid of ſugar, together with a fatty oil; whereas cotton gives no ſaccharine acid, no oil, and, in ſhort, that the whole ſubſtance is capable of being diſſipated in the form of gas, leaving no reſiduum in the retort, and communicating nothing permanent to the nitrous acid which diſtils into the receiver.

I wiſh that ſome perſon, whoſe opportunities and leiſure are greater than mine, would compare, by ſuch an analyſis, cotton in its natural ſtate, and cotton prepared in the ſeven leading operations for the Turkey red; in order to determine whether it have, by this treatment, acquired pro-

 perties

perties more nearly approaching to animal matter; viz. whether in the latter state it will afford more acid of sugar, and give over on distillation an oily matter, resembling that obtained from animal substances.

Another point which it might be important to ascertain is, what increase of weight the cotton acquires after each steeping. It appears from the account of the gentlemen appointed to superintend and repeat M. Borelle's process, that, previous to the maddering, or imparting of the colouring matter, the cotton had increased to the amount of $\frac{1}{4}$ of its original weight, though it had been well washed previous to that operation. In this increase, however, was included what it had acquired in the operations of galling and aluming.

The operation of galling, in this as well as some other processes of dying, is used previous to the application of the boils to the material. Galls contain an astringent matter, to which chemists have lately given the appellation of the astringent principle, and the Dijon Academicians have proved it to be of an acid nature. It has not only the property of decomposing metallic, but also

earthy,

earthy, ſolutions, and of combining with the precipitates which fall from them: hence its uſe, previous to the aluming, in the proceſs of dying. Steep cotton which has not been galled in a ſolution of alum, the ſolution will remain clear, and the cotton, when dried, will be covered with aluminous cryſtals: let another parcel of cotton, which has been galled, be immerſed in a ſimilar ſolution, the liquor will become turbid, and plain marks of precipitation will appear.

This aſtringent principle is of ſtill farther uſe in the art of dying, and we ſhall preſently ſee the manner in which it acts, when combined in thoſe vegetables which afford colouring-matter.

Having thus given an account of the previous operations in dying, relative to the application of the baſis, let us next enquire into the principles on which this application is made, and the modes by which it is more firmly attached to the material.

We have already remarked that alum contains an earth in its compoſition, united to vitriolic acid. This earth is purely argillaceous, and may be ſeparated from the acid to which it is united, by any ſubſtance to which either the earth, or the acid, has a ſtronger attraction than they poſſeſs to each other.

The firſt theory we meet with, to account for the action of allum, and other intermediate ſubſtances uſed to furniſh baſes for colouring-matter in dying, is that of M. Hellot; who ſuppoſes that theſe ſaline bodies form vitriolated tartar, a ſalt difficult of ſolution in water, and that the minute cryſtals of this ſalt inſinuate themſelves into the pores of the material to be dyed; that to theſe cryſtals the colouring-matter becomes attached, and firmly united, and they to the material, ſo as to reſiſt the ſolvent power of water. Thus, when tartar and alum are uſed, he imagines the vitriolated tartar to be formed from them; and, in every other caſe of dying, he accounts for the production of a vitriolated tartar, but often in a manner by no means ſatisfactory. This vitriolated tartar he deſcribes as cryſtalliſing in the dilated pores of the cloth, attracting the colouring-matter, and, being difficult of ſolution in water, detaining the colouring-particles, which are farther cemented by the crude tartar.

But,

But, though these salts are not *easily* soluble in water, yet a *sufficient* quantity of water will dissolve them; and, if the colouring-particles were attached to them, they must be carried off whenever the solution of the salts is effected. But, as this is not the case, (for, when these particles are properly affixed to the material, they are not movable by any quantity of water, however large,) their fixity must depend on some more permanent basis.

Mr. Keir, the ingenious translator of Macquer's Dictionary of Chemistry, ppears to have been the first who suspected that the earth of alum was precipitated, and in this form attached to the material; indeed, it seems wonderful that this idea did not occur to M. Hellot, who was fully aware that, in the dying of scarlet, the cochineal became firmly united to the white calx of tin.

M. Macquer, in the last edition of his Dictionary, has been more explicit on this subject. From the experiments which have been alluded to, in the second part of this paper, by which laques and carmine are made by pouring solutions of alum, or of tin, into clear decoctions of extractive

tractive various colouring-ingredients, he concludes that the same effects take place in dying; that, when the materials are loaded with these earthy or metallic salts, and then thrown into the liquors impregnated with the colouring-substances, the colouring-matter quits the other principles to which it was united, seizes on the earthy basis of the salt, and, uniting with it, loses its solubility in water, and, in this combination, becomes attached to the materials in so permanent a manner as not to be washed away by water. M. Macquer, however, does not seem to have been aware, that it is by means of the astringent principle that this precipitation is effected. All the substances which form laques contain this principle; as is evinced by the blackness they produce with martial solutions, and to this the colouring-principle seems to be closely united. A few drops of infusion of galls produce an immediate precipitation of the earth of alum from its acid; this precipitation is more copious than that produced by any of the common colouring-substances, and is, at the same time, white.

Here

Here again new experiments are ſuggeſted. Let a large quantity of earth of alum be thus precipitated by galls; let the precipitate be well waſhed, and afterwards expoſed in a retort, with a receiver adapted to it, to a ſtrong heat; the aſtringent principle, if united to the earth of alum, being volatile, will probably be driven over into the receiver, and thus the ſuppoſed combination be rendered evident.

Again, let the ſupernatant liquor, from which all the earth has been precipitated, be examined, to ſee in what ſtate of combination the vitriolic acid of the alum rema[illegible].

In the common dyes then, with metallic or earthy baſes, the theory is pretty clearly as M. Macquer has repreſented, only taking the aſtringent principle into the account; and, with reſpect to wool and ſilk, nothing more ſeems neceſſary than the impregnation of the one with alum and tartar, and of the other with alum alone, previous to their immerſion in the coloured liquor.

But when cotton is to be dyed, and ſome of theſe baſes are requiſite, not only the baſis is to be precipitated by the aſtringent colouring-principle, but the attraction of the material to the basis is to be increased by other *intermedia*. The permanency of the extractive dyes, therefore, depends on the previous treatment of the cotton; and, when alum is employed, of that salt, so as to procure a more copious precipitation of its earth, and to unite it, by means of other substances, to the material.

For this reason, in the common dying of cotton the alum is previously neutralized, by the addition of alkaline salt; whereby, not only the acid is prevented from injuring the cotton, but the alum is put into a state more ready to be precipitated by the astringent colouring-matter.

For this reason also, in the process of calico-printing, the earth of alum is made to change its natural acid for the acetous; for, by this means, not only a salt is prepared, capable of dissolving more copiously in water than common alum, but the acetous acid, being more loosely attached to the aluminous earth, is, as it becomes concentrated by drying, easily driven off by heat, the earth being left spread upon and cemented to the calico.

When

When ſpeaking of the uſe of animal ſubſtances, it was obſerved, that they yield ſeveral different acids by various modes of analyſis; *viz.* the phoſphoric, the ſebaceous, the Pruſſian, and the ſaccharine. Of theſe, the two firſt are formed in the animal ſyſtem; the third is perhaps the creature of fire, and originates from a combination of ſome of the more ſimple conſtituent parts of animal ſubſtances; and, of the laſt, it ſhould ſeem that theſe ſubſtances only contain the baſis *. M. Berthollet, by uniting cauſtic alkalies with animal ſubſtances, is ſaid to have found them neutralized, and that the animal matter, when afterwards ſeparated from the alkali, is no longer ſuſceptible of putrefaction. This animalized neutral ſalt may be decompoſed by means of alum; and, while the vitriolic acid ſeizes on the alkali, the earth of alum becomes intimately combined with the animal acid. It appears to me highly probably, that this acid is ſupplied to the cotton, in the proceſs for dying the Adrianople red; that the attraction between the cotton and acid being ſtrong, and that between the latter and the earth of alum being likewiſe

* Critical Review, vol. LXII. p. 377.

 power-

powerful, fuch an union is effected as affifts in rendering the material capable of attracting and retaining the colouring-matter, in fo forcible and permanent a manner as can be done either by wool or filk.

The ufe of the galls alfo, in this and other proceffes, feems intended to promote a fimilar purpofe. Cotton, either unbleached, or which has undergone no procefs but that of bleaching, when immerfed in a folution of alum, produces no change in the appearance of the folution; but, as has been already fhewn, cotton previoufly fteeped in an infufion or decoction of galls foon renders the liquor turbid, occafioning a precipitation of the earth of alum on the cotton.

The imperfect foap alfo, formed by the union of the alkali and oil, when mixed with the alum, will both decompofe that falt, and be itfelf decompounded, and a foap of a different nature will refult, from the union of the oil with the earth of alum. M. Berthollet, who has made feveral experiments on earthy and metallic foaps, found this argillaceous foap to be totally infoluble in water, and in fpirit of wine. It is probable alfo, that the blood, which is employed with the madder,

der, may supply both animal salts, and a glutinous matter, to the cotton. This seems to be the use of the blood, and not, as M. Sordie supposes, to communicate a pink tinge to the madder.

Here then appear to be several different substances employed, tending to form insoluble compounds with the argillaceous earth of the alum. But whether, when deposited on the cloth, they remain so many distinct compounds, or may all unite into one insoluble body, I do not pretend to determine.

M. Macquer, whose opinions always deserve the most respectful attention, declares, that the excellence and permanency of the Turkey red depend on the great quantity of alkali, used in the process of aluming, redissolving the earth of alum, after its separation from the vitriolic acid, and forming with it a saline compound, easily separable into its constituent parts, so that the aluminous earth may be conveniently deposited on the cotton, and united to the colouring-matter. The following is a translation of his own words, from the last edition of his Dictionary.

"In examining," says this excellent chemist, "the effects of all the complicated operations at-

" tendant on the Levant, or Adrianople, procefs,
" for giving to cotton a more beautiful and
" durable red, by means of madder, than can be
" communicated by the common method, I was
" ftruck with a fingularity which attends the
" aluming in this procefs, and which confifts in
" mixing a great quantity of fixed alkali with the
" folution of alum, previous to the impregnation
" of the cotton with it.

" As the alum is certainly decompofed by the
" fixed alkali in this operation, I wifhed to dif-
" cover what was the refult; and I found that
" the alkali, at the inftant it precipitated the
" earth of alum, rediffolved a confiderable part
" of it, and that the alkaline falt, with aluminous
" bafis, is the real mordant in the Levant procefs.
" I have actually determined, by fuitable experi-
" ments, firft, that both fixed and volatile alkalies,
" efpecially if cauftic, are capable of diffolving and
" reducing to a faline ftate a fufficiently-large por-
" tion of earth of alum, even in the moift way; and
" that, by calcination, fixed alkalies become ca-
" pable of diffolving a fomewhat-larger quantity
" of this earth; fecondly, that this alkaline earthy
" falt is decompofed, even by water alone, but ftill
" more

" more easily by means of a decoction of madder, " or other extractive tinctures, on the colour of " which the earthy part of the salt seizes, and " forms with it a laque, or coloured precipitate, in " the same manner as those mordants which are " formed of an acid combined with an earth or a " metal; thirdly, I have proved, by several " experiments, that when cotton or linen is im- " pregnated with a strong solution of this alka- " line mordant, without any other preparation " than scouring and galling, these substances re- " ceive, in the madder-bath, a red much more " beautiful and deep than can be given them, " when alum alone is used *."

Notwithstanding my deference for the opinion of this great man, I must, on this occasion, differ from him, for reasons which, it is hoped, will prove satisfactory.

1st. The portion of barilla used in the operation of aluming is only six pounds, supposing the whole quantity employed to be dissolved in the first liquor; but, as there are two other solutions made

* Macquer, Dictionnaire de Chymie, 2 édit. tom 4. Article Teinture.

before

before the whole of the salt is dissolved. It is probable that six gallons of the first liquor will not contain near one half of that weight; for, the barilla being dry and hard, and the mineral alkali less soluble than the vegetable, the first water will act but slowly on it; and it is observable, that, through the whole process, the second liquor is considered as the strongest, and is used for mixing with the oil. Besides, not much above one half of the barilla consists of aërated mineral alkali; we may therefore conclude, that the amount of this salt contained in six gallons of the first barilla liquor (the quantity added to thirty pounds of alum) does not exceed one pound and a half. Now, as 100 parts of alum contain 38 of vitriolic acid, these will require, for their saturation, 35 of aërated mineral alkali; so 30 parts of alum, containing 11.4 of that acid, these will require, for their saturation, 11.1 of the same alkali: whereas, the quantity employed amounts only to 1.5, or rather more than $\frac{1}{8}$ of the quantity requisite for the neutralization of the acid: and, as a superabundant quantity of the precipitant, above what is necessary to the saturation of the acid, is requisite before re-solution of the preci-

pitate

pitate can take place, we have, in this cafe, no reafon to expect it.

2dly. The quantity of alkali employed is not fuperior to that ufed in the aluming, in other proceffes for dying with madder; viz. $\frac{1}{6}$ or $\frac{1}{7}$ of the alum.

3dly. The alkali, being aërated, is in the moft unfavourable ftate for rediffolving the aluminous earth; and,

4thly. The re-folution of the aluminous earth takes place only fo long as any of the fuperabundant vitriolic acid remains unneutralized, except the addition of alkali be continued after the precipitation of the aluminous earth is wholly effected; and it cannot be fuppofed that the alkali, with which the cotton has been impregnated, in the previous operations, added to that contained in the barilla liquor, mixed with the alum, can be fuch, even if it were in an uncombined ftate, as to produce fuperfaturation.

It fhould feem probable, therefore, that the permanency of the Turkey red depends on the caufes already affigned, and that its brightnefs is produced by the action of the mineral alkali on the madder. This appears, at firft fight, difcordant with the theory of Mr. Delaval, that alkalies reduced red colours to crimson, and these to purple; whereas, in the present case, the red is brightened by boiling in a strong solution of mineral alkali: but the fact is perfectly agreeable with that theory; for, the madder colour is too much inclining to a dusky orange, and this, by means of the intensifying alkali, descends to red.

Before I conclude, permit me to advance a few circumstances relative to the black dye.

For the dying of black, the calx of iron is the mordant employed; and this, uniting with the astringent principle of the galls, forms a black pigment, which is attracted by, and adheres to, the material to be dyed.

The late Dr. Lewis had ascertained, by a number of well-conducted experiments, that the colouring-matter of ink consisted of a very-finely-attenuated calx of iron, combined with this principle. He found also, that this matter, (which, if not kept suspended by some mucilaginous substance, separates and precipitates from the liquor,) resembles in some degree martial æthiops; but that it was not, like that powder, attracted by the magnet till after it had been exposed to a red

heat

heat, when it loſt its blackneſs, and became of a ruſty brown colour; a proof that the black colour of ink, or that of the black dye, which is formed on ſimilar principles, does not depend merely on the iron acquiring phlogiſton from the galls. He alſo found, that both acids and alkalies deſtroy blackneſs thus produced; the former by diſſolving the ferruginous body, the latter by acting on the aſtringent principle; he, however, was of opinion, that this principle was of a fixed, not of a volatile nature. But our worthy preſident, Dr. Percival, very early ſuſpected that this aſtringent principle poſſeſſed ſome volatility; in ſupport of his opinion, he mentions artichoke-ſtalks loſing their aſtringent principle by being dried in an oven. He likewiſe appears to be the firſt who obſerved the action of acids and aſtringents on each other.

The ſubject has been farther purſued by the Dijon Academicians; from the reſult of whoſe experiments it appears, that the aſtringent principle is ſoluble in water, in ſpirit of wine, in oils, and in ether; that it riſes copiouſly in diſtillation, reddening the blue vegetable juices, but is capable of uniting, with equal facility, with acids and with alkalies; that, though it does not revive iron, without the aid of fire, yet gold and silver are precipitated by it in their metallic form; and that it is capable of decomposing most metallic solutions, and of giving different colours to their precipitates.

Dr Percival had endeavoured to produce an ink, by macerating iron filings, without their being combined with any acid; but, making his infusion without heat, he did not succeed. The Dijon chemists, not content with making a similar attempt, boiled the liquor; and thus obtained a violet-coloured ink, the traces of which were as well defined, and permanent, as those produced by ink prepared in the common way, even without the addition of gum. Hence it should seem, that the heat not only enabled the astringent principle to dissolve the iron, but also extracted a mucilaginous matter, which supplied the place of gum.

I have related these facts, in order to elucidate some circumstances attending the dying of black. Green vitriol was formerly used, but the calx of iron is too much dephlogisticated in this salt, and the black produced by it is not permanent. Solutions of iron in acetous acid have of late been

2 pre-

preferred, especially for cotton; and even solutions of that metal, made by macerating it with alder-bark and water, in which the astringent principle should seem to unite with the vegetable acid to form the solvent. In these solutions the iron is not too much deprived of its phlogiston, and, contrary to those made in mineral acids, they improve with age; for, the vegetable acid tending to putridity evolves phlogiston, which unites with the iron: whereas the vitriolic solution is continually parting with the volatile principle, and thereby not only becoming less fit for producing blackness, but the calx of iron, when highly dephlogisticated, is very injurious to the texture of the cloth.

The improvements made in dying black are perhaps the strongest proofs that can be given of the utility of chemical knowledge; nor can a more apt instance be adduced of the inconvenience arising from the want of it than the French process, related by M. Macquer, for this purpose; in which no less than thirty different ingredients are directed to be employed, several of which are the same things under different denominations, and others tend directly to destroy each other.

XXXV. Obſervations on Gunpowder; by the Honourable GEORGE NAPIER, M. R. I. A.

WITH A PLATE.

From the TRANSACTIONS of the ROYAL IRISH ACADEMY.

IN the following obſervations on gunpowder, (which are deduced from a ſeries of experiments, in the conducting of which I was ably aſſiſted when ſuperintending the Royal Laboratory at Woolwich,) I ſhall confine myſelf to ſuch facts as appeared new or intereſting in the courſe of my inveſtigation; only introducing thoſe parts of the common proceſs which may tend to elucidate an experiment, or ſerve to eſtabliſh the expediency of an alteration. To effect this with ſome degree of accuracy, I ſhall arrange my remarks under the following heads. Firſt, The ſelection of the materials which compoſe gunpowder. Secondly, The

The ſtrongeſt and moſt durable proportion of thoſe materials. Thirdly, The beſt mode of intermixing and combining them. Laſtly, I ſhall add ſome general obſervations.

The qualities of nitre are not eaſily aſcertained by thoſe means which chemiſts have preſcribed for determining its purity; their deviations are frequent, and ſometimes material, in the compoſition of gunpowder, whoſe bulk this ſalt conſtitutes. The method I have generally adopted, for detecting the impurity of nitre, is to drop a ſtrong ſolution of ſugar of lead into a phial of diſtilled water, ſaturated with ſaltpetre; which, if it retained any conſiderable portion of marine ſalt, or magneſia, aſſumed a turbid milky appearance. The lunar ſolution is too powerful a teſt for any nitre I have met with; but it does not always follow that the pureſt nitre produces the ſtrongeſt powder. The beſt I have ſeen is the Ruſſian; yet the manufacturers in that country are not very ſolicitous about the magnitude of the cryſtals, and whiteneſs of the ſalt, nor even its freedom from heterogeneous ſubſtances; though with us theſe qualities are accounted eſſential. In Ruſſia, I am informed, they

they ſeldom refine their nitre more than twice; and, having analyzed ſome very excellent Ruſſian powder, I found the ſaltpetre contained a conſiderable portion of marine ſalt and magneſia. It is difficult to account for this phenomenon, as marine ſalt both impedes the ignition, and leſſens the exploſion, of gunpowder; and I believe it may be demonſtrated that magneſian or calcareous nitre produces at leaſt the laſt of thoſe effects, if we conſider the faintneſs of its own detonation, when it has any; and that deliqueſcent quality, which muſt communicate a degree of humidity to the compoſition, inimical to a forcible exploſion, and (what is, in my opinion, of much greater conſequence) which muſt be noxious, in the extreme, to the durability of gunpowder. I have reaſon to believe (as far as my experience can eſtabliſh the fact) that powder, made with ſaltpetre oftener than four times refined, is of inferior ſtrength, though probably more durable, than with that which has been only thrice depurated. If the elaſtic and expanſive fluid contained in nitre partakes at all of a ſpirituous nature, may not repeated evaporation liberate a portion of it? Stahl aſſerts, that the nitrous acid is a combination

combination of the vitriolic acid with the principle of inflammability, effected by the agency of putrefaction; and Pietsch, of the Berlin Academy, seems to prove this theory, by his experiment of moistening a calcareous stone with vitriolic acid and urine, which, being exposed for some time to the action of the atmosphere, was found strongly impregnated with nitre. If the aforesaid experiment be accurate, we must admit that saltpetre is a compound substance; and it may not be a very improbable deduction to suppose, that repeated elixation in part deprives this salt of that elastic fluid which constitutes the strength of gunpowder; and this opinion is strongly corroborated by two well-known facts; first, in purifying a large quantity of nitre, there is a deficiency of weight, after the process, which cannot be accounted for by the weight of the residuum; and, secondly, as great a proportion of saltpetre cannot be extracted from damaged powder as is obtained from serviceable, though originally manufactured with the same *quantum* of nitre. Perhaps, in the Russian powder, the noxious qualities of the magnesia and marine salt were sufficiently counteracted by the

native

native excellence of the nitre, aided by ſome unknown ſuperiority in their method of combining and incorporating the materials.

In the choice of ſaltpetre I ſhould prefer that whoſe cryſtals are of a moderate ſize, ſolid, tranſparently white, which do not readily break with a crackling noiſe when gently graſped in the hand, and which, when ignited on a red-hot ſhovel, do not decrepitate, but melt and conſume with an equable and continued inflammation: the firſt of thoſe ſymptoms is produced by haſty and imperfect deſiccation, and the laſt is a proof that the marine ſalt has not been entirely ſeparated from the nitre. I muſt obſerve that, however carefully the proceſs of deſiccation is performed, the cryſtals will retain a certain portion of humidity, (beſides their eſſential waters,) which, when rarefied by the heat of the hand, produces a crackling noiſe; this proof of the quality of nitre muſt therefore depend on the degree of decrepitation. It may be aſked, Why take ſuch pains to avoid moiſture in nitre, when its combination with the other materials of gunpowder is effected by water? I anſwer, it is this particular ſpecies of

moiſture

moiſture I object to, known to ſaltpetre-refiners by the name of mother-waters, which, taken up in the act of cryſtallization, is replete with a greaſy magneſia and common ſalt. If the powder-maker refines his nitre himſelf, I adviſe him to boil it thrice, carefully ſkimming off the fœculent matter which floats on the ſurface, and abſtracting the marine ſalt, which, being cryſtallized by evaporation during the proceſs, falls to the bottom: let him filter it through canvas, made in the form of a jelly-bag, leaving it to cryſtallize (after each elixation) in leaden or copper veſſels, expoſed to a free circulation of air, in a dry ſituation, and not in a cold cellar, which is frequently, though erroneouſly, practiſed, with this palpable diſadvantage, that ſudden refrigeration forming the nitrous cryſtals before all the common ſalt has been precipitated, a part of it enters into their compoſition; they are alſo of a leſs ſize, and not ſo compact as when the ſolution is gradually cooled. It is cuſtomary with powder-makers to prefer the cakes depoſited towards the bottom of the pans, in which the ſolution of ſaltpetre is ſet to cryſtallize: theſe are formed by a congeries of

 minute

minute crystals, and are considerably less pure than the larger shoots, being intimately mixed with whatever heterogeneous matter the solution may retain, which is generally precipitated towards the commencement of crystallization: I suspect the predilection for this kind of nitre has no better foundation than its being more readily pulverized. The mother-water, which oozes from the pans, is commonly sprinkled on earth intended for generating saltpetre; instead of this, were the refiner to add to the mixture a small quantity of wood-ashes, and repeat the operation of extracting, he would find it advantageous; he would also save considerably by substituting iron boilers and leaden pans to his copper ones.

Charcoal affords few new observations: I have tried various kinds, with a scarce perceptible difference in their effects, provided they were completely charred, and equally well pulverized; however, on chemical principles, we should prefer that made from wood containing the greatest quantity of fixed salts, and whose ashes abound with alkaline salts, as such inflames more rapidly, and burns with greater vehemence. Dogwood (*Cornus ſanguinea*) and Alder (*Rhamnus Frangula*) are eſteemed by powder-makers the fitteſt for their charcoal, but I have not been able to diſcover any cogent reaſon for this preference. Green wood, being harder when charred than dry, I believe admits of a more complete comminution, and is conſequently better adapted to that intimate combination of the ingredients, neceſſary for the ſtrength and durability of gunpowder. I am informed of an improved method lately diſcovered for the preparation of charcoal; it is a kind of oven, which admitting the external application of heat, the wood piled within is more equally charred, and its volatile parts more completely evaporated.

Experience has convinced me that it is of the utmoſt importance to give an exact attention to the purity of the ſulphur, the third ingredient in the compoſition of gunpowder. On this agent depends that rapidity of inflammation, to which the charcoal contributes intenſe fire, and the nitre its aſtoniſhing elaſticity and expanſion.

A manufacturer of gunpowder ought never to use ſulphur which he has not purified and ſublimed himſelf; the beſt method of doing this is by melting it in an iron pot, over a gentle coal-fire which does not blaze, and ſtraining it through a double linen cloth; the operation muſt be repeated till there appears little or no reſiduum. When ſulphur is bought in a prepared ſtate, it is (notwithſtanding the low price) frequently adulterated with wheat-flour, which, in moiſt or hot climates, readily induces fermentation, and irrecoverably decompoſes the powder. I am convinced that inattention to this circumſtance is a principal cauſe of Britiſh gunpowder being leſs durable now than formerly.

TO BE CONCLUDED IN OUR NEXT.

XXXVI. Compoſition of a Water which has the Property of deſtroying Caterpillars, Ants, and other Inſects; invented by C. TATIN, Seedſman and Floriſt, at Paris *.

FROM THE *ANNALES DE CHIMIE.*

TAKE of black ſoap, of the beſt quality, 1lb.¾.
———— flowers of ſulphur, - 1lb.¾.
———— muſhrooms, of any kind, 2lb.
———— river or rain water, - 15 gallons.

Divide the water into two equal parts; pour one part, that is to ſay, ſeven gallons and a half, into a barrel, of any convenient ſize, which ſhould be uſed only for this purpoſe; let the black ſoap

* The *Bureau de Conſultation* of Paris gave a reward to the author of this compoſition for his diſcovery, which they deſired might be made as public as poſſible.

be

be ſtirred in it till it is diſſolved, and then add to it the muſhrooms, after they have been ſlightly bruiſed.

Let the remaining half of the water be made to boil in a kettle; put the whole quantity of ſulphur into a coarſe open cloth, tie it up with a packthread in form of a parcel, and faſten to it a ſtone or other weight, of ſome pounds, in order to make it ſink to the bottom. If the kettle is too ſmall for the ſeven gallons and a half of water to be boiled in at once, the ſulphur muſt alſo be divided. During twenty minutes (being the time the boiling ſhould continue) ſtir it well with a ſtick, and let the packet of ſulphur be ſqueezed, ſo as to make it yield to the water all its power and colour. The effect of the water is not rendered more powerful by increaſing the quantity of ingredients.

The water, when taken off the fire, is to be poured into the barrel, where it is to be ſtirred for a ſhort time with a ſtick: this ſtirring muſt be repeated every day until the mixture becomes fetid in the higheſt degree. Experience ſhews that the

old[illegible]

older, and the more fetid, the compoſition is, the more quick is its action. It is neceſſary to take care to ſtop the barrel well every time the mixture is ſtirred.

When we wiſh to make uſe of this water, we need only ſprinkle it, or pour it, upon the plants, or plunge their branches into it; but the beſt manner of uſing it is to inject it upon them with a common ſyringe, to which is adapted a pipe of the uſual conſtruction, except that its extremity ſhould terminate in a head of an inch and a half in diameter, pierced in the flat part with ſmall holes, like pin-holes, for tender plants; but, for trees, a head pierced with larger holes may be made uſe of.

Caterpillars, beetles, bed-bugs, *aphides*, and many other inſects, are killed by a ſingle injection of this water. Inſects which live under ground, thoſe which have a hard ſhell, hornets, waſps, ants, &c. require to be gently and continually injected, till the water has penetrated to the bottom of their abode. Ant-hills, particularly, require two, four, ſix, or eight quarts of water, according to the ſize and extent of the ant-hill, which

which ſhould not be diſturbed till twenty-four hours after the operation. If the ants which happen to be abſent ſhould aſſemble, and form another hill, it muſt be treated in the way before mentioned. In this manner we ſhall at laſt deſtroy them, but they muſt not be too much diſturbed with a ſtick; on the contrary, the injection ſhould be continued till, by their not appearing upon the ſurface of the earth, they are ſuppoſed to be all deſtroyed.

We may advantageouſly add to the mixture two ounces of *nux vomica*, which ſhould be boiled with the ſulphur; the water, by this means, will acquire more power, particularly if uſed for deſtroying ants.

When all the water has been made uſe of, the ſediment ſhould be thrown into a hole dug in the ground, leſt the poultry, or other domeſtic animals, ſhould eat it.

REPERTORY
OF
ARTS AND MANUFACTURES.

NUMBER XI.

XXXVII. Specification of the Patent granted to BRYAN HIGGINS, Doctor of Phyfick, of the Parifh of St. Anne, Middlefex; for his Invention of a Water Cement, or Stucco, for building, repairing, and plaftering, Walls; and for other Purpofes.

Dated Jan. 8, 1779.—Term expired.

TO all to whom thefe prefents fhall come, &c. NOW KNOW YE, that, in compliance with the faid provifo, I the faid Bryan Higgins do hereby declare, that my faid invention of a water cement, or ftucco, for building, repairing, and plaftering, walls, and for other purpoſes, is deſcribed in the manner following: that is to ſay, drift-ſand, or quarry-ſand, which conſiſts chiefly of hard quartoſe flat-faced grains with ſharp angles, which is the freeſt, or may be moſt eaſily freed by waſhing, from clays, ſalts, and calcareous, gypſeous, or other grains leſs hard and durable than quartz, which contains the ſmalleſt quantity of pyrites, or heavy metallic matter inſeparable by waſhing, and which ſuffers the ſmalleſt diminution of its bulk in waſhing, in the following manner, is to be preferred before any other; and, where a coarſe and a fine ſand of this kind, and correſponding in the ſize of their grains with the coarſe and fine ſands hereafter deſcribed, cannot be eaſily procured, let ſuch ſand of the foregoing quality be choſen, as may be ſorted and cleanſed in the following manner. Let the ſand be ſifted in ſtreaming clear water through a ſieve, which ſhall give paſſage to all ſuch grains as do not exceed one ſixteenth of an inch in diameter, and let the ſtream of water, and the ſifting, be regulated ſo that all the ſand which is much finer than the Lynn ſand, commonly uſed in the London glaſs-houſes,

together

together with clay, and every other matter specifically lighter than sand, may be washed away with the stream; whilst the purer and coarser sand, which passes through the sieve, subsides in a convenient receptacle; and whilst the coarse rubbish and shingle remain on the sieve, to be rejected. Let the sand, which thus subsides in the receptacle, be washed in clean streaming water through a finer sieve, so as to be farther cleansed, and sorted into two parcels; a coarser, which will remain in the sieve, which is to give passage to such grains of sands only as are less than one thirtieth of an inch in diameter, and which is to be saved apart, under the name of coarse sand; and a finer, which will pass through the sieve, and subside in the water, and which is to be saved apart, under the name of fine sand. Let the coarse and the fine sand be dried separately, either in the sun, or on a clean iron plate, set in a convenient furnace, in the manner of a sand-heat. Let lime be chosen which is stone-lime, which heats the most in slaking, and slakes the quickest when duly watered, which is the freshest made and closest kept, which dissolves in distilled vinegar with the least effervescence, and leaves the smallest residue insoluble, and in this residue the smallest quantity of clay, gypseous or martial matter. Let the lime chosen according to these important rules, be put in a brass wire sieve, to the quantity of fourteen pound. Let the sieve be finer than either of the foregoing, the finer the better it will be. Let the lime be slacked, by plunging it in a butt filled with soft water and raising it out quickly, and suffering it to heat and fume, and by repeating this plunging and raising alternately and agitating the lime, until it be made to pass through the sieve into the water; and let the part of the lime which does not easily pass through the sieve be rejected; and let fresh portions of the lime be thus used, until as many ounces of lime have passed through the sieve as there are quarts of water in the butt. Let the water thus impregnated stand in the butt, closely covered, until it becomes clear, and, through wooden cocks, placed at different heights in the butt, let the clear liquor be drawn off, as fast and as low as the lime subsides, for use; this clear liquor I call the cementing liquor. The freer the water is from saline matter, the better will be the cementing liquor made with it. Let

fifty

fifty-fix pounds of the aforefaid chofen lime be flaked, by gradually fprinkling on it, and efpecially on the unflaked pieces, the cementing liquor, in a clofe clean place. Let the flaked part be immediately fifted through the laft mentioned fine brafs wire fieve. Let the lime which paffes be ufed inftantly, or kept in air-tight veffels; and let the part of the lime which does not pafs through the fieve be rejected; this finer richer part of the lime, which paffes through the fieve, I call purified lime. Let bone-afh be prepared in the ufual manner, by grinding the whiteft burnt bones, but let it be fifted to be much finer than the bone-afh commonly fold for making cupels. The moft eligible materials for making my cement being thus prepared, take fif y-fix pounds of the coarfe fand, and forty-two pounds of the fine fand, mix them on a large plank of hard wood, placed horizontally; then fpread the fand, fo that it may ftand, to the height of fix inches, with a flat furface on the plant; wet it with the cementing liquor, and let any of the fuperfluous quantities of the liquor, which the fand in the condition defcribed cannot retain, flow away off the

the plank. To the wetted sand add fourteen pounds of the purified lime, in several successive portions, mixing and beating them up together, in the mean time, with the instruments generally used in making fine mortar: then add fourteen pounds of the bone-ash in successive portions, mixing and beating all together. The quicker and more perfectly these materials are mixed and beaten together, and the sooner the cement thus formed is used, the better it will be. This I call the water cement coarse grained, which is to be applied in building, pointing, plastering, stuccoing, or other work, as mortar and stucco now are; with this difference chiefly, that as cement is shorter than mortar, or common stucco, and dries sooner, it ought to be worked expeditiously in all cases, and in stuccoing it ought to be laid on by sliding the trowel upwards on it; and the materials used along with this cement in building, or the ground on which it is to be laid in stuccoing, ought to be well wetted with the cementing liquor, in the instant of laying on the cement; and the cementing liquor is to be used when it is necessary to moisten the cement, or when a liquid is required to facilitate the floating of the cement. When ſuch cement is required to be of a finer texture, take ninety-eight pounds of the fine ſand, wet it with the cementing liquor, and mix it with the purified lime and the bone-aſh, in the quantities, and in the manner, above deſcribed; with this difference only, that fifteen pounds of lime, or thereabouts, are to be uſe[d] inſtead of fourteen pounds, if the greateſt part of the ſand be as fine as Lynn ſand. This I call water cement fine-grained: it is to be uſed in giving the laſt coating, or the finiſh, to any work intended to imitate the finer-grained ſtones, or ſtucco; but it may be applied to all the uſes of water cement coarſe-grained, and in the ſame manner. When for any of the foregoing purpoſes of pointing, building, &c. ſuch cement is required much cheaper and coarſer grained, then much coarſer clean ſand than the foregoing coarſe ſand, or well waſhed fine ſhingle, is to be provided; of this coarſeſt ſand, or ſhingle, take fifty-ſix pounds, of the foregoing coarſe ſand twenty-eight pounds, and of the fine ſand fourteen pounds, and, after mixing theſe, and wetting them with the cementing liquor, bone, in the foregoing manner, and fourteen pounds of [illegible] method make and then [illegible], a sufficient [illegible] of [illegible] In the manner [illegible] the [illegible] and [illegible] and ground bone, [illegible] to [illegible] cement [illegible] and any other colour [illegible] by [illegible] coloured [illegible] or [illegible] mixture of [illegible] of [illegible] in powder [illegible] in [illegible] powder, or [illegible] commonly [illegible] To the [illegible] cer-tain, and I [illegible] that the [illegible] that [illegible] that [illegible] and [illegible] may be [illegible] by [illegible] varia-tions, [illegible] may be made in the foregoing pro-cess without producing any [illegible] to the cement. [illegible] that the principle of this art, as well as the [illegible] of making my ce-ment, may be gathered from this specification,

and

and perpetuated to the public, I ſhall add the following obſervations. This my water cement, whether the coarſe or fine grained, is applicable in forming artificial ſtone, by making alternate layers of the cement, and of flint, hard ſtone, or brick, in moulds of the figure of the intended ſtone, and by expoſing the maſſes ſo formed to the open air, to harden. When ſuch cement is required for water fences, two thirds of the preſcribed quantity of bone-aſh are to be omitted, and, in their place, an equal meaſure of powdered tarras is to be uſed; and, if the ſand employed be not of the coarſeſt ſort, more tarras muſt be added, ſo that the tarras ſhall not be by weight one ſixth part of the weight of the ſand. When ſuch a cement is required of the fineſt grain, and in a fluid form, ſo that it may be applied with a bruſh, flint-powder, or the powder of any quartz, or hard earthy ſubſtance, may be uſed in the place of ſand; but in a ſmaller quantity, as the flint or other powder is finer, ſo that the flint-powder, or other ſuch powder, ſhall not be more than ſix times the weight of the lime, nor leſs than four times the weight. The greater the quantity of the lime, within these limits, the more will the cement be liable to crack by quick drying; and *vice versa*. Where such sand as I prefer cannot be conveniently procured, or where sand cannot be conveniently washed and sorted, that sand which most resembles the mixture of coarse and fine sand above prescribed may be used, as I have directed, provided due attention is paid to the quantity of lime, which is to be greater as the sand is finer, and *vice versa*. Where sand cannot be readily procured, any durable stony body, or baked earth, grossly powdered, and sorted nearly to the sizes above prescribed for sand, may be used in the place of sand, measure for measure, but not weight for weight, unless such gross powder be as heavy specifically as sand. Sand may be cleansed from every softer, lighter, and less durable matter, and from that part of the sand which is too fine, by various methods preferable, in certain circumstances, to that which I have described. Water may be found naturally free from fixible gas, selenite, or clay; such water may, without any notable inconvenience, be used in the place of the cementing liquor; and water approaching piling them in heaps, where they quickly begin to heat and putrify. The hair, being loofened, is fcraped off, and the tanner proceeds to the operation called *flefhing*; which confifts in a farther fcraping, with a particular kind of knife contrived for the purpofe, and cutting away the jagged extremities, and offal parts, fuch as the ears and noftrils.

The raw leather is then put into an alkaline ley, in order to difcharge the oil, and render its pores more capable of imbibing the ooze. The tanners of this country generally make their ley of pigeon's dung; but a more active one may be prepared from kelp, or pot-afh, taking care, however, not to make it too ftrong of the afhes, nor to allow the leather to remain too long in the ley.

The oil being fufficiently difcharged, the leather is ready for the ooze, and, at firft, is thrown into fmaller holes, which are termed *handlers*, becaufe the hides or fkins, during this part of the procefs, are taken up, from time to time, and allowed to drain; they continue to work the leather in thefe handlers, every now and then ftirring it up with the utenfil called a *plunger*, which is nothing more than

than a pole with a knob at the end of it, until they think proper to lay it away on the vats. In these holes, which are the largest in the tan-yard, the leather is spread out smooth; whereas they toss it into the handlers at random; and between each layer of leather they sprinkle on some powdered bark, until the pit is filled by the leather and bark, thus laid *stratum super stratum*: water is then turned on, to fill up the interstices; and the whole is covered with a sprinkling of bark, which the tanners call a *heading*.

In this manner, the leather is allowed to macerate, until the tanner sees that it is completely penetrated by the ooze; which when that is accomplished (which he knows by cutting off a bit of the thickest part of the hide) the manufacture is finished, so far as relates to tanning, there being nothing now remaining but to dry the goods thoroughly, by hanging them up in airy lofts, built for the purpose.

Such in general is the process for tanning calf-skins, and the lighter sorts of hides, which are called butts; but the large, thick, heavy hides, of which the strongest and most durable kind of sole-leather is made, require to have their pores

more

proaching this ſtate will not require ſo much lime as I have ordered, to make the cementing liquor; and a cementing liquor, ſufficiently uſeful, may be made by various methods of mixing lime and water in the deſcribed proportions, or nearly ſo. Where ſtone lime cannot be procured, chalk lime, or ſhell lime, which beſt reſembles ſtone lime in the characters above written of lime, may be uſed in the manner deſcribed; except that fourteen pounds and a half of chalk lime will be required, in the place of fourteen pounds of ſtone lime. The proportion of lime which I have preſcribed above may be increaſed, without inconvenience, when the cement, or ſtucco, is to be applied where it is not liable to dry quickly; and, in the contrary circumſtance, this proportion may be diminiſhed, and the defect of lime in quantity, or quality, may be very advantageouſly ſupplied, by cauſing a conſiderable quantity of the cementing liquor to ſoak into the work, in ſucceſſive portions, and at diſtant intervals of time, ſo that the calcareous matter of the cementing liquor, and the matter attracted from the open air, may fill and ſtrengthen the work. The powder of almoſt every well-dried or burned animal fubftance may be ufed inftead of bone-afh; and feveral earthy powders, efpecially the micaceous, and the metallic, and the elixated afhes of divers vegetables, whofe earth will not burn to lime, and the afhes of mineral fuel, which are of the calcareous kind, but will not burn to lime, will anfwer the ends of bone-afh in fome degree. The quantity of bone-afh defcribed may be leffened without injuring the cement, in thofe circumftances efpecially which admit the quantity of lime to be leffened, and in thofe wherein the cement is not liable to dry quickly; and the art of remedying the defects of lime may be advantageoufly practifed to fupply the deficiency of bone-afh, efpecially in building, and in making artificial ftone with this cement. In witnefs whereof, &c.

N. B. For white work the admixture of hair with this cement is ufeful.

XXXVIII. Specification of the Patent granted to Mr. John Skeys, Member of the Britifh Factory, at Lifbon; for a Difcovery, made, and communicated to him, by a certain Foreigner with whom he is connected, of a Pump on a new Conftruction.

WITH TWO PLATES.

Dated Nov. 7, 1785.

To all to whom thefe prefents fhall come, &c. Now know ye, that, in compliance with the faid provifo, I the faid John Skeys do hereby declare, that my faid difcovery is defcribed in the following plan and defcription. In witnefs whereof, &c.

Expla-

EXPLANATION OF THE DRAWINGS.

(See Plates XVII. and XVIII.)

A number of wheels or flies, which I call *aqualators*, A, (Figs. 3, and 4.) constructed with inclined leaves or fans, which diverge from the centre to the extremity of the wheel, similar to a common ventilator, having a hoop or ring of metal to secure the ends of the fans or leaves, and to enable them to resist the force of the water, it being essential to the easy working of the pump, that the leaves or fans should be as thin as possible, particularly the lower edge, which cuts the water. The number of these leaves or fans may be more or less, but nine will generally be found sufficient. Their elevation may be varied, as the power used to work the pump is greater or less; for, if a greater elevation will admit of a greater flow of water, it must likewise add to the resistance. These *aqualators* are made with a socket or hole in their centre, so as they may be easily fixed on the shaft or spindle D, (Fig. 1.) or they may be connected to each other by hollow tubes, secured

In doing this, the following canon, which is borrowed from the French pyrotechnifts, and eftablifhed by experiments, may be found ufeful: begin with 3 lbs. of nitre, and 9 oz. of charcoal; (this will explode without fulphur;) increafe the quantum of charcoal till the moft forcible combination of thofe two ingredients is difcovered, which will commonly happen at between 12 oz. and 1lb. of charcoal to the 3 lbs. of nitre: to this procefs let fulphur be added, beginning with ½ oz. till the ftrongeft explofion is found; which will be when the proportion of this ingredient, to the above, is from 2¾ to 3¼ oz. Finally, let the dofe of charcoal be diminifhed, till the compofition no longer gains in the eprouvette; this will commonly happen when the proportions of the three materials ftand as follows: Nitre 3 lbs.; Charcoal 8½ to 9½ oz.; Sulphur 2¾ to 3¼ oz.

The Manufacturer may poffibly difcover ftill greater variations than I have ftated, as they muft evidently be determined by the comparative excellence of his materials; but, by adopting this method of afcertaining their qualities, (however troublefome it at firft appears,) I can venture to affirm he will in the end be a confiderable gainer. There are various opinions refpecting the liquid moft eligible to moiften the ingredients during the procefs of preparing them for the mill: urine, vinegar, fpirit of wine and water, plain water, have feverally been recommended for this purpofe. I have tried them all, without being able to eftablifh any data on which to found a decifion; yet the volatile nature of fpirits, and the heterogeneous matter to be met with in urine and vinegar, feem to point out a preference due to pure water; but, as this is warmly contefted, and my experiments exhibited no conclufive fuperiority, I will not hazard a determination on the fubject. It was my intention, in this place, to have given a formula of the feveral proportions in ufe amongft the different powder-makers of Europe and Afia, had I not been deterred by the apprehenfion of fwelling my obfervations to a volume; I fhall therefore confine myfelf to China, as that country claims the original invention, with fome appearance of probability. Having procured fome powder manufactured at Canton, I analyzed two ounces of it; and, after repeating the opera-

tion

tion fix times, the mean refult gave the following proportions. Nitre 1 oz. 10 dwts.; Charcoal 6 dwts.; Sulphur 3 dwts. 14 gr.

Here is a deficiency in weight of ten grains, probably the confequence of fome defect in my procefs, which was, firft, to weigh the powder; next, to feparate the nitre by folution, evaporation, and filtering; I then weighed the refiduum of charcoal and fulphur combined; and, laftly, I fublimed the fulphur, by a degree of heat not fufficient to inflame the charcoal, which, when weighed, completed the operation, producing the aforefaid refult. But as M. Baumé, a French chemift, made a variety of experiments to obtain a total feparation of the fulphur from the charcoal, and was never able to effect it, one fourteenth part remaining united, three grains muft be deducted from the charcoal, and added to the fulphur, to give the accurate proportion of the ingredients. This powder was unufually large-grained, not ftrong, but I believe very durable; it had been made many years when I got it, yet there was no vifible fymptom of decay, the grain being hard, well coloured, and, though angular,

 (which

(which form commonly generates duft,) it was even-fized, and in perfect prefervation.

I next proceed to the moft effential and moft neglected operation in manufacturing gunpowder; the combining and incorporating the ingredients. This, if poffible, fhould be performed in clear dry weather; a lowering fky, and a humid atmofphere, being found inimical to that thorough blending of the materials which ought to precede their being worked in the mill. Stamping-mills were formerly ufed for working gunpowder; their conftruction was very fimple, being a large mortar, in which a ponderous wooden peftle, moved by men, by horfes, or by water, performed the operation very perfectly, but with obvious danger to the workmen. In Sweden, and I believe in Ruffia, they ftill continue to ftamp the powder during the firft part of the procefs, and afterwards roll it under ftones; by this means leffening the probability of an explofion, as the compofition is lefs inflammable in the beginning, than when the materials are more intimately blended. Since government, alarmed by the frequency of accidents, thought proper to prohibit ftamping in the

ordnance-

XLIV. An improved Method of tanning Leather; by DAVID MACBRIDE, M.D. of Dublin.

From the TRANSACTIONS of the ROYAL SOCIETY of LONDON.

AS the following method of tanning leather, in leſs time, and at a ſmaller expence of materials, than can be done by any of the ways hitherto known or practiſed, would not otherwiſe be underſtood by thoſe who are not already, in ſome degree, acquainted with the ordinary proceſs of tanning, I ſhall beg leave to mention the principal operations in this branch of manufacture.

The uſe of tanning is two-fold: firſt, to preſerve the leather from rotting; and, ſecondly, to render it impervious to water.

An infuſion of any ſtrongly-aſtringent vegetable will ſerve to tan leather, ſo far as to prevent its rotting, but if this vegetable does not contain a good gard [illegible] of [illegible]; it will not answer for enabling it to keep out water; and hence it is that oak bark, which is [illegible] in the greatest request [illegible] than any of [illegible] common [illegible] is preferred to all other substances for the purpose of tanning.

The tanners prepare their bark by gently drying it on a kiln, and grinding it into a very coarse powder. They then either use it in the way of infusion, which is called *ooze*, or they strew the dry powder between the layers of hides and skins, when these are laid away in the tan-pits.

The [illegible] is made by macerating the bark in water, in a particular set of [illegible] or pits which, to distinguish them from the other [illegible] in the tan-yard, are termed *latches*.

The first operation of the tanner is to denude his skins from all extraneous filth, and remove any particles of flesh or fat which may have been left on them by the butcher.

The hair is next to be taken off; and this is either done [illegible] by steeping the hides for a short time in a mixture of lime and water, which is termed *liming*, or by piling them up close, and fecured by fcrews, in fucceffion, one above another, at equal fpaces; the diftance between each may be varied, but generally from one-third to half the diameter of the *aqualator* will anfwer beft; and they are continued to the height to which the water is required to be raifed. Immediately under fuch *aqualator* may be placed what I call a ftrainer, B, (Fig. 1, and 5.) which is made in two parts, grooved and tongued together in the middle, and run into a groove cut in the cylinder G, as at F, (Fig. 1.) which renders the water more fteady, fo that it muft afcend in right lines, and likewife prevents a return of water between the outward rim of the *aqualator* and the cylinder. Under the ftrainer is placed what I call a breaker, C, (Fig. 2, and 3.) which is a flat piece of metal, or wood, extended from, and faftened to, each fide of the cylinder. Thefe, in pumps of a large diameter, may be made in the form of a crofs; they are intended to break the circular motion of the water, and are highly effential to the power of the pump. The *aqualators*, thus fixed to the fhaft, as before explained, muft be placed in the cylinder, whofe dimenfions muft be as near the diameter of the *equalator* as poſſible, but not ſo near as to rub, or occaſion friction. The bottom of the ſhaft turns in a centre, about the point E, (fig. 1.) and runs through a ſtep or block, which is made to prevent any irregularity of motion; and the top of the ſhaft is ſecured by a [illegible] or otherwiſe, to take and preſerve a [illegible] the ſame ſhaft; which circular motion to be given by any mechanic power adapted to the peculiar ſituation or work required, cauſes the water (conducted to the centre by the breakers) through the trunnels and between each fan or leaf of the *equalators*, to the top of the pump; and it is there diſcharged in a conſtant ſtream, which is either increaſed or diminiſhed, according to the power and velocity applied to give the pump motion. Where particular circumſtances may make it needful to keep the machine full of water when at reſt, a valve may be placed in the [illegible]; and where the pump cannot reach the water, a pipe or cylinder, with a valve at the bottom, will anſwer, by filling the pump with water as is practiſed in common pumps.

XXXI.

ordnance-mills, this part of the procefs has been effected by means of two ftone cylinders, applied to the ends of a common axis, and moved in a vertical pofition round a circular trough, either by water, or by horfes. The inferiority of the prefent practice is vifible in its operation on the powder, which has certainly degenerated, both in ftrength and durability, fince the abolition of ftamping-mills. This may be attributed, firft, to neglect in the manufacturer, who is fatisfied with working his powder feven or eight hours, inftead of twenty-four, which was the ufual time when ftamping-mills were employed; and, fecondly, to a radical defect in the machine, where the circumferences of two fmooth and ponderous ftones comprefs the moift pafte into a hard folid cake, over which they make repeated circumvolutions, with a very trifling derangement of the indurated furface, and confequently without contributing much to the incorporation of the ingredients. To obviate the firft objection, it is neceffary that government fhould ftimulate the induftry of the merchant, by giving him a more liberal price for his powder; or (what would be of greater national advantage) that the board of ordnance ſhould take the management of this manufacture (as far as is requiſite for the ſupply of the army and navy) into their own hands; whilſt it is furniſhed by contract, and the proceſs of manufacturing ſubjected to no controul on the part of government, its quality can never be depended on. Towards the cloſe of laſt war the manufacturer was paid thirty ſhillings, excluſive of eighty pounds of ſaltpetre, *per* barrel of powder, containing one hundred net pounds; which, conſidering the enormous price of nitre at that period, made the full coſt to the nation about five pounds. Extravagant as this may appear, when we combine the high wages of workmen, the danger of exploſion in the mills, the riſk of rejection in the proof, and, above all, the irregular dilatory mode of payment in uſe with the ordnance-board, candour muſt oblige us to allow that the merchant's profit was moderate indeed. I have been informed by ſeveral of theſe gentlemen, that they certainly could increaſe the ſtrength and durability of their powder, by milling it ſome hours longer; but that the price given would not indemnify them

for

far that, in ordnance of a higher *calibre* than twelve pounders, the charge of powder amounted to half the weight of the ſhot; the conſequence of this was, that about a fourth of the powder remained uninflamed, which, added to the weight of the ball, gave a reſiſtance of 27 lbs. to be overcome by 9 lbs. of powder, inſtead of 24 by 12, the ſuppoſed *reſiſtance* and *power*. To demonſtrate more accurately the abſurdity of this practice, (which had been already reprobated by the beſt artillery officers,) I encloſed the vertical eprouvette ſo as to prevent the eſcape of uninflamed powder, and, after fifty diſcharges, in each of which two drachms were compreſſed by a weight of 22 lbs. I collected above a thirtieth part, or 3½ drachms, of ſtrong and highly inflammable powder. The preſent charge is a third of the ſhot's weight for heavy, and a fourth for light, artillery; it would ſtill admit of reduction.

Salt of tartar may be introduced as an auxiliary in the compoſition of gunpowder; it increaſes the report aſtoniſhingly, but is noxious to ſtrength and durability. Government ſhould, however, give ſome attention to this matter, as a powder might be manufactured, a small portion of which would produce a tremendous report, and prevent the unnecessary expenditure of that which is so valuable, in the *parade of war*, where noise only is required. The strength of powder is by no means established by the proof of the vertical eprouvette, unless corroborated by the brass mortar, which I am informed is constantly used by the gentleman who at present superintends the manufactory and proof of government powder; from whose acknowledged abilities I prognosticate considerable improvement in this valuable composition, which, though become essential in war, and of consequent importance in commerce, affords ample room for melioration.

Explanation of the Figures.

(See Plate XX.)

Fig. 1. Perspective view of the roller.

Fig. 2. Plan of the periphery of ditto.

A. Grooves, or flutes, crossing ditto.

B. Longitudinal grooves on ditto.

C. Section of flutes on ditto.

for the additional labour. It is ſurely unpardonable to neglect, and an ill-judged œconomy to be parſimonious in, an article whoſe quality may determine the event of a conteſt, deciſive of our exiſtence as an independent people. If to this ſerious conſideration we add the expence of remanufacturing powder which, defective in its original conſtruction for want of ſufficient working, is returned and condemned ſoon after being iſſued, (to the entire loſs of the charcoal and ſulphur,) with the ſums paid for ſtore-houſes, workmen, &c. we may ſafely conclude, that a ſmall additional expenditure in the firſt inſtance, judiciouſly applied, would turn out a very eſſential public advantage.

I will next ſuggeſt an alteration in the ſubſtance and conſtruction of the rollers, which may remedy ſome of thoſe defects I noted in the proceſs of milling; inſtead of marble, or granite, I propoſe that they ſhall be made of caſt iron, as well as the circular trough in which they move. Let the periphery of the cylinder be divided into eight equal parts, alternately *grooved* and *plain*, with two of the fluted diviſions having their grooves tranſ-

verſe,

verſe, the other two longitudinal, as in the annexed drawing, (ſee Plate XX.) where Fig. 1. repreſents the perſpective of the roller, and Fig. 2. is a plan of its circumference, ſhewing the diſpoſition of the compartments, and the direction of the grooves. Theſe grooves ſhould be an inch in breadth, and a quarter of an inch in depth, with their angles rounded off; the trough muſt continue ſmooth, as in the preſent practice. The effect propoſed from this conſtruction is, that the alternations of the plain and fluted diviſions, when the rollers are in motion, will penetrate the ſubſtance of the paſte, producing a more intimate connexion and intermixture of the component parts, than can poſſibly reſult from the equable and ſcarcely interrupted progreſſion of one ſmooth ſurface over another; this operation becoming equivalent to many hours labour. Where the private manufacturer is unwilling or unable to afford new cylinders, he may break the continuity of the paſte, by affixing a ſmall but *weighty* harrow, with copper teeth, to the axis of the roller, and following its direction in the trough. Should iron cylinders be objected to, as dangerous, they

may

The ſize, ſhape, and colour, of the grain in powder are conſidered as indications of its quality; and, though I have met with good and bad of all forms and colours, yet I am clearly of opinion that the general preference is due to powder of a moderate-ſized, and ſomewhat ſpherical, grain; as being leaſt apt to generate duſt, which ſhould be carefully avoided, becauſe ſubverſive of that equal ſtrength which ought to be diffuſed through the whole contents of a barrel, and which is, in all caſes, important to the efficacy of artillery, but in mortar practice becomes indiſpenſably neceſſary. The colour ſhould be a greyiſh blue, tinged with red, and the texture of the grain firm, but not ſo hard as to reſiſt a very forcible preſſure from the finger againſt a board. I am aware that my opinion diſagrees with the general ideas of Britiſh powder-makers, who prefer a dark blue colour, and an angular grain, thinking that hue and form ſuſceptible of the readieſt inflammation; but a general deduction from numerous experiments has convinced me of their miſtake.

The ſtrength of powder is frequently impaired by being too precipitately dried; this I diſcovered

 on

on examining some of the rooms appropriated to that operation, where, finding the heat intense, I suspected its being sufficiently powerful to evaporate the sulphur, which a closer inspection proved to be the case; as the crevices of the walls and shelves were filled with flowers of brimstone, sublimed, by the action of the fire, from the surface of the grains, precisely where the greatest proportion of this inflammable principle is required. The acceleration of the drying process has the farther disadvantage, that it leaves the powder moist in the centre of the grain. I fear this practice, though every way pernicious, is become so general as to demand the interference of government; the deception of such powder is easily seen, when fresh from the drying-house it will throw a high proof, but, being left in the magazine for a month, will lower its strength at least a fourth: and here I must observe, that in times of peace, when the demand cannot be very pressing, powder should not be proved sooner than two months after being manufactured.

It was formerly the practice to load with large quantities of powder; and the limits extended to

for

Fig. 1.

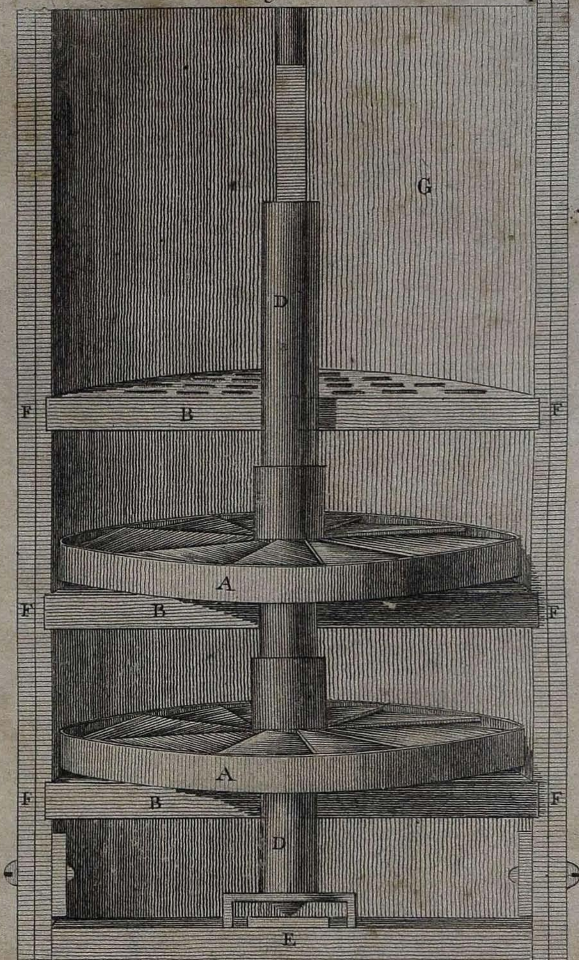


Fig. 2.

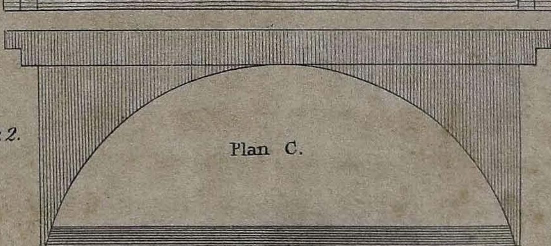


Fig. 3.

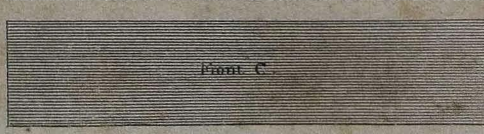


Fig. 4.

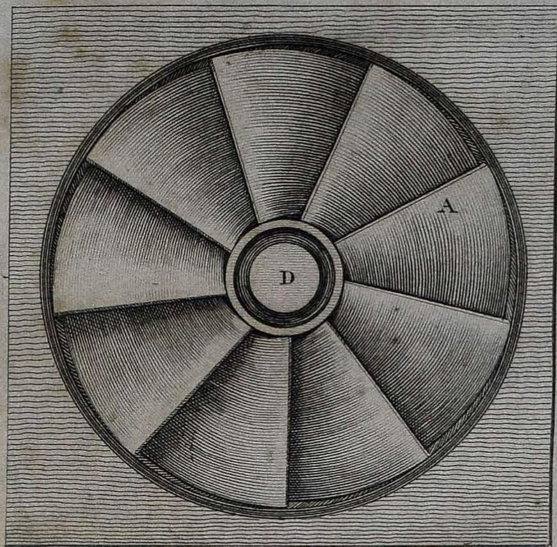
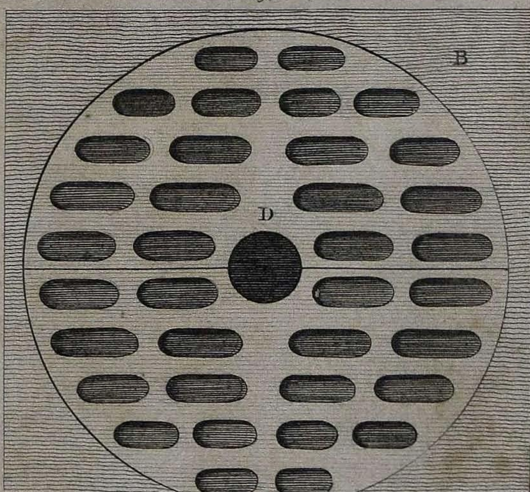


Fig. 5.



XXXIX. Specification of the Patent granted to Mr. THOMAS FLEET, of Prefton Candover, in the County of Hants, Farmer; for his Medicine for preventing the Rot in Sheep, and checking the farther Progrefs of the faid Difeafe, in thofe Sheep already infected with it, in fuch a Degree as to render them capable of being fatted, on the Herbage of the fame Land which produced or occafioned fuch Difeafe.

Dated October 1, 1794.

TO all to whom thefe prefents fhall come, &c. NOW THESE PRESENTS WITNESS, and the faid Thomas

Thomas Fleet, in compliance with the ſaid proviſo, doth hereby declare, that the ſaid invention, for the making the ſaid medicine, which ſaid medicine the ſaid Thomas Fleet diſtinguiſhes by the name of Fleet's Reſtorative for the Rot in Sheep, doth conſiſt of the following ingredients: *videlicet*, turpentine, bole-armenic, turmeric, quickſilver, brimſtone, ſalt, opium, alkanet-root, bark, antimony, camphor, and diſtilled water; to be prepared according to chemical, and compounded according to medical, art. In witneſs whereof, &c.

XL.

XL. Propoſal for an univerſal Character, or PANGRAPH; in a Letter from THOMAS NORTHMORE, Eſq. of Queen-ſtreet, Mayfair.

THE readineſs with which you inſerted my Invention of a Telegraph in your repoſitory induces me to ſend you another invention, not leſs ſimple in conſtruction, and, I ſhould hope, more uſeful in operation; I have called it a PANGRAPH; *or, a mode of writing by which the various nations of the earth may communicate their ſentiments to each other.* The want of an univerſal medium has long been a ſubject of lamentation among men of letters; hence ſeveral plans have been propoſed by Biſhop Wilkins, and others. Theſe, if I may be allowed an opinion, have failed of ſucceſs principally by reaſon of their being too complex, and difficult of attainment: that mine will be more ſucceſsful I do not promiſe to myſelf; I can only ſay that I have ſtudied ſimplicity.

The original thought that occurred to me, and which is the groundwork of the whole ſuperſtructure, is the following: "That if the *ſame numerical figure* be made to repreſent the *ſame word*, in the various languages upon earth, an univerſal medium is immediately obtained." I mentioned this to three friends, who agreed with me in the practicability of it, and ſaw only one objection, viz. "that which originated from the diverſity of idioms." But, independently of this objection applying with the greateſt force to the dead languages, it ſurely cannot be thought of any weight, when we conſider that every ſchool-boy has daily to encounter it when he conſtrues his Terence. If a foreigner writes to me, he of courſe will ſtudy plainneſs of language, and I muſt be dull indeed, let his idiom be never ſo different from my own, if I cannot make out common ſenſe when I have every word before my eyes. Such then was my original thought, but both myſelf and friends ſoon perceived that it was capable of conſiderable improvement; for, inſtead of uſing a figure for *every* word, it will be neceſſary to apply one only to every *uſeful* word; and we all know how few words are abſo-

lutely

lutely neceſſary to the communication of our thoughts. Even theſe may be much abbreviated by the adoption of certain *uniform fixed* ſigns, (not amounting to above twenty,) for the various caſes, numbers, genders, degrees of compariſon, of nouns, tenſes, and moods, of verbs, &c. All words of negation too may be expreſſed by a prefixed ſign: a few inſtances will beſt explain my meaning.

Suppoſe the number 5 to repreſent the word	*ſee,*
6	*a man,*
7	*happy,*
8	*never,*
9	*I.*

I would then expreſs the tenſes, genders, caſes, &c. *in all languages*, in ſome ſuch *uniform* manner as the following.

(1)	5	=	*preſent tenſe,*	—	*ſee,*
(2)	·5	=	*perfect tenſe,*	—	*ſaw,*
(3)	:5	=	*perfect participle,*	—	*ſeen,*
(4)	5:	=	*preſent participle,*	—	*ſeeing,*
(5)	5·	=	*future,*	—	*will ſee,*
(6)	$\underline{5}$	=	*ſubſtantive,*	—	*ſight,*

(7)

(7)	$\underline{\underline{5}}$	=	*perſonal ſubſtantive,*		*ſpectator,*
(8)	6	=	*nominative caſe,*	—	*a man,*
(9)	$\ddot{6}$	=	*genitive,*	—	*of a man,*
(10)	$\dddot{6}$	=	*dative,*	— —	*to a man,*
(11)	$\frown{6}$	=	*feminine,*	—	*a woman,*
(12)	+6	=	*plural,*	— —	*men,*
(13)	7	=	*poſitive,*	—	*happy,*
(14)	$\hat{7}$	=	*comparative,*	—	*happier,*
(15)	$\hat{\hat{7}}$	=	*ſuperlative,*	—	*happieſt,*
	$\underline{7}$	=	as above N° 6,		*happineſs,*
(16)	−7	=	*negation,*	—	*unhappy,*

From the above ſpecimen I ſhould find no difficulty in comprehending the following ſentence, though it were written in the language of the Hottentots: 9, 8, .5, —$\hat{7}$, $\frown{6}$. *I never ſaw a more unhappy woman.*

Thoſe languages which do not uſe the pronoun prefixed to the verb, as the Greek and Roman, &c. may apply it, in a ſmall character, ſimply to denominate the *perſon*; thus, inſtead of 9, 8, .5. *I never ſaw*; they may write, 8, 9.5, which will ſignify that the verb is in the firſt perſon, and will ſtill have the ſame meaning.

The

The above ſpecimen is merely a rough ſketch of my deſign. I might very eaſily have added examples from the dead languages, as well as from the French and Italian; ſuch for inſtance as in the preſent caſe, the French would have ſaid, "Je n'ai jamais vu"—*I have never ſeen*; but this would make little difference in the ſenſe, and I ſend you the ſpecimen thus imperfect, that others may have an opportunity of ſuggeſting their improvements.

I ſhall conclude with obſerving that, in my opinion, about twenty ſigns, and *leſs* than 10,000 *choſen* words, (ſynonyms being ſet aſide,) would anſwer all the ends propoſed; and foreigners, by referring to their numerical dictionary, which, for convenience, might be a duodecimo, would eaſily comprehend each other. I am, &c.

THOMAS NORTHMORE.

XLI. Deſcription of a propoſed Improvement in the Conſtruction of Cranes; by the Rev. E. C.

WITH A PLATE.

A CRANE acting upon a ſimple and certain principle, by which the man walking in the wheel can lower goods with ſafety and expedition, has been long conſidered as a great deſideratum in mechanics. Repeated premiums have been offered by the Society for the Encouragement of Arts, to induce ingenious men to attempt the invention of ſuch a machine; and various have been the contrivances for accompliſhing ſo deſirable a purpoſe. All that have come to my knowledge have been much too complicated in their conſtruction, and in their operation too uncertain. ſeems in this buſineſs, as in half the concerns in life, that the object in purſuit has been overlooked by the purſuers extending their views too far. The whole, it appears to me, is to be accompliſhed by a very ſimple and obvious contrivance; merely, by introducing the action of a worm. Whenever a worm is introduced (I mean a worm of not more than two threads) into a machine, all retrograde motion is ſtopped, unleſs the worm receives its re-action from the firſt moving power; for, powerfully as a worm acts upon a wheel, a wheel has no power upon a worm, whatever force may be applied to it. Suppoſe then the firſt motion in a crane were given by a worm, upon the axis of the wheel in which the man walks; the man would have perfect command of the machine, to raiſe or lower the goods at pleaſure, without the remoteſt poſſibility of being overpowered by the deſcending weight.

Two objections, I am aware, may be brought againſt the method propoſed; the one, from the greater friction there is ſuppoſed to be between a worm and wheel than between two wheels; the other, from the ſlowneſs of the motion. This laſt objection I conſider as nothing; all the neceſſary ſpeed being to be gained by the firſt pair of wheels, and the diameter of the barrel of the windlaſs. The other objection does not ſtrike me as of much force: I grant the friction is conſiderable; yet, from its not being by intervals, as the friction between the teeth of wheels is, and on that account being a diſtinct object of ſight, I apprehend we eſtimate it, in the compariſon, as more conſiderable than what it really is. But as the friction, whatever it may be, between the teeth of two wheels, muſt be, while it laſts, greater than between a worm and wheel for the ſame ſpace of time, it ſeems to me no unreaſonable ſuppoſition that the aggregate of friction will, in the two caſes, nearly balance each other; eſpecially if it be taken into the account, that, to obtain the power of *one* worm and wheel, there will be in moſt caſes required two pair of wheels, and two additional axiſes, all which will add to the friction. But, granting the balance of friction to be againſt the action of the worm, the power to overcome it is greater in proportion than to overcome the friction of two wheels.

In ſpeaking of the friction between the teeth of wheels, I conſider wheel-work as it is *uſually* conſtructed. Wheels, the teeth of which are formed upon the *true* epicycloidal principle, I am well appriſed, act with no perceptible friction; but ſuch wheels are not yet much uſed, or underſtood.

Were I to conſtruct a crane upon the principle ſuggeſted above, I would have the axis of the wheel in which the man walks, and the axis of the worm, in ſeparate parts, and occaſionally united by a coupling-box. When goods were to be raiſed, the two axiſes ſhould be connected; when lowered, they might be diſunited, and the worm turned by a winch, which would be done much more expeditiouſly that way than by the wheel. For the reaſons before ſuggeſted, the deſcent of the weight could be accelerated, or ſtopped, at pleaſure, at the diſcretion of the perſon turning the winch.

This contrivance might be not inconveniently applied to a crane already erected upon the common principle: let there be a wheel put upon any convenient axis in the machine as it now ſtands; upon this let there lie a worm, that can be thrown in or out of gear at pleaſure; and let the lever, by which it is done, lie within reach of the man's hand in the wheel. The goods being faſtened to the crane, and raiſed off the floor of the warehouſe ready for letting down, the man puts the worm into gear, leaves the wheel, and lets the goods down by the winch. Provided it can conveniently be done, it would be advifable to throw the wheel in which the man walks out of gear, when the winch is made ufe of; this, however, I fhould apprehend, would not be a matter of abfolute neceffity.

The fketch, which accompanies this defcription, will fully explain the idea meant to be conveyed by it. I have given merely that part of the machine in which I would fuggeft any alteration, omitting the frame and crane part, &c. as being unneceffary.

Explanation of the Figure.

(See Plate XIX. Fig. 1.)

A. The wheel in which the man walks.

B. The coupling-box.

C. The worm.

D. The wheel in which it works.

E. A wheel upon the fame axis, giving motion to F.

F. A wheel upon the axis of the windlafs.

G. The winch.

XLII. Defcription of an Implement for taking the Levels for watering Ground.

WITH A PLATE.

From the general View of the Agriculture of the County of Aberdeen; drawn up, for the Confideration of the Board of Agriculture, by JAMES ANDERSON, LL. D. &c.

THIS is one of thofe implements that are more adapted for ufe than fhow; but which, as being perfectly within the reach of every man, both in refpect to its price, and the manner of ufing it, I confider as of ineftimable value. It has been already recommended to the notice of the public, by the very refpectable prefident of the Board of Agriculture; but it can never be too generally known.

It confifts of two legs of common deal, A and B (Plate XIX. Fig. 2.) about twelve feet long, joined together at top, and connected below by a

crofs

crofs bar, as reprefented in the figure, which is fo fimple as to need but little defcription. From the angle at top is fufpended a plummet, C, by a fmall cord, and a mark being made in the middle of the connecting bar, it is plain, that when the two legs are level, the ftring of the plummet will ftrike the mark on the bar, but not otherwife; fo that the level is thus very eafily afcertained.

The method of ufing it is thus. At the level of the water, where you are to begin, drive a pin into the ground, on which one of the legs of the frame can reft; then bringing the other leg round, till it touches the ground on a level with the top of that pin, there drive in another pin; and, having adjufted the level perfectly, make ufe of this laft pin as a reft for one foot, and turn the other about till you find the level in the fame way; and proceed in that manner, always following the direction that will thus be indicated. In this way you difcover at once, without trouble, the precife direction that your water-courfe fhould hold, without being at the expence of digging through heights or filling up hollows.

If

Fig. 1.

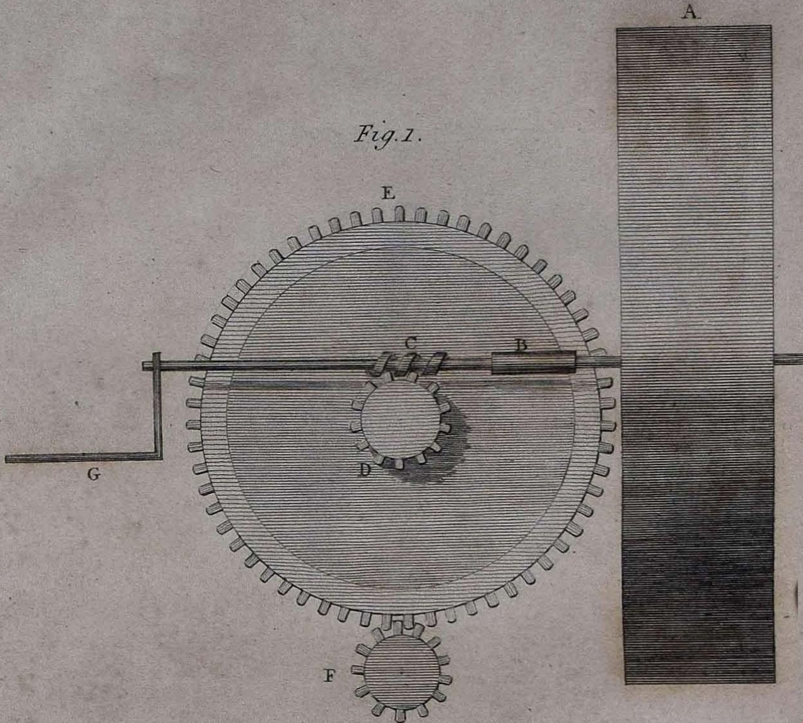
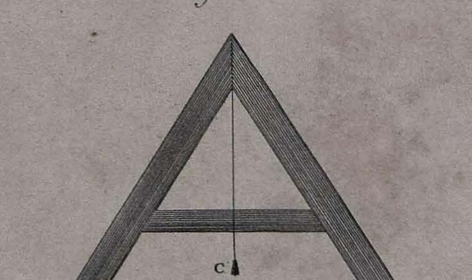


Fig. 2.



If you mean to conduct the water perfectly level, you have only to follow the pins thus placed implicitly; but, if it is your intention to give the canal a certain degree of declivity, (ſay a quarter or half an inch, or more, in twelve feet,) inſtead of wooden pins, make uſe of one pin of ſteel, having the inches, halves, and quarters, marked on the ſides regularly, from the ſquare top downwards. Having provided, at the ſame time, a number of wooden pins, cut neatly at the top quite ſquare, after having fixed your iron pin quite level with the firſt, drive a wooden pin into the ground cloſe by it, making the head of it go a quarter, or half an inch, lower than the top of the iron pin; then, pulling out the iron pin, and employing the wooden pin as a reſt for one of the legs, put the iron pin in once more for the other leg, and, driving another wooden pin into the ground a quarter of an inch lower, proceed forward in this manner, and your canal will have the ſame uniform degree of ſlope throughout its whole extent. In this manner the fall can be regulated to any aſſignable degree.

XLIII.

XLIII. Conclufion of the Honourable Mr. NAPIER's Obfervations on Gunpowder.

(FROM p. 284.)

THE moft eligible proportion of the three ingredients is next to be confidered; and here I muft premife that, after an accurate examination of powder manufactured according to the moft approved practices of Europe and Afia, together with the numerous variations of the chemifts, I find it beyond my experience to give a decided preference, as I have feen them all fucceed and fail; changed by the qualities of the materials, or influenced by the temperature of the atmofphere, either when the powder was manufactured and barrelled, or when it was proved. I would therefore recommend that the proprietors of powder-mills fhould manufacture a fmall quantity of powder from each frefh affortment of materials. In may be ſhod with braſs, which will be found ſufficiently hard for this purpoſe; I muſt however obſerve, that the former are already uſed in ſeveral mills; and intelligent powder-makers allow, that accidental exploſions are moſt frequently produced by the colliſion of chips which break from the edges of ſtone rollers. I am aware of one plauſible objection to fluted cylinders; the paſte, if very moiſt, may adhere to the grooves, but this I think will be prevented by the application of oil to the fluted ſurfaces, in ſuch ſmall quantities as ſhall not injure the compoſition.

Before I diſmiſs this part of my ſubject, I will hazard propoſing another alteration in the conſtruction of powder-mills; it is, ſimply working four rollers in the *ſame* trough, inſtead of two. Where water is the moving power, the coſt of additional mechaniſm will appear trifling, if oppoſed to the time and labour obviouſly ſaved by the adoption of this idea.

I will not prolong a tedious, and I fear a tireſome diſſertation, by introducing a minute detail of the proceſſes of granulating and drying powder; but content myſelf with obſerving that the firſt is performed by a horizontal wheel, on which are fixed circular ſieves with parchment bottoms, perforated to the largeſt intended ſize of the grain; in thoſe ſieves the paſte is depoſited, and with it (in each of them) a ſmall oblate ſpherical piece of lignum vitæ, which, being moved about the ſieve by the action of the wheel, breaks the compoſition, and forces it through the parchment bottom, into veſſels placed for its reception; but, as this operation leaves the powder in grains of various dimenſions, it is ſorted by being paſſed through wire ſcreens of progreſſive reticulations. Powder is commonly dried in an apartment, three ſides of which are furniſhed with ledged ſhelves, containing the compoſition, and the fourth is occupied by a large iron ſtove, which projects into the room, but is heated from without. This apparatus is very faulty in many reſpects, but more particularly in not diffuſing an equal heat; an amendment has been attempted by carrying flues round the drying-room, filled with heated ſteam; however, the change has been little, if at all, for the better. Perhaps a circular room, with a ſpherical ſtove in the centre, might communicate

a more

a more equal degree of ſiccity to the compoſition.

I ſhall next mention ſome general obſervations, ſelected from thoſe which occurred during the courſe of my experiments on gun-powder. The powder, returned by the navy and garriſons as unſerviceable, was depoſited in the magazine at Purfleet, where that which ſtill retained its grain was ſeparated from the duſt; and, if two drachms of it, when tried in the vertical eprouvette, had ſufficient ſtrength to project a ſuperincumbent weight of twenty-two pounds to the height of three inches and five-tenths, it was again iſſued for ſervice. But this happening very rarely, ſuggeſted a doubt that, by abſtracting the duſt, our powder was deprived of its principal ingredient; this conjecture I eſtabliſhed by repeated experiments in the vertical and mortar eprouvettes, as the duſt (though varying in degree) almoſt always exhibited ſuperior ſtrength to the granulated powder, from which it had been ſeparated. The phænomenon remained to be accounted for; this was effected by an accurate examination of powder in its damaged ſtate, when, with the aſſiſtance of a convex lens, I diſcovered a new cryſtallization of the nitre, (called by powder-makers the ſtarting of the petre,) which, having been partially diſſolved, ſhot its minute ſalts to the ſurface of the grain, where they appeared like the *ſpiculæ* of hoar-froſt; till, broken and detached by the attrition produced in moving the powder, they were converted into that duſt, which conſequently contained the eſſence of the compoſition. The eprouvette experiments were corroborated by the leſs fallacious teſtimony of analyzation, and this erroneous practice corrected. The foregoing obſervations muſt, however, be applied to ſuch powder only as, though injured, in part retains its grain. When it is ſo far damaged as to cake, the cryſtallization of the nitre being more complete, and its ſhootings larger, they adhere more tenaciouſly to the lumps, or when broken off are prevented, by their magnitude, from that intimate admixture with the ſulphur and charcoal-duſt which is eſſential to forcible exploſion; all attempts to renovate powder, when thus far decompoſed, are nugatory, and can only be dictated by ignorance or fraud; it ſhould be immediately transferred

transferred to the extracting houſe. The ſtrength of new powder is not diminiſhed by reducing it to duſt, but rather encreaſed, a ſecret well underſtood by powder-merchants, who mix duſt in ſmall quantities with that powder they apprehend will not riſe to proof. It was formerly the practice of government, to manufacture their powder as ſmall in the grain as that made at Dantzic or Battel is at preſent; whether the large-corned powder now uſed merits a preference appears to me problematical. The grain of the Chineſe powder, before mentioned, was as large as ſmall pepper-corns; and, in 1782, I diſcovered at Purfleet ſome barrels of very ſmall-grained powder, manufactured by Sir Polycarpus Wharton, ſurveyor of the ordnance in Charles the Second's reign; a part of this powder was above proof, and none of it much under; the whole retained its grain, and was in complete preſervation. It may not be improper to remark that, during the aforeſaid reign, and for ſome time after, moſt of the nitre uſed in England was collected in the country; and, if I am not miſtaken, there ſtill exiſt acts of parliament, granting the crown the ſoil of ſhambles and ſlaughter-houſes, and the earth under the flooring

ing of ſtables, bullock-hovels, &c. and alſo directing the magiſtrates to have tubs placed in the ſtreets of populous towns, for the collection of urine: from theſe materials there was a ſufficiency of nitre extracted to ſupply the ordinary conſumption of government. I cannot in this place avoid noting the paradoxical peculiarities of this extraordinary foſſil, which, generated by a combination of animal and vegetable putrefaction, exhibits the moſt energetic antiputreſcent principles; and, though claſſed amongſt the coldeſt of the ſaline genus, is replete with vehement and irreſiſtible fire.

Formerly government manufactured three ſorts of powder, viz. mortar, cannon, and muſquet. I am of opinion the practice ſhould be revived in part, for the following reaſon: ſulphur, by its proneneſs to fermentation, is probably the ingredient which contributes moſt to the decompoſition of powder. Believing this poſition, but retaining ſome doubts of its being practicable to produce forcible powder from nitre and charcoal alone, I directed a ſmall quantity to be ſo made, and was agreeably ſurpriſed to find that fifteen pounds of it projected a thirteen-inch ſhell as far as the beſt powder compoſed in the uſual manner. Hence I conclude, that a powder might be made ſufficiently ſtrong (when uſed in quantities *above ten pounds)* with a much leſs proportion of ſulphur than the preſent practice admits of. In caſes where a ſmaller charge is uſed, or where a rapid inflammation is required, the uſual doſe of ſulphur is indiſpenſably neceſſary.

The proceſs of glazing powder is effected by attaching caſks, ſomething more than half full, to the axis of a water-wheel; which turning with velocity, the operation is completed in a ſhort time, by the friction of the grains againſt each other. I found, from a mean of near ſix hundred experiments, that glazing powder reduces its ſtrength about one-fifth, if the powder is good; and nearly a fourth, if of an inferior quality; this proceſs being more noxious to the force of bad powder than of good is accounted for, in my opinion, by the greater proportion of duſt ſeparated during the operation from the former than from the latter; as this reſiduum is invariably ſtronger than the glazed powder from which it has been ſcreened. I am confident, however, that it would be a wiſe meaſure were government to adopt the practice of glazing all high-proof powder, and reserving it for the garrisons abroad, where it must remain long in the magazine, as powder of this description retains its grain better, and is consequently more durable, than when unglazed.

Government powder manufactured at Feversham, when received from the mills, is considerably stronger than either Dantzic or Battel shooting powder; and, I believe, it would continue so were it secluded from the action of the atmosphere, which might be effected by lining the barrels with the thin lead used for the preservation of tea; or were it exposed to a free circulation of dry air, according to the practice in Dutch men of war, which have an ingenious and safe mechanism for ventilating their magazines, worthy the imitation of the British navy. Frequently reversing the barrels contributes to the preservation of powder from that species of decomposition induced by the different gravitation of the ingredients. In barrelling powder it is of the utmost importance to select dry clear weather; the consequences of inattention to this material point have, I fear, been oftener *felt* than *suspected* by our fleets and armies.

The

Fig. 1.

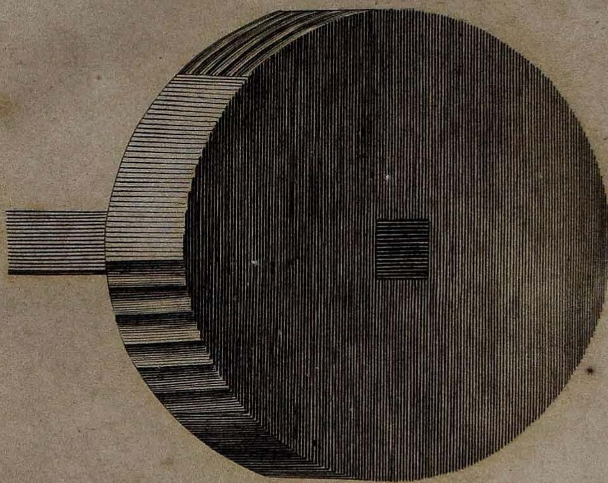
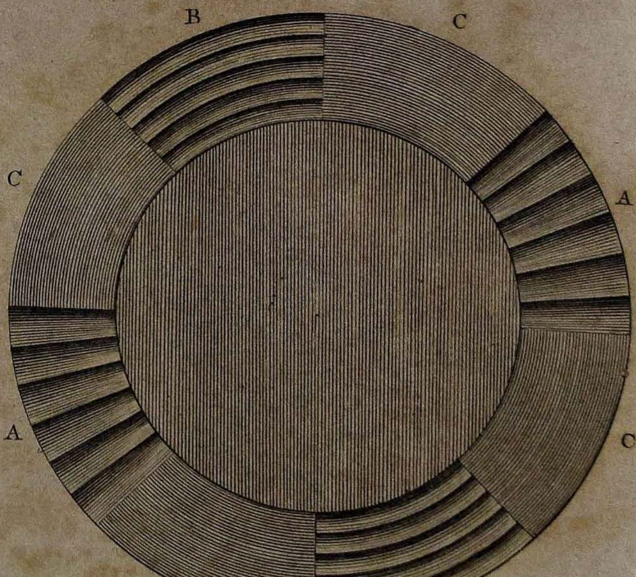


Fig. 2.



more thoroughly opened, before the ooze can sufficiently penetrate them. For this purpose, while the hides are in the putrescent state, from being allowed to heat in the manner already mentioned, and well soaked in an alkaline ley, they are thrown into a sour liquor, generally brewed from rye, in order that the effervescence which necessarily ensues may open the pores.

The tanners term this operation *raising*, as the leather is considerably swelled, in consequence of the conflict between the acid and alkali.

This is an English invention; for it appears from M. de la Lande, who was employed by the Royal Academy of Sciences to write on the art of tanning, that the foreign tanners know nothing of this branch of the business; indeed, their whole process, according to his account, is slovenly, and even more tedious than our common method, and must make but very indifferent leather.

When the raising is accomplished, the leather is put into the handlers, and worked in them for the requisite time; then laid away in the vats, and there left to macerate, until the tanning is found to be completely finished; which, for the heavieſt kind of leather, ſuch as this of which I am now ſpeaking, requires, from firſt to laſt, full two years. At leaſt, the tanners of this country (Ireland) cannot make ſole-leather in leſs time; what they are able to perform in England, I am not ſo thoroughly acquainted with.

It is this tediouſneſs of the proceſs which enhances the value of leather; and the returns being ſo ſlow, the trade of tanning never can be carried on to advantage, but by perſons poſſeſſed of a large capital; therefore, one ſure way of increaſing the number of tanners, and of courſe of bringing down the price of their manufacture, is to ſhorten the proceſs; and if, at the ſame time, we can improve the quality of the leather, and ſave ſomewhat in the expence of the tanning materials, the public will be eſſentially benefited in reſpect to one of the neceſſary articles of life.

All this, I will venture to ſay, can be done by purſuing the method which is laid down in the following paper, and which may be introduced into any common tan-yard.

With reſpect to time, it is poſſible, in the way that I have found out, to finiſh leather in a

 fourth

fourth part of what is required in the ordinary procefs; for I have repeatedly had calf-fkins tanned in a fortnight, or four weeks, which, in the common way, could not be done in lefs than from two to four months.

I fhall not pretend, however, to affirm, that that bufinefs can be carried on in the large way with fuch expedition, becaufe a great deal of this abridgement of time was probably owing to frequent handling and working of the leather; but I am confident, and know it from four years experience, that, in the ordinary courfe of bufinefs, and in a common tan-yard, the tanner may fave at leaft four months out of twelve, produce better leather, and find his bark go much farther than in the old way of tanning.

Having premifed thus much, I flatter myfelf that the paper of inftructions will be found perfectly intelligible. It fhews, that the principles on which my method is eftablifhed are derived from chemiftry, and therefore it will not appear ftrange that thefe improvements fhould have been made by a perfon of the medical profeffion:

 indeed,

indeed, they took their riſe from a ſeries of experiments carried on purely for medical purpoſes; (the very ſame that confirmed me in the opinion that infuſion of malt would cure the ſea-ſcurvy;) and any perſon who will look into the account of thoſe experiments, will readily underſtand the theory of the new method of tanning *.

It would be treſpaſſing on the time of the Society, to enter into any detail of the circumſtances that firſt induced me to think of this matter, or to give a hiſtory of the progreſs of my experiments, which at firſt were made at home, and with little pieces of raw leather; it is ſufficient to ſay that the efficacy of this method has been fully proved, by the experience of near ten years, (during which I have thought proper to keep it ſecret,) and I now beſtow it on the public.

* See the Eſſay on the diſſolvent power of quickſilver, among the Experimental Eſſays on medical and philoſophical ſubjects.

Instructions to tanners, for carrying on the new method of tanning, invented by Dr. Macbride, of Dublin; whereby the leather is not only improved in its quality, but tanned in much less time, and with a smaller quantity of bark, than in any other method hitherto known or practised.

As the new method of tanning depends on this principle, "That lime-water extracts the virtues "of oak-bark more completely than plain water;" the first thing in which the tanner is to be instructed, is the making of lime-water.

I. Provide a large vessel, in the nature of a cistern, whose depth shall be at least twice its diameter, and of a capacity adapted to the extent of the tan-yard.

II. This cistern must be fixed in a convenient corner of the yard, under a shed, and should stand so that the liquor which is to be drawn off from it may run freely into the letches.

III. There must be a cock fixed in the side of the cistern, about a foot from the bottom, to let off the contents; and there must be a hole in the bottom

bottom of it, of five or ſix inches diameter, which is to be ſtopped with a plug: let this hole open over a gutter.

IV. The ciſtern muſt be covered with a flooring of boards, ſtrong enough to bear a man's weight; and, from ſide to ſide of this lid, there muſt be an opening of two or three feet wide.

V. If it can be ſo contrived that a water-pipe may be led into the ciſtern, it will ſave the ſervants a good deal of trouble; but, if this cannot be done, a pump muſt be fixed in the moſt convenient way, for the purpoſe of filling it from time to time.

VI. The ciſtern being once fixed, (which is all the additional apparatus that the new method of tanning requires,) the making of lime-water will be found extremely ſimple and eaſy.

VII. You are firſt to fill the ciſtern with water, and then, for every hogſhead that it may contain, throw in ten or a dozen pounds' weight of unſlaked lime.

VIII. Mix the lime thoroughly with the whole body of the water, by ſtirring it exceedingly well from the bottom, with a bucket and plunger, until

until you perceive that the lime is completely diffufed, and the whole mixture grows as white as milk; leave it then to fettle for a couple of days, that the undiffolved part of the lime may entirely fubfide, and the water become perfectly limpid, and clear as rock-water: your lime-water will then be fit for immediate ufe.

IX. The cock, as already mentioned, is to be fixed at leaft twelve inches from the bottom of the ciftern, in order that only the limpid part of the lime-water may run off; and the ufe of the hole in the bottom, which is ordered to be ftopped with a plug, is to let off the grofs and infoluble remains of the lime, as often as it may be found neceffary to clean out the ciftern.

X. When the firft brewing (as it may be termed) of lime-water is all expended, you are to fill up the ciftern with water a fecond time, ftir up the lime from the bottom with the bucket and plunger, fo as to mix it thoroughly with the whole body of the water, as before directed, and then leave it to fubfide for the requifite time. Thus you will have a fecond brewing of lime-water; and you may go on in the fame way to

make

make a third, fourth, fifth, or perhaps a ſixth, or more brewings, from the original quantity of lime; provided you ſhall find the lime-water continue ſufficiently ſtrong.

XI. There are two ways of knowing when lime-water is ſufficiently ſtrong. The one is by the taſte, and this a little practice will teach you to diſtinguiſh; the other is, by obſerving a certain ſolid ſcum, like the flakes of very thin ice, which collects and forms itſelf on the ſurface of the lime-water. As long as you find this ſolid ſcum floating on the top of the water in the ciſtern, ſo long you may conclude that there is no neceſſity for throwing in freſh lime.

XII. But when the ſcum ceaſes to appear, or you find from the taſte that the lime-water is not ſo ſtrong as it ought to be, you muſt then take out the plug from the bottom of the ciſtern, and clear it, by ſweeping away the groſs remains of lime; and, after you have cleanſed the ciſtern, begin your brewings of lime-water a-new, and proceed in the manner already directed, as to ſtirring up the lime, and leaving it to ſettle for the neceſſary time, ſo as to have your lime-water perfectly

perfectly limpid. In this manner you may go on from year to year, and conſtantly keep yourſelf in ſtock, with reſpect to lime-water.

XIII. It is this lime-water which is now to be uſed, in making your ooze, inſtead of plain common water; and this is all the difference between the old and the new method of tanning: for, when your ooze is prepared, by ſteeping your bark in lime-water, (in the letches, as you do at preſent, only running it through two letches,) you are to make uſe of it in the very ſame way that you have hitherto uſed the common ooze; there not being the leaſt variation required with reſpect to any of the previous management, before the ſkins or hides are fitted for the ooze. Every thing that relates to cleaning, liming, fleſhing, &c. is to be conducted preciſely as in the old, or common method of tanning; and the goods are to be worked in the handlers for the requiſite time, and then laid away in the vats, with layers and heading of bark, juſt as you now practiſe; and, when you obſerve that the leather is ſufficiently penetrated with the ooze, that is to ſay, completely tanned, you will take it up, dry it, and afterwards drefs it, according to the different ufes for which it is intended. You are always to obferve, however, that the ooze is to be turned from one letch on another, before it is ufed, otherwife it will be apt to blacken the leather.

TO BE CONCLUDED IN OUR NEXT.

XLV. Addition to the Account of the Method of bleaching Cloths, and Thread, by the Oxygenated Muriatic Acid; by M. BERTHOLLET *.

FROM THE *ANNALES DE CHIMIE.*

IT was always my intention, when I publifhed the defcription of the method of bleaching by means of the muriatic acid, to communicate to the public every ufeful remark I could add to

* See our firft volume, page 53, &c.

it,

it, whether they arofe from my own obfervations, or from thofe of my correfpondents, provided the latter were not made known to me under the tie of fecrecy; for, it is natural that thofe who devote themfelves to the practice of any particular art, fhould wifh to keep fecret thofe improvements which they may fucceed in making; and there is no kind of property which ought to be more refpected than thofe difcoveries which arife from induftry.

M. Welter has found it of advantage to finifh the procefs of bleaching, by expofing the cloths and thread on the field for three or four days, during which they fhould be fometimes wetted, and afterwards wafhed in pure water. He thinks that this expofition is abfolutely neceffary, in order to take away a yellow tinge, which they are apt to retain, but he obferves that cotton does not want this operation.

Others, however, have bleached, to the entire fatisfaction of the dealers, without this expofition, and I have convinced myfelf, by many experiments, that linen may be brought to the moft perfect whitenefs without it; neverthelefs, when thread or cloth is preſſed together in any parts, during the proceſs, (which, when a large quantity is bleached at the ſame time, it is very difficult to avoid,) thoſe parts are apt to preſerve a yellow tinge, which it would perhaps require ſeveral operations to efface equally throughout; theſe repeated operations would increaſe the charge, and tend to weaken the texture of the linen; whereas a ſhort expoſition on the field entirely takes away that tinge. This practice, therefore, ſeems to me proper to be adopted with reſpect to linen; it requires but a ſmall extent of ground, and it occaſions but a ſmall loſs of time.

M. Decroiſille, whoſe eſtabliſhment at Rouen is in full vigour, has made many advantageous alterations in the proceſs; as indeed might be expected from the attention of ſo able a chemiſt. I have his permiſſion to publiſh the following extract from one of his letters. "We bleach here "(at about the ſame price as other bleachers) "coarſe cotton cloths, fine linen for ſhirts, "ſtockings, caps, &c. made of thread and cot-"ton. I flatter myſelf, alſo, that I have im-"proved upon your diſcovery: my great reci-

" pient, in the diſtilling apparatus, is of a kind
" entirely new; I have no wood in any part of it,
" and each of my diſtilling matraſſes contains
" ſixty pounds of vitriolic acid, &c. I have alſo
" left off uſing wood for thoſe veſſels in which
" the ſubjects to be bleached are plunged; and
" the whiteneſs of our goods is now eſteemed to
" be ſuperior to that produced by the Engliſh
" before your diſcovery. Cotton-yarn bleached
" by your proceſs takes, very advantageouſly,
" the red dye called the Turkey red; as, by
" means of that proceſs, about one-third of the
" uſual labour is ſpared; leſs oil is required in
" the preparation; and your ley, employed in
" certain ſtages of the operation, in concurrence
" with the other ingredients, produces a much
" more beautiful colour. Your diſcovery will be
" particularly uſeful to our city, many merchants
" finding it worth while to give us dyed cloths
" to have their colours diſcharged; no colour
" reſiſts, and we return them their cloths as
" ſound and as white as if they had never been
" dyed or printed."

The

The making uſe, inſtead of wood, (for the pneumatic tub, and troughs,) of a matter which is not acted upon by the liquor, is certainly of great advantage to the ſucceſs of this method of bleaching; as, by that means, we not only avoid the loſs of that portion of the liquor which exerts its action upon the wood, but we alſo ſave expence in repairing the veſſels, which are very ſoon worn out.

I have ſaid that the cloths, when taken out of the water acidulated with vitriolic acid, ought to be plunged into common water; but that precaution is not ſufficient, they muſt be plunged into a weak cauſtic ley, moderately warm, and kept in it during ſome minutes.

When the liquor is immediately drawn off into the troughs, as I directed, we muſt take care that it is firſt well ſtirred with the agitator; otherwiſe, that which is at the bottom of the tub, and is moſt ſaturated with acid, would firſt run off, and would act too ſtrongly upon the cloths. We may, indeed, omit the uſe of the agitator, by drawing off only half, or three quarters, of the liquor, which muſt afterwards be mixed with a proper

proper quantity of water, according to the proportions I have pointed out; and the reſt of the liquor, which is but weakly impregnated, may ſerve, with an additional quantity of water, for another diſtillation.

Many perſons have attempted to execute this proceſs without having any knowledge of chemiſtry, and without attending to the quality of the thread and cloth they meant to bleach; and it either did not ſucceed with them, or the expence of it, according to their calculation, was too great.

No one muſt flatter himſelf that he can execute this proceſs, ſimple as it is, unleſs he is guided at firſt by ſome perſon who is accuſtomed to the operations of chemiſtry. Reſpecting the expences of the proceſs, I think it right to be more particular: we muſt not expect a decreaſe, or even an equality of expence, (in compariſon with the common method,) except in bleaching fine cloths, unleſs we are acquainted with a good proceſs for extracting the mineral alkali from the reſidue of the diſtillations; and, without this advantage, we ought not to undertake to bleach the coarſer kinds of cloth, except in thoſe caſes where the quick-

neſs

neſs of the operation, the power of executing it in all places and ſeaſons, and the diminution of the capital required in the linen trade, may compenſate for the increaſe of expence.

It is impoſſible to eſtabliſh *data* upon which to determine in every particular caſe, but I would adviſe thoſe who are intereſted in this ſubject, to begin by trials upon a ſmall ſcale, and, from them, to form fair calculations, without ſeeking to flatter themſelves; on the other hand, they muſt not be led aſtray by thoſe loſſes to which every one is liable, before he becomes familiarized with the management of the proceſs; it is, however, not very expenſive to follow, for a certain time, ſuch operations on a ſmall ſcale as may lead us afterwards to undertake, with advantage, others on a large one.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER XII.

XLVI. Specification of the Patent granted to Mr. Anthony George Eckhardt, of Sloane Square, Chelsea; for his Invention and Method of applying the Use of Animals to Machinery in general.

WITH THREE PLATES.

Dated January 31, 1795.

To all to whom these presents shall come, &c. Now know ye, that I the said Anthony George Eckhardt,

Eckhardt, in purſuance of the ſaid proviſo, in the ſaid letters patent, do hereby deſcribe and aſcertain the nature of the ſaid invention, and in what manner the ſame is to be performed, as follows; that is to ſay, the peculiar merits of the invention conſiſt in employing cattle, and all other bulky animals, to give motion to mills, cranes, pumps, or any other kind of mechanical apparatus whatſoever, where force or motion is required; by cauſing them, as it were, to walk on the top of large wheels, or on inclined planes, in ſuch a way and manner as to produce, by the weight of their bodies, the effect intended. The figures, or drawings annexed, more plainly ſhew the true nature of the invention. AB, Fig. 1, (Plate XXI.) is the ſection of a drum-wheel of large diameter, and its width not more than ſufficient to allow two oxen, or other bulky animals, to ſtand abreaſt upon it. This wheel, or drum, is hung on a round iron ſpindle, or axis, paſſing through its centre, ſimilar to a pulley on its pin; and, by means of a ratchet-wheel, which is fixed on the ſaid ſpindle, or axis, and a click or paul on the wheel, the wheel

wheel is at liberty to turn one way without moving the axis, but cannot be turned the contrary way without turning the ſaid ſpindle, or axis, with it; this property is to give the axis, when a plurality of wheels are to operate together, the capacity of being turned by one or more wheels, when others are not in action, and thus admit of one animal, or ſet of animals, to be at work while others are at reſt. E and F repreſent two oxen, treading with their hind legs on the top or outſide of the wheel A B, while their fore feet bear on the fixed floor G G; and thus the animals may work while they are feeding in a trough H, or in a rack I I. In ſome caſes it will be advantageous to cauſe the animals to bear on the wheel with their fore feet alſo. K K is a partition, which ſeparates the animals from each other. Behind the animals, in every ſtall, there is a door or croſs bar L L, to which are fixed ſharp points, or ſpurs, which prevent the animals from receding from the place of action. M M M M ſhew the application of this power to a ſugar-mill, &c. as repreſented in the drawing; which, by this mode, has the peculiar advantages of making the ſugar-cane find its way, unaſſiſted, between three or more cylinders; (and thus ſaves the expence of a man;) of preventing the loſs of an arm or fingers, to perſons employed in directing the cane back, (which very frequently happens by the mills now in uſe,) and on that account admits of the mills working much faſter than by the mode hitherto practiſed. Fig. 2, (Plate XXII.) ſhews how two, or any greater number of wheels, may be applied to the ſame machine, for pumps, &c. A and A ſhew the ſides of two drum-wheels, (as above deſcribed by A B in Fig. 1,) connected by their iron ſpindles B B; and, by an horizontal ſhaft H H, communicate their motion (by a large cog wheel) to a fly I I, for the purpoſe of regulating the motion, which will be particularly neceſſary when a conſiderable number of oxen are employed. This fly conſiſts of an upright ſhaft C D, to which are joined, beſides the fly-wheel I I, two wings or vanes E F and E F, fixed in a large ciſtern or veſſel of water, as deſcribed by G G, (and the quantity of water by K L M N,) which may be made in brick-

brick-work under ground, or otherwiſe, as the ſituation may require. This fly is put in motion by the rotation of the ſhaft H H, which ſhaft muſt be turned by a wheel joined to the axis of the drum-wheel, ſo as to be always in motion, and conſequently turn the large quantity of water in the ciſtern, by any of the drums which may be in action, at the time others may be ſtanding ſtill. Fig. 3, (Plate XXIII.) repreſents an ox A, walking on an inclined movable floor B B B B, which may be varied according to the faculty of the animal employed. This floor conſiſts of a chain of boards or planks, connected by joints or hinges CCCC; the width of this floor muſt be ſufficient to enable the animal to walk without danger of approaching too near the ſide, or it may be made for two animals, placed abreaſt. At each joint of the planks muſt be projecting pivots or pins, to fall into the notches of the click or ratchet-wheel D D, on each ſide of the floor: theſe wheels are fixed on an angle, ſupported by the frame E F, E F. In order to make the motion of the floor eaſy, there is a chain of rollers under

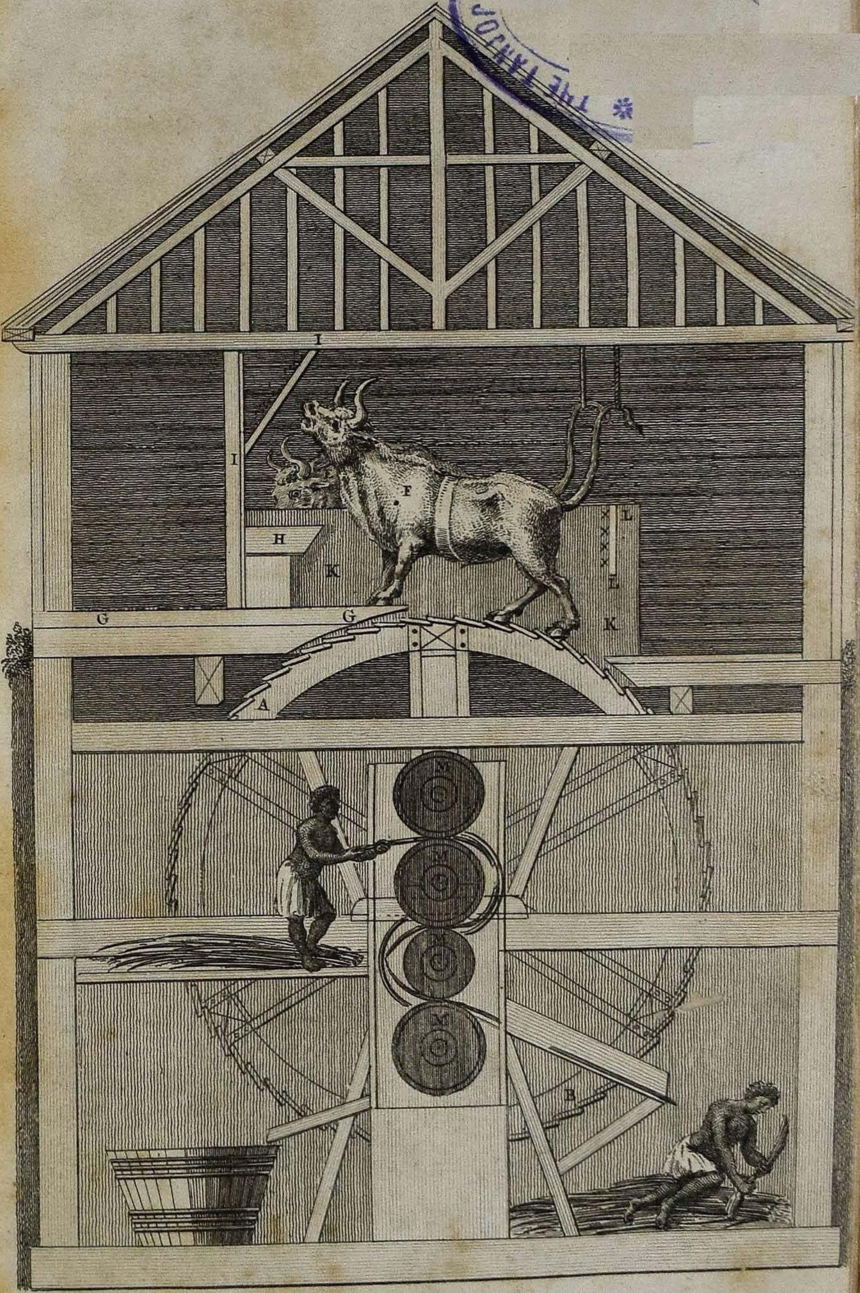
 it,

it, as defcribed by GGGG, refting on the fixed inclined plane HH, and revolving round the two drums II, II. In order to connect this apparatus with any other machine which it is to move, there muft be fixed a wheel, or row of teeth or cogs, KKK, to one of the click wheels DD; which is to turn or to communicate its motion to a fecond wheel or pinion L, which, by the means of an horizontal fpindle MM, will turn the third wheel NN, from which wheel the motion may be dif-tributed to any direction, and may put in motion a fly, as above mentioned, or any other fort, that in many cafes may be neceffary to regulate the motion of this machine or power. The movement or power of this application may alfo be commu-nicated by a row of cogs or teeth on the movable floor BBBB; or by a wheel fixed to one on the other drum wheel II; or it is poffible to com-municate the motion by conftructing teeth or cogs to the links of the chain of rollers GGGG. The motion may alfo be communicated by a fpliced rope, leather ftraps, or a chain on wheels, fixed to the click or ratchet-wheel DD, or on the axis

of

Fig.

Vol. II. Pl. XX.



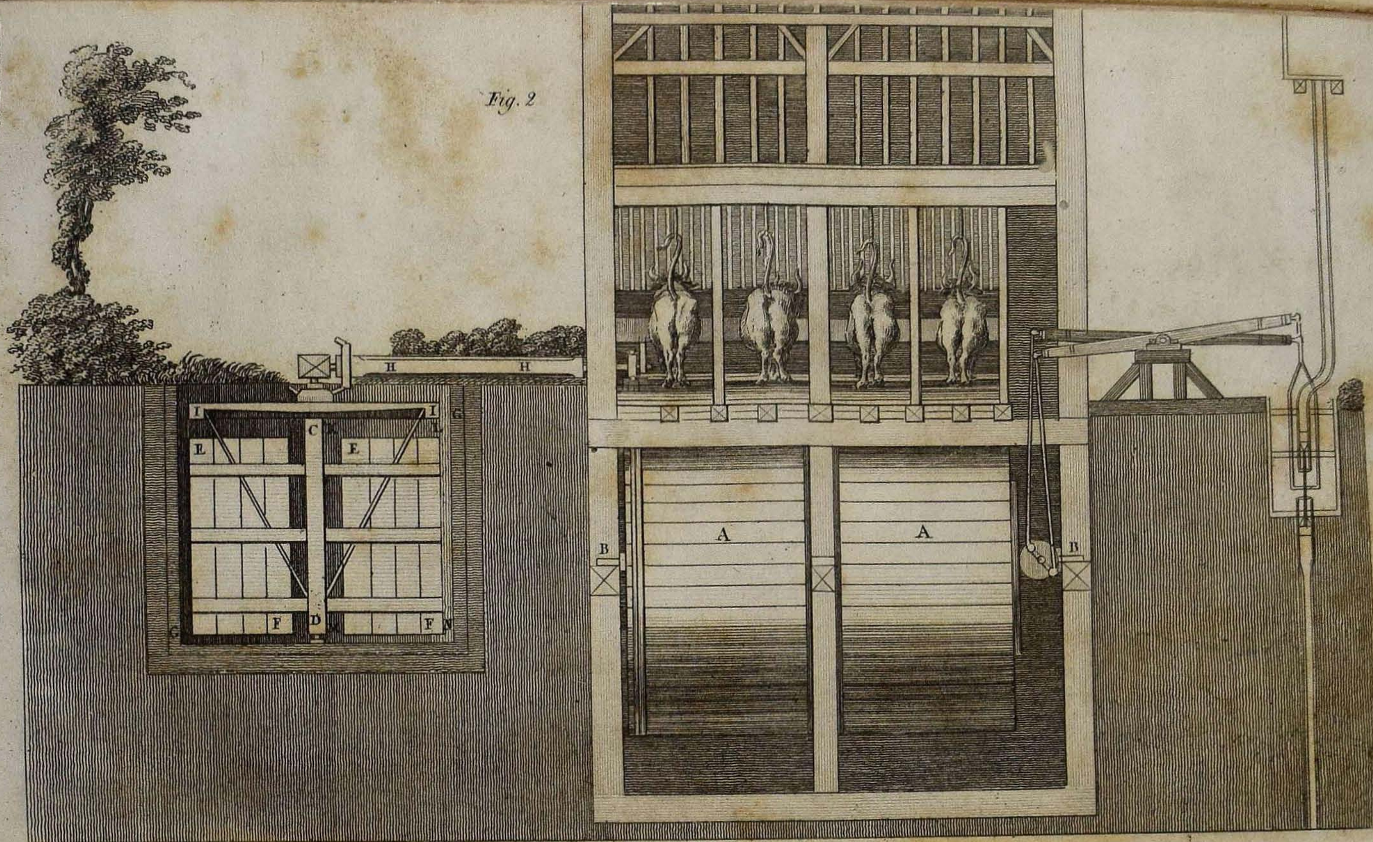
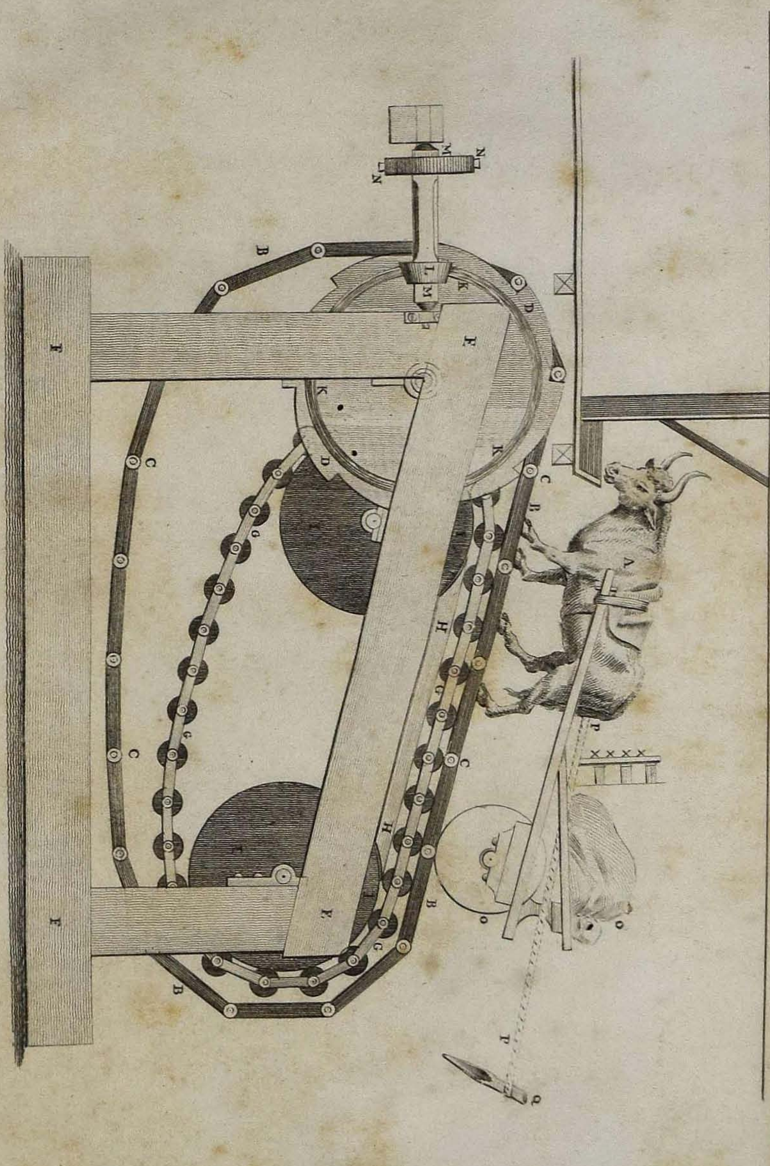


Fig. 2



of the drums I I; or by any way ufed in mechanics, as that of friction-rollers, &c. &c. With refpect to the ox, an addition may be made to his weight by the introduction of a roller or car, as in the figure is defcribed by O O; or the ox may be made to pull a rope P P, fixed to a poft Q, behind him. If horfes fhould be ufed inftead of oxen, the laft-mentioned application may be rendered particularly ufeful. The accommodation and treatment of the animal, in this application, is the fame as that already defcribed, in the reference to Fig. 1 and 2. The apparatus according to Fig. 3 may be fo increafed as to employ whole rows of cattle, or other animals, as in the former cafe. In witnefs whereof, &c.

XLVII. Specification of the Patent granted to Mr. Arnold Wilde, of Sheffield, in the County of York, Saw-maker; for making all Sorts of Plane-irons, Scythes, Sickles, Drawing-knives, Hay-knives, and all other Kinds of Edge Tools, from a Preparation of Caſt-ſteel and Iron, united and incorporated together by Means of Fire.

Dated January 19, 1795.

TO all to whom theſe preſents ſhall come, &c. Now know ye, therefore, that I the ſaid Arnold Wilde do hereby declare, that my ſaid invention of making and manufacturing all ſorts of plane-irons, ſcythes, ſickles, drawing-knives, hay-knives, and all other kinds of edge tools, from a preparation of caſt-ſteel and iron, united and

and incorporated together by means of fire, is particularly defcribed and afcertained in manner following; that is to fay, take a mould of caft iron, or other fit material, of a dimenfion that will beft fuit the fize of the article intended to be manufactured; then take a piece of wrought iron, and prepare it, by heating in a fire and hammering it, or in any other manner you may think proper, to the fize you want it; then fix the iron in the mould, (leaving a fufficient vacancy to receive the caft fteel in a fluid ftate), in fuch a direction as that, when the caft fteel is poured into the mould, the iron may be either in the middle or the centre of the caft fteel; or on one or both fides of the caft fteel; or in fuch other direction as may beft fuit the purpofe for which the iron and caft fteel, when incorporated, fhall be wanted. Then put the crucible or pot into the furnace; when the crucible or pot is hot put fteel into it; then fix on the lid to the crucible or pot, and continue it in the furnace or fire till the fteel becomes fluid. When you fuppofe the fteel to be nearly in a fluid ftate, take your piece of iron, which you intend to incorporate with the

 caft

caſt ſteel, put it into a fire, and heat it to what is uſually called a welding heat; then take the iron out of the fire, clean it from any ſcale or dirt, and fix it in the mould, in the like direction you had before fitted it; take care that your ſteel be now in a fluid ſtate, and, immediately on your taking the iron out of the fire, take the crucible or pot containing the melted ſteel from the furnace of fire, and, immediately after the iron thus heated ſhall be fitted in the mould, pour or turn the fluid ſteel into the ſpace or vacancy left in the mould to receive the ſame, which will incorporate with the iron, and become one ſolid maſs or body of caſt ſteel and iron united. To make all ſorts of plane-irons, ſcythes, ſickles, drawing-knives, hay-knives, and all other kinds of edge tools, of caſt ſteel and iron, united as herein before mentioned, take a piece of the caſt ſteel and iron, united as before mentioned, forge, roll, ſlit or tilt it, in ſuch way as is proper, for any, or either of the articles intended to be manufactured; then the article may be made in the uſual manner, or by ſuch other mode as a workman may judge moſt convenient. In witneſs whereof, &c.

XLVIII.

XLVIII. Specification of the Patent granted to Mr. SAMUEL HOOPER, of the Parish of St. Giles, Bookseller and Stationer; for manufacturing from Leather Cuttings, &c. and Whit-Leather, a Leather for covering Coaches, &c. and for making Boxes of various Kinds, and other Articles, Mouldings, and other Ornaments, for Rooms; and for binding of Books; and for making Paper of various Sorts.

Dated January 20, 1790.

TO all to whom these presents shall come, &c. The process and method for manufacturing a leather, for covering the fronts, backs, sides, and tops, of coaches, chariots, post-chaises, se-

 dan-

dan-chairs, and trunks, is to take the leather cuttings, ſhavings, or parings of leather, and put into an engine, according to its ſize, one hundred weight or more of ſuch leather cuttings, ſhavings, or parings of leather; to be waſhed with water till clean from dirt, and then worked with a proper quantity of water in the engine, till it is reduced to a fine pulp. For ſome purpoſes a ſurface of great ſmoothneſs is required; and, in this caſe, mix with the pulp in the engine ſuch a quantity of ſize as will give it the fine texture and quality wanted. The pulp being prepared, it muſt be put into a cheſt or tub, and worked on braſs or iron wire moulds, and made to any degree of thickneſs the different articles of the manufacture require. The pulp being ready to work, it muſt be put into the moulds, and then, with a hand-ſcrew preſs ſuſpended in a frame over a table, preſſed ſufficiently to ſeparate the water from the pulp, in order to deliver it free from the mould; which done, lay each piece, as it is made, between a kind of blanketing, or felting. This being done, put it in an upright ſtrong preſs, and preſs it with ſuch force as to leave it as

free

free from water as poſſible; when preſſed as dry as you can, take it immediately out, and ſpread it flat on the ground, or on ſtages made fit for the purpoſe. As ſoon as it is dry it muſt be again put into the preſs, and preſſed with great force, to give it a ſmooth and even ſurface; and, ſhould the ſecond preſſing be not ſufficient to give it that even face neceſſary, then put each piece between metal plates and re-preſs it, or run it through iron or braſs rollers, which finiſhes the operation. The proceſs for manufacturing the leather cuttings, ſhavings, or parings of leather, for binding books, is the ſame, in every reſpect, as above-deſcribed for making the covering for the fronts, backs, ſides, and tops, of coaches, chariots, poſt-chaiſes, ſedan-chairs, and trunks, leaving out the ſize. The proceſs for manufacturing the leather cuttings, ſhavings, or parings of leather, for making band, hat, and other boxes, waiters, and tea-trays, ink-ſtands, and ink-pots, ſnuff and tobacco boxes, and other things, ſuch as mouldings, cornices, cielings, and other ornaments for rooms, is the ſame as above deſcribed for making the covering for the fronts,

fronts, backs, ſides, and tops of coaches, chariots, poſt-chaiſes, ſedan-chairs, and trunks, and for binding of books, except that when the leather cuttings, ſhavings, or parings of leather, are reduced to a pulp, as before deſcribed, the water muſt be drained from them, and then mix with the pulp a ſtrong ſize; this will form a kind of paſte, or ſoft dough, which, from its ſoftneſs and yielding quality, may be moulded into any form. The proceſs for manufacturing the leather cuttings, ſhavings, or parings of leather, for making brown paper, is to put to the leather cuttings, ſhavings, or parings of leather, a fourth part or more of junk, or hemp, with a little fine clay, which will give it a ſmoothneſs and ſtrength: theſe materials are to be put together into the engine, and beat till reduced to a proper pulp. The mode of working is the ſame as commonly practiſed for making brown paper. The proceſs for manufacturing the leather cuttings, ſhavings, or parings of leather for making whited brown paper, is the ſame as that for making the brown paper, as above deſcribed, except that, inſtead of junk,

junk, or hemp, the ſame quantity with the coarſeſt rags muſt be ſubſtituted, leaving out the clay. The proceſs for manufacturing the leather cuttings, ſhavings, and parings of leather, for making, from white leather, paper for drawing, and printing of copper-plates, is to add to the cuttings, ſhavings, and parings of leather, including whit-leather, three fourths or more of fine rags. Theſe muſt be put into the engine, and beat to a fine pulp, and, to make it ſufficiently tough and firm, uſe ſuch a quantity of ſize as is neceſſary for that purpoſe; the ſize may be mixed with the pulp in the engine, or after the paper is made, in the uſual way. The method of making it is the ſame as commonly practiſed for making paper. In witneſs whereof, &c.

XLIX. On the Cultivation of Willows.

From the general View of the Agriculture of the County of Nottingham; drawn up, for the Consideration of the Board of Agriculture, by ROBERT LOWE, Esq.

THE following obſervations, relative to the method I make uſe of in cultivating willows on waſte moiſt lands, I flatter myſelf, will not prove unacceptable to the Board of Agriculture. I have found, from experience, the advantage of it, and am convinced my country will be benefited, ſhould it be generally adopted.

I would firſt adviſe the laying out the ground into lands, like hop-lands, viz. from three to four yards wide; with a ditch on each ſide, three feet wide at the top, one foot at the bottom, and two and a half deep. The earth that comes out of the ditch ſhould be thrown on the land: but if there is not ſufficient fall for the water to get off, the ditch ſhould be made deeper and wider, till you have near a yard of earth above the level of the water.

As ſoon as this is done, the ground muſt be double dug, viz. trenched two ſpades depth, except your ground be very boggy, which will afford room for the plants to ſhoot, and will ſave the expence of weeding, which otherwiſe muſt be incurred in the firſt ſummer, after the plants are ſet; for, if they are not kept clear of weeds the firſt year, the hopes of the planter will certainly be deſtroyed.

The willow I recommend as moſt advantageous, on every account, is the broad-leaved red-hearted Huntingdonſhire willow; every other ſpecies I have tried, and find reaſon to give a decided preference to this.

The ſets, or truncheons, muſt be cut from twenty inches to two feet long; particular care ſhould be taken, in the cutting, that the bark should not be fridged or bruifed, or in any other refpect injured, for in that cafe the plant will be weak and puny. They fhould be cut, not on a block, but in the hand, obliquely, and with a very fharp bill, or other inftrument.

They muft be dibbled into the earth, by an iron crow, to the depth of fourteen or twenty inches, fo that not more than fix, nor lefs than four, appear above. If the truncheon fhould not fill the hole, the earth muft be trampled clofe round it, in order that the air may be excluded; and care muft be taken that the plant be fet as the pole grows. The cuttings fhould be from poles of about three years growth: maiden poles are the beft; they fhould be fet three feet afunder, in the *quincunx* form. Thofe truncheons will fhoot out many branches, two or three of which will grow to poles, if the land is good; if not, only one. Thofe poles I have fold, at eight years growth, for £.214 per acre, neat money; the fprays, or brufh-wood, pay for the felling. Had I fuffered them to have ftood two years longer, they would have produced £.300 *per* acre. Should any of the plants

look

look weak or puny, or not ſhoot vigorouſly, it will be neceſſary to dig in a ſkuttle full of manure, to the roots, which I have no doubt in ſaying will pay.

Though I have planted no leſs than ten acres, I cannot ſay poſitively, from my own knowledge, what the value would have been had they remained on the ground for fifteen or twenty years, having been called on for ſets by the gentlemen of the neighbourhood, which I have ſold for £.3 a thouſand. I muſt here obſerve, that the ſtools, whence the ſets are cut, ſhoot very luxuriantly, and will produce from three to four poles.

The length of poles, at eight years growth, was from thirty-three to thirty-ſix feet, and moſt of them were large enough to make three rails, two at the bottom, and one at the top; but the great uſe to which they are applied, is the making of hurdles, flakes, gates, and other farming implements, being a wood uncommonly tough and light; owing, as I conceive, to a new method I made uſe of, in planting them cloſe to the ground.

If it is the design of the planter to let them grow into timber, (which I would venture to say would be far superior to deal, for the purpose of flooring, or other light work, particularly as it will neither splinter nor fire: and, if suffered to remain for twenty or twenty-five years, would make good masts for small craft, as they shoot up perfectly straight, and without any collateral branches,) it is necessary, at the first or second year's growth, to observe which pole is the strongest, as the remaining poles must be cut away. In about fifteen years time I am led to suppose they will want thinning; of course the inferior must be taken out, and the superior must be suffered to remain.

The times of planting must be from January to the end of March: but the sets for that purpose should be cut from December to the end of February, when the sap is down; and the reason is, that if poles are cut in the spring (the sap being up), the stool will at last be weakened by bleeding, if not killed; and of course prevented from shooting so vigorously as if cut at the pro-

ceding

ceding time. If, however, there are people ſo injudicious as to ſell ſets in ſpring, it will be to the advantage of the purchaſer to plant them, as the ſap is then in the poles. The reaſon why many are induced to cut at that time is on the ſuppoſed account of their peeling better; but I can affirm, from experience, that poles cut in December, January, or February, and laid in rows upon the ground, or the ends put in water, will peel as well in the ſpring as at the uſual time.

In regard to fencing, the planter ſhould pay the greateſt attention to it, otherwiſe his time and expence will be fruitleſs.

L. Conclusion of Dr Macbride's improved Method of tanning Leather.

(From p. 354.)

XIV. WHAT has been hitherto said relates only to butts and calf-skins: as to sole-leather, which is prepared for the ooze by steeping it in some sour liquor, in order to open its pores, and raise it, (according to the tanners phrase,) the new method requires a different practice from the old one.

XV. In the old method, the tanners made use of sourings brewed generally from rye, or some other grain; these liquors are not only troublesome to brew and to ferment, but they are always uncertain as to their degree of sourness or strength, which depends on the state of the weather, and other variable circumstances; they are, moreover, exceedingly apt to rot the leather, and, without great care, may injure it very materially in its texture.

XVI. To obviate theſe inconveniences, you are to imitate the bleachers of linen, who make uſe of a ſour prepared by diluting the ſtrong ſpirit of vitriol (vulgarly, but improperly, termed oil of vitriol) with a ſufficient quantity of plain water.

XVII. It was not without much difficulty that the bleachers could be prevailed on to quit their old ſourings, made either, like yours, of rye or barley, or of ſour butter-milk, from a groundleſs fear that the vitriolic ſouring would corrode their cloth; but the experience of many years has convinced them of their error, and now no other ſouring is uſed. In like manner the tanners at firſt may be afraid to uſe the ſpirit of vitriol; but a little practice will ſhew how far ſuperior this ſouring is to what they have hitherto uſed. They will never find it ſubject to any change, in reſpect to ſtrength, from variations of weather, or different degrees of heat; and, ſo far from tending to rot the leather, it gives it unuſual firmneſs; and the ſoles which are raiſed by the vitriolic ſouring are remarkably ſound, and always free from the ſlighteſt degree of rottenneſs. Beſides, the ſame ſour may do for many parcels of leather, by adding a little a little ſpirit of vitriol to it; and it need not be thrown away, till it becomes too dirty for uſe, by the frequent ſucceſſion of hides.

XVIII. A wine pint of the ſtrong ſpirit of vitriol, which will not coſt more than nine or ten pence *, is ſufficient for fifty gallons of water, to prepare the ſouring at firſt: therefore all you have to do, in raiſing the ſoles, is only to prepare them before-hand in the uſual way; and, when they are fitted for the ſouring, mix up a quantity of ſpirit of vitriol and water, according to the number of hides that you require to have raiſed, ſtill obſerving the proportion of a pint to fifty gallons, which will be enough, if the ſpirit be of the due degree of ſtrength. The hides may lie in the ſouring till you find them ſufficiently raiſed, for they will be in no danger of rotting, as they would be in the common corn ſourings, which in time might turn putrid, and rot the leather; whereas the vitriolic ſouring keeps off putrefaction.

XIX. When you find your hides ſufficiently raiſed, put them directly into the ooze, and go

* The oil of vitriol is ſold by the druggiſts in large bottles, containing eight or ten gallons.

on with the tanning as in the old way ; and you will ſee that the lime-water ooze penetrates raiſed leather even faſter than it does butts or calf-ſkins, allowance being made for their different degrees of thickneſs.

XX. Let it be now ſuppoſed that you have your ciſtern fixed, your lime-water prepared, and ſome letches full of lime-water ooze, which has been run through two letches, in order that the lime-water may completely ſpend its force on the bark ; you are not to throw away what common ooze you have in ſtock in the yard, but only as it ſhall be ſpent ; then indeed you are to throw it away, and ſupply its place with the lime-water ooze.

XXI. In a very few days you will perceive the difference between the activity of the two oozes, the new and old, with reſpect to penetrating the leather ; and thus, without any kind of loſs or waſte, you will get rid of all your old liquors, and come ſpeedily into a full ſtock of the ooze made with lime-water ; and, after you have got the new method eſtabliſhed, your buſineſs will go on in a regular courſe, and one parcel of goods will ſucceed another, as faſt as you can manufacture and diſpoſe of them.

XXII. Though it is poſſible to tan ſmall parcels of leather, (by way of experiment,) by the uſe of lime-water ooze, in a fourth part of the time which is required if only common ooze be made uſe of, yet the buſineſs of a large tan-yard cannot be carried on with ſo much expedition; but, even in large works, and in the common courſe of buſineſs, ſole-leather can be completely tanned and finiſhed in from eleven to fifteen months, according to the different weights and thickneſs of the hides; butts in from eight to twelve months; and calf-ſkins in from ſix to twelve weeks. In general, the tanner may ſave at leaſt one third of the time that has hitherto been required.

XXIII. The leather which is manufactured in the new way is of a ſuperior quality to that of the old tannage, eſpecially the ſole-leather, which wears remarkably well, and never ſhews the leaſt ſign of rottenneſs.

XXIV. Let it always be remembered, that the lime-water is never to be uſed but when it is ſufficiently ſtrong, and as clear as rock-water.

XXV. Whenever you make freſh ooze, you muſt always uſe freſh lime-water, and run the ooze through two letches; and the lime-water ooze, when ſpent from lying on the leather, is never to be returned upon the bark which is in the letches, (as you now return your ſpent ooze,) but muſt always be thrown away, as being entirely uſeleſs; for which purpoſe you muſt contrive a gutter in the tan-yard, to carry off the ſpent ooze.

XXVI. The letches ought to be under cover, leſt the rain get into them and weaken the ooze; and, if the handlers are ſheltered, it will be ſo much the better; but it is of no importance to cover the vats, provided, when the leather is laid away in them, they are kept conſtantly full to the brim.

XXVII. You muſt always take care to have a ſufficient ſtock of unſlaked lime by you; (for if it be ſlaked it will not anſwer to make lime-water;) therefore, get your lime freſh, if poſſible, from the kiln, and immediately pack it in any kind of old dry caſks. Weigh one of theſe caſks, and it will enable you to aſcertain the quantity of lime neceſſary to be thrown into the ciſtern, each time you begin a fresh brewing of lime-water, and thus save you the trouble of repeated weighings; not that there need be much nicety about the quantity of lime, a score of pounds over or under making no sensible difference in the strength of the lime-water.

XXVIII. Any expence you may be at in procuring lime, which, even in the largest tan-yards, can amount but to a trifle, will be amply compensated by the saving of bark; because lime-water completely exhausts the bark, and makes it go much farther than when the ooze is made only of plain water. As a proof of this, you may make a pretty strong ooze from the tan, or spent bark, (which you now consider as completely exhausted,) by infusing it in lime-water.

Tanners, as they become acquainted with the new method, will find it perfectly easy, and may no doubt make farther improvements by experience. The following directions were found sufficiently full for enabling a gentleman at Belfast to carry on the business, in an extensive way, for these four years past; and, it is presumed, they will prove equally clear and intelligible to all other persons in the tanning trade.

LI. Some Obſervations on ancient Inks, with the propoſal of a new Method of recovering the Legibility of decayed writings. By Charles Blagden, M. D. * Sec. R. S. and F. A. S.

From the Transactions of the Royal Society of London.

In a converſation, ſome time ago, with my friend Thomas Aſtle, Eſq. F. R. S. and A. S. relative to the legibility of ancient MSS, a queſtion aroſe, whether the inks in uſe eight or ten centuries ago, and which are often found to have preſerved their colour remarkably well, were made of different materials from thoſe employed in later times, of which many are already become ſo pale as ſcarcely to be read. With a view to the deciſion of this queſtion, Mr. Aſtle obligingly furniſhed me with ſeveral MSS on parchment and vellum, from the ninth to the fifteenth

* Now Sir Charles Blagden, Knt.

cen-

centuries inclufively; fome of which were ftill very black, and others of different fhades of colour, from a deep yellowifh brown to a very pale yellow, in fome parts fo faint as to be fcarcely vifible. On all of thefe I made experiments with the chemichal re-agents which appeared to me beft adapted to the purpofe; namely, alkalies both fimple and phlogifticated, the mineral acids, and infufion of galls.

It would be tedious and fuperfluous to enter into a detail of the particular experiments; as all of them, one inftrnce only excepted, agreed in the general refult, to fhew, that the ink employed anciently, as far as the above-mentioned MSS extended, was of the fame nature as the prefent; for, the letters turned of a reddifh or yellowifh brown with alkalies; became pale, and were at length obliterated, with the dilute mineral acids; and the drop of acid liquor, which had extracted a letter, changed to a deep blue or green on the addition of a drop of phlogifticated alkali; moreover, the letters acquired a deep tinge with the infufion of galls, in fome cafes more, in others lefs. Hence it is evident, that one of the ingre-

dients

dients was iron, which there is no reaſon to doubt was joined with the vitriolic acid; and the colour of the more perfect MSS, which in ſome was a deep black, and in others a purpliſh black, together with the reſtitution of that colour, in thoſe which had loſt it, by the infuſion of galls, ſufficiently proved, that another of the ingredients was aſtringent matter, which, from hiſtory, appears to have been that of galls. No trace of a black pigment of any ſort was diſcovered; the drop of acid, which had completely extracted a letter, appearing of an uniform pale ferruginous colour, without an atom of black powder, or other extraneous matter, floating in it.

As to the greater durability of the more ancient inks, it ſeemed, from what occurred to me in theſe experiments, to depend very much on a better preparation of the material upon which the writing was made, namely, the parchment or vellum, the blackeſt letters being generally thoſe which had ſunk into it the deepeſt. Some degree of efferveſcence was commonly to be perceived when the acids came in contact with the ſurface of theſe old vellums. I was led, however, to ſuſpect,

pect, that the ancient inks contained a rather less proportion of iron than the more modern; for, in general, the tinge of colour, produced by the phlogisticated alkali in the acid laid upon them, seemed less deep; which, however, might depend in part upon the length of time they had been kept; and perhaps more gum was used in them; or possibly they were washed over with some kind of varnish, though not such as gave any gloss.

One of the specimens sent me by Mr. Astle proved very different from the rest. It was said to be a MS. of the fifteenth century: and the letters were those of a full engrossing hand, angular, without any *fine* strokes, broad, and very black. On this none of the above-mentioned re-agents produced any considerable effect; most of them rather seemed to make the letters blacker, probably by cleaning the surface; and the acids, after having been rubbed strongly upon the letters, did not strike any deeper tinge with the phlogisticated alkali. Nothing had a sensible effect toward obliterating these letters, but what took off part of the surface of the vellum, when small rolls, as of a dirty matter, were to be perceived.

ceived. It is therefore unqueſtionable, that no iron was uſed in this ink; and, from its reſiſtance to the chemical ſolvents, as well as a certain clotted appearance in the letters, when examined cloſely, and in ſome places a ſlight degree of gloſs, I have little doubt but they were formed with a compoſition of black, ſooty, or carbonaceous, powder and oil, probably ſomething like our preſent printer's ink, and am not without ſuſpicion that they were actually printed *.

Whilſt I was conſidering of the experiments to be made, in order to aſcertain the compoſition of ancient inks, it occurred to me, that perhaps one of the beſt methods of reſtoring legibility to decayed writing might be, to join phlogiſticated alkali with the remaining calx of iron; becauſe, as the quantity of precipitate formed by theſe two ſubſtances very much exceeds that of the iron alone, the bulk of colouring matter would thereby be greatly augmented. M. Bergman was of opinion, that the blue precipitate contains only

* A ſubſequent examination of a larger portion of this ſuppoſed MS. has ſhewn, that it is really part of a very ancient printed book.

 between

between a fifth and a fixth part of its weight of iron; and, though fubfequent experiments * tend to fhew, that, in fome cafes at leaft, the proportion of iron is much greater, yet, upon the whole, it is certainly true, that, if the iron left by the ftroke of a pen were joined to the colouring matter of phlogifticated alkali, the quantity of Pruffian blue thence refulting would be much greater than the quantity of black matter originally contained in the ink depofited by the pen; though perhaps the body of colour might not be equally augmented. To bring this idea to the teft, I made a few experiments as follows.

The phlogifticated alkali was rubbed upon the bare writing in different quantities; but in general with little effect. In a few inftances, however, it gave a bluifh tinge to the letters, and increafed their intenfity, probably where fomething of an acid nature had contributed to the diminution of their colour.

Reflecting that when the phlogifticated alkali forms its blue precipitate with iron, the metal is

* Crell Beyträge, B. I. ft. 1. p. 42, &c.

ufually

ufually firft diffolved in an acid, I was next induced to try the effect of adding a dilute mineral acid to writing, befides the alkali. This anfwered fully to my expectations, the letters changing very fpeedily to a deep blue colour, of great beauty and intenfity. It feems of little confequence, as to the ftrength of colour obtained, whether the writing be firft wetted with the acid, and then the phlogifticated alkali be touched upon it, or whether the procefs be inverted, beginning with the alkali; but, on another account, I think the latter way preferable. For, the principal inconvenience which occurs in the propofed method of reftoring MSS is, that the colour frequently fpreads, and fo much blots the parchment as to detract greatly from the legibility; now this appears to happen in a lefs degree when the alkali is put on firft, and the dilute acid is added upon it. The method I have hitherto found to anfwer beft has been, to fpread the alkali thin, with a feather, over the traces of the letters, and then to touch it gently, as nearly upon or over the letters as can be done, with the diluted acid, by means of a feather, or a bit of ftick cut to a blunt point.

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Though the alkali has occaſioned no ſenſible change of colour, yet the moment that the acid comes upon it, every trace of a letter turns at once to a fine blue *, which ſoon acquires its full intenſity, and is beyond compariſon ſtronger than the colour of the original trace had been. If now the corner of a bit of blotting paper be carefully and dexterouſly applied near to the letters, ſo as to ſuck up the ſuperfluous liquor, the ſtaining of the parchment may be in great meaſure avoided; for, it is this ſuperfluous liquor which, abſorbing part of the colouring matter from the letters, becomes

* The *phlogiſticated alkali* (which is to be conſidered ſimply as a name) appears to conſiſt of a peculiar acid, in the preſent extenſive acceptation of that term, joined to the alkali. Now the theory of the above mentioned proceſs I take to be, that the mineral acid, by its ſtronger attraction for the alkali, diſlodges the colouring (Pruſſian) acid, which then immediately ſeizes on the calx of iron, and converts it into Pruſſian blue, without moving it from its place. But, if the mineral acid be put upon the writing firſt, the calx of iron is partly diſſolved and diffuſed by that liquor, before the Pruſſian acid combines with it; whence the edges of the letters are rendered more indiſtinct, and the parchment is more tinged. The ſudden evolution of ſo fine a colour, upon the mere traces of letters, affords an amuſing ſpectacle.

a dye

a dye to whatever it touches. Care muft be taken not to bring the blotting paper in contact with the letters, becaufe the colouring matter is foft whilft wet, and may eafily be rubbed off.

The acid I have chiefly employed has been the marine; but both the vitriolic and nitrous fucceed very well. They fhould undoubtedly be fo far diluted as not to be in danger of corroding the parchment, after which the degree of ftrength does not feem to be a matter of much nicety.

The method now commonly practifed to reftore old writings, is by wetting them with an infufion of galls in white wine *. This certainly has a great effect, but it is fubject, in fome degree, to the fame inconvenience as the phlogifticated alkali, of ftaining the fubftance on which the writing was made. Perhaps if, inftead of galls themfelves, the peculiar acid, or other matter, which ftrikes the black with iron, were feparated from the fimple aftringent matter, for which purpofe two different proceffes are given by Piepenbring †

* See a complicated procefs for the preparation of fuch a liquor in Caneparius, de Atramentis, p. 277.

† Crell. Annal. 1786, B. I. p. 51.

and

and by Scheele *, this inconvenience might be avoided. It is not improbable likewiſe, that a phlogiſticated alkali might be prepared better ſuited to this object than the common; as, by rendering it as free as poſſible from iron, diluting it to a certain degree, or ſubſtituting the volatile alkali for the fixed. Experiment would moſt likely point out many other means of improving the proceſs deſcribed above; but in its preſent ſtate I hope it may be of ſome uſe, as it not only brings out a prodigious body of colour upon letters which were before ſo pale as to be almoſt inviſible, but has the farther advantage over the infuſion of galls, that it produces its effect immediately, and can be confined to thoſe letters only for which ſuch aſſiſtance is wanted.

* *Kongl. Vetenſk. Acad. Nya Handlingar*, tom. VII. p. 30. See alſo M. de Morveau's account of this ſubſtance in the *Encyclopédie par ordre des matieres.*

LII. A Method of cutting very fine Screws, and Screws of two or more Threads, &c. by the Rev. GILBERT AUSTIN, A. M. M. R. I. A.

WITH A PLATE.

From the TRANSACTIONS of the ROYAL IRISH ACADEMY.

HAVING lately wanted a micrometer ſcrew, for an equatorial inſtrument of twelve inches diameter, made by Mr. Robinſon, of Dublin, I ſought in vain, among the beſt workmen in this town, for one which might anſwer my purpoſe. Screws of the neceſſary fineneſs are not generally uſed in mechanics; rather, therefore, than ſubmit to the delay and difficulty of obtaining one from London, I determined to endeavour to make one. The machine for cutting ſcrews of this deſcription uſed by Mr. Ramſden, and by the firſt aſtronomical-inſtrument-makers in London, I underſtood to be complex, and of great nicety: ſuch an one would not ſuit me. I thought I might poſſibly hit upon ſome ſhort and ſimple method of making fine ſcrews without it. That which I uſed I beg leave to ſubmit to the Academy, in order that they may make it public, ſhould they think it worthy their attention, and likely to be of ſervice to the practical aſtronomer, who might otherwiſe find it difficult to furniſh himſelf with very fine ſcrews for micrometers. The uſe of this method is not confined to the forming of very fine ſcrews alone, but may be applied to the cutting of original taps of any ſize, and of any number of threads required, as double, triple, &c. for what are called ſwift ſcrews, and that with much leſs trouble and time than workmen are obliged to ſpend in the common methods.

I took a piece of the beſt ſteel wire, of about a quarter of an inch diameter, and about two inches long, which I turned perfectly cylindrical at one end, about three quarters of an inch in length, to

about

about one eighth of an inch, or ſomething more, in diameter. I made a nick near the point, and faſtened the end of a very fine piece of ſteel wire to it, and then rolled the wire about the cylinder, as far as the ſhoulder, where I faſtened it, as at the point. I did not roll the wire quite ſo cloſe as I could, but left room, between one of the revolutions, for the edge of a very fine knife. I then ſet the edge of the knife at the beginning of the thread of the wire, in the direction of the inclination of the threads, and preſſed it down ſo as to touch the ſteel cylinder. I turned the cylinder about with my hand, and, guiding the knife by the threads of the wire, by a few turns, I made an impreſſion on the ſteel, ſufficient, when I ſtripped off the wire, to ſerve as a guide for the knife to run in, and to cut the thread to a ſufficient depth.

This method, on account of the difficulty of guiding the hand, and determining the proper degree of tenſion to be given to the wire on the cylinder, I found ſubject to a conſiderable variation, with reſpect to the fineneſs of the ſcrew produced. For, from the ſame wire, on different cylinders, Mr. Robinſon made two taps, one of 80 and one of 110 threads to an inch; and I made two taps, one of 120 and one of 140 threads to the inch; and, among theſe taps, not above ten or twelve threads could be found ſufficiently regular for uſe. Thoſe however, as workmen know, were enough for original taps, and from them, by the uſual methods, I formed four very good taps, of the fineneſs I have mentioned. In this method I was alſo ſubject to another inconvenience, which was, that I frequently cut the wire before I had made ſufficient impreſſion on the cylinder.

I ſhould not have mentioned this method, as I have very much improved upon it, only that its great ſimplicity may render it practicable by thoſe who cannot execute conveniently the tool for this purpoſe, of which I now proceed to give the deſcription, together with the manner of uſing it.

a a (ſee Plate XXIV.) is a ſmall vice, which is opened or cloſed, at pleaſure, by the long milled ſcrew *b*; its jaws, at *c*, are punched or cut very rough at the inſide. It is faſtened, on the end of the cylinder *e e*, by the ſcrew *n*, and in a plane perpen-

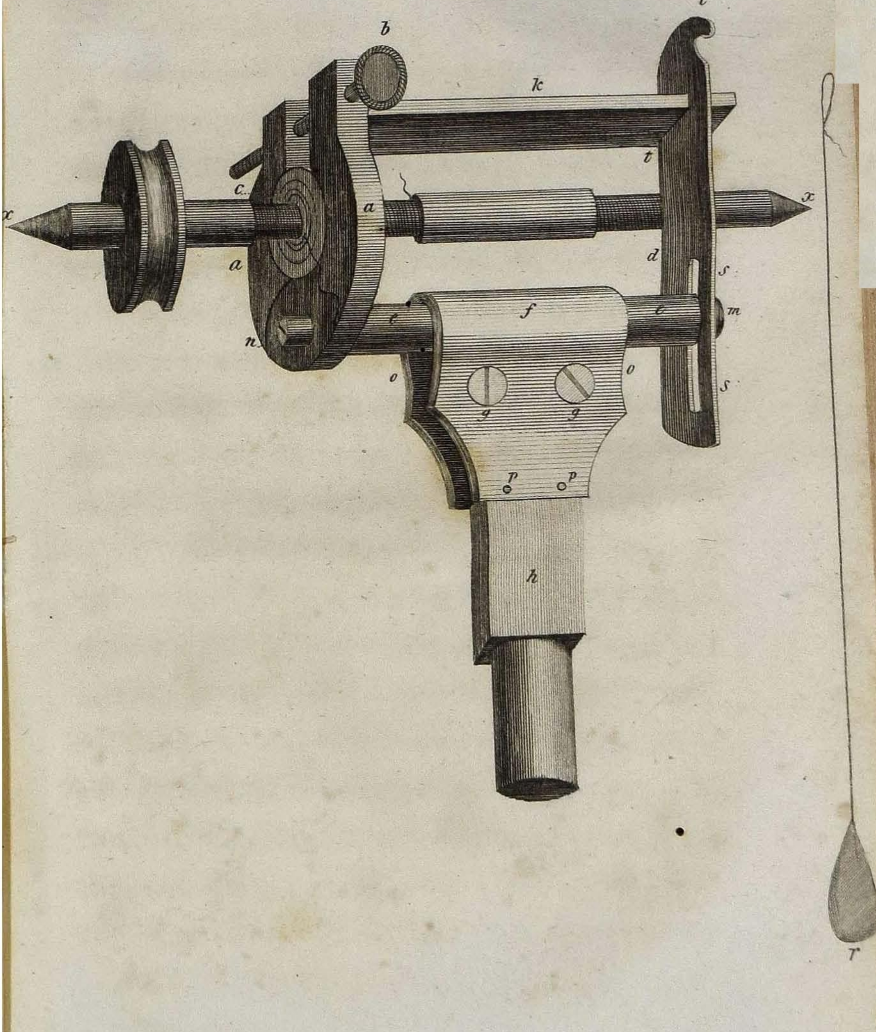
perpendicular to the axis of the cylinder. At the other end of the cylinder *e e* is fixed a fine knife *d*, turning up with a hook *l*, and having in it a long flit *s s*, by which it may be puſhed on the ſcrew *m*, ſo that any part of the edge which is beſt may be applied to cut the ſcrew. The cylinder *e e* turns freely on its axis, and ſlides, in the direction of its axis, backwards and forwards (but without ſhake) in the ſocket *f*, which is made of a piece of braſs hammered about it, and is capable of being more or leſs cloſed, at *o o*, by the ſcrews *g g*; the ends of this braſs ſocket are rivetted, at *p p*, to the ſolid piece *h*, which fits the hole of the reſt of a common clock-maker's turn-bench.

The bar *k* is joined on one ſide of the vice *a a*, and extends acroſs to the knife, which drops into the cut *t*, in the bar, and is thus kept ſteady and parallel to the vice.

The ſteel, of which the original tap is to be made, is to be prepared as at *x x*, the end is to be truly turned and poliſhed; and, at the diſtance of the length of the cylinder *e e*, a part of it is to be turned truly cylindrical, with two ſhoulders, between which the wire of the ſize deſired is to be lapped, as tight and as cloſe as it will go, taking care that the threads do not run too obliquely, by making them, at each revolution, advance on the ſteel cylinder only their own thickneſs.

A bit of lead, about double the length of the jaws of the vice, and about the tenth of an inch thick, is now to be bent about the wire on the ſteel; the tool is to be fixed in the place of the reſt of the turn-bench, and, puſhing it near the ſteel wire, the vice is to be faſtened on the lead, ſo tight as to make on it an impreſſion of the thread. The knife is then to be let down into the notch of the bar *k*, and the cylinder *e e* is to be adjuſted parallel to the ſteel. The edge of the knife will touch the end of the ſteel, (the weight *r* being hung on the hook,) and, when the ſteel is turned about by the hand, or by a bow, it will exactly cut a ſcrew, the threads of which will be at the ſame diſtance as thoſe of the wire on the ſteel, becauſe the wire ſerves as an outſide ſcrew, and the lead as a ſcrew at the inſide; ſo that whatever motion the vice receives, from this

cauſe,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caufe, in the revolutions of the fteel, is communicated by the bar *e e* to the knife; the edge of which cuts the thread on the polifhed end of the fteel, which is intended for the original tap.

If double threads, &c. are required, there muft be an adjuftment, by which the knife may be moved the thicknefs of each additional thread; which may be eafily effected by collets, or by an adjufting fcrew. The wire is then to be lapped on the cylindrical fteel; in a double, or triple, &c. inftead of a fingle thread; taking care that it fhall be difpofed evenly, and well faftened.

LIII.

LIII. On the Uſe of Oak-leaves in Tanning; by the Rev. GEORGE SWAYNE, of Pucklechurch, near Briſtol.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES and COMMERCE.

KNOWING that the bark of the oak was a chief material in the art of tanning leather, and conceiving that every other part of that tree was fraught with the ſame aſtringent principle through which the bark becomes ſo efficient in that art, the thought had often occurred, that the leaves might be advantageouſly applied for the ſame purpoſe. Having in my poſſeſſion a quantity of thoſe leaves, which had been collected on account of the galls attached to them, I was deſirous of aſcertaining the proportion of aſtringent matter contained in them, and of comparing it with

with that contained in the bark. It was ſome time before I could think of a method of doing this; whether the method I at length uſed was fully adequate to the intention muſt be left to the determination of thoſe who have more knowledge in chemiſtry that I can pretend to.

The well-known property, which this aſtringent matter poſſeſſes, of uniting and ſtriking a black colour with the calx of iron, ſuggeſted to me that its quantity might probably be aſcertained, by extracting this matter, through the medium of hot water, in which it is known to be ſoluble; ſaturating the extract with a known weight of the calx of iron, and afterwards filtering, drying, and weighing it. Suppoſing martial vitriol to contain iron in a very proper ſtate for this experiment, the firſt thing I had to do was, to aſcertain the weight of iron in a given weight of vitriol; and this I attempted by the following proceſs: I weighed five pennyweights of vitriol, diſſolved it in water, and added a like weight of vegetable fixed alkali, which immediatly precipitated the iron; the mixture was then thrown on a paper filtre, the weight of which was noted down, and, after

after being plentifully elutriated with hot water, the residue was dried and weighed. Its weight, exclusive of the filtre, was two pennyweights thirteen grains. This proportion of iron, in martial vitriol, differs from that given by Professor Neuman from his Analysis; (See Lewis's Translation of Neumann's Chemistry, vol. I. p. 278;) but it is necessary to mention, that the vitriol which I made use of had been kept in a dry place, uninclosed in a glass vessel, by which it had lost much of its water of crystallization, and this accounts for the difference. At the same time, and from the same parcel of vitriol, I weighed several other portions, for after-experiments.

The weight of iron, in a given weight of vitriol, being known, I then attempted to follow the process above suggested; but, upon trial, found that the coloured particles were so minute, or so intimately mixed, that they passed, with the fluid, through the filtre; this I attributed to the presence of the vitriolic acid, and its close attachment to the coloured particles. With a view, therefore, to destroy this suspected combination, by presenting to the acid a substance with which

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it has a nearer affinity, I added ſome mild ſalt of tartar, which inſtantly produced the deſired effect, and brought on an entire ſeparation of the coloured maſs. I then went on with my intended experiments, in the following manner.

I took a half-peck meaſure full of dried oak-leaves, well preſſed down, from which I had before ſeparated ſeveral ounces of muſhroom-galls, and having put them into a braſs kettle, with a ſufficient quantity of water, boiled them therein for two hours. The decoction was then poured from the leaves, and freſh water added to them; this was likewiſe boiled for a conſiderable time, till it was judged that the water had extracted all the aſtringent matter; both the decoctions were then boiled down in the ſame kettle, to one gallon. In a certain meaſure of this concentrated extract I diſſolved five pennyweights of green vitriol, and afterwards added the like weight of ſalt of tartar: this mixture was then thrown on a filtre of ſinking paper, (the weight of a which was three pennyweights,) and, after being perfectly elixiviated with hot water, the reſiduum was dried and weighed.

	dwts.	grs.
The filtre, with its contents, weighed,	6	14
Subtract the weight of the filtre, .	3	0
	3	14
Subtract the calx of iron, . .	2	13
There remains of aſtringent matter	1	1

Two pints of this reduced extract were ſtill farther evaporated to one pint; and a like meaſure of this was treated as the former.

	dwts.	grs.
The filtre, with its contents, weighed	7	1
Subtract the filtre, which weighed	2	15
	4	10
Subtract the calx of iron, . . .	2	13
Remainder of aſtringent matter, .	1	21

I then

I then obtained from a tanner two pounds of oak-bark, which was perfectly dry, and, after cutting it into thin ſhavings with a plane, boiled it in three portions of water for ſeveral hours, till, from the colour as well as the taſte of the laſt decoction, the aſtringency ſeemed to be perfectly extracted. Theſe ſeveral decoctions were added together, and evaporated to the ſame quantity as thoſe of the leaves, namely, one gallon. An equal meaſure of this, as above, produced by the like treatment a reſiduum which, with its filtre,

	dwts.	grs.
Weighed	7	10
Subtract the filtre, which weighed	2	19
	4	15
Subtract the calx of iron, .	2	13
Remainder of aſtringent matter, .	2	2

A quart of this reduced extract was farther concentrated to a pint, and an equal meaſure of this was treated as before.

 The

	dwts.	grs.
The filtre, with its contents, weighed	9	12
Subtract the filtre, which weighed	2	15
	6	21
Subtract the calx of iron, .	2	13
Remainder of astringent matter, .	4	8

These experiments do not exactly tally, since, in those with the leaves, the amount of astringent matter in the second experiment ought to have been double that of the first; and, in those with the bark, the astringent matter of the first experiment ought to have been half as much as that of the second. The supposition of a small inaccuracy in the weighing, or a small loss in the process of these experiments, will tend to reconcile them; where the error lay, in the first instance, I cannot pretend to guess. In the first experiment with the bark, the filtre caught fire while it was drying, and, although it was extinguished almost immediately, there must have

have been a lofs of fome grains from it. Notwithftanding the experiments do not perfectly accord, yet I think we may fairly deduce from them, provided the method of trial be not objected to, that half a peck of leaves contain nearly as much aftringent matter as one pound of bark. Oak-bark was fold in this neighbourhood, laft feafon, for five guineas a ton. In its marketable ftate, it is by no means fufficiently dry for prefervation; the tanners are obliged to dry it more perfectly; and, at a confiderable trouble and expence, they likewife get it cleaned from much extraneous matter. The lofs of weight, from thefe operations, cannot, I fhould fuppofe, be eftimated at lefs than twenty fhillings *per* ton: what I mean is, that if a ton of bark coft the tanner, in the firft purchafe, five guineas, the fame weight of bark, when properly dried and cleaned, will ftand him in fix pounds five fhillings; for the fake of eafier calculation, we will fay fix pounds. I have heretofore had oak-leaves collected for the purpofe of making hot-beds for melons, (for which they are excellent,) at three-pence and four-pence *per* fack, of four bufhels, or thirty-two half-pecks; which,

which, according to the conclusion above, are equal to thirty-two pounds of bark. Thirty-two pounds of bark, at six pounds *per* ton, come to one shilling and eight-pence halfpenny, and a fraction. If then my premises stand unimpeached, it will follow that the tanner might obtain as much astringent matter, in leaves, for four-pence, as costs him, in bark, five times that sum; whether it would equally answer his purpose, remains to be proved. There would be undoubtedly much trouble, and some expence, in drying the leaves, which would be necessary, in order to preserve them, and they would occupy much room. Perhaps, for these reasons, the most œconomical plan would be, to obtain a concentrated extract from them, on or near the place where they should be collected, which might be conveyed, and afterwards stored, in casks. This likewise remains as the subject of experiment; but, before leaves can in any way be legally used by the tanner, it is necessary that the act of parliament be repealed, which confines him to the use of ash and oak bark; this restriction was probably laid, not solely from the belief that those substances ftances were the moft proper for the purpofe of tanning leather, but likewife to encourage the planting and nurturing of thofe valuable timber-trees. Be this as it may, at prefent it rather operates to their deftruction than prefervation or increafe; fince the high price which oak-bark now bears proves an irrefiftible temptation, with needy proprietors, to cut down their oaks before they arrive at a proper age for timber. Should oak-leaves ever come into much requeft for tanning, it doubtlefs would prove an antidote to the rage for felling, and an effectual prefervative of timber; fince no one furely would ever think of felling his oaks prematurely, whilft they yielded him an annual profit by ftanding.

N. B. The vitriol was, in every cafe, fufficient to faturate the aftringent matter, and the quantity of falt of tartar fufficient for the acid.

LIV. Account of a violent Explofion which happened in the Flour-Warehoufe, at Turin, December the 14th, 1785; to which are added fome Obfervations on fpontaneous Inflammations; by Count Morozzo.

From the MEMOIRS of the ACADEMY OF SCIENCES of TURIN.

THE Academy having expreffed a defire to have a particular account of the explofion which I mentioned to them a few days after it happened, I have made all poffible hafte to fulfil their defires, by afcertaining, with the utmoft attention, all the circumftances of the fact, fo as to be able to relate it with the greateft exactnefs.

 I fhall

I ſhall take the liberty to add to it a ſhort account of ſeveral ſpontaneous inflammations, which have happened to different ſubſtances, and which have been the cauſe of very great misfortunes. Although the greater number of theſe phœnomena is already well known to philoſophers, I truſt the collecting them together in this place will not be diſpleaſing, as it is impoſſible to render too well known facts which ſo ſtrongly intereſt the public utility.

On the 14th of December, 1785, about ſix o'clock in the evening, there took place in the houſe of Mr. Giacomelli, baker in this city, an exploſion which threw down the windows, and window-frames of his ſhop, which looked into the ſtreet; the noiſe was as loud as that of a large cracker, and was heard at a conſiderable diſtance. At the moment of the exploſion, a very bright flame, which laſted only a few ſeconds, was ſeen in the ſhop; and it was immediately obſerved, that the inflammation proceeded from the flour-warehouſe, which was ſituated over the back ſhop, and where a boy was employed in ſtirring ſome flour by the light of a lamp. The boy had his face and arms ſcorched by the exploſion; his hair was burnt, and it was more than a fortnight before his burns were healed. He was not the only victim of this event; another boy, who happened to be upon a ſcaffold, in a little room on the other ſide of the warehouſe, ſeeing the flame, which had made its paſſage that way, and thinking the houſe was on fire, jumped down from the ſcaffold, and broke his leg.

In order to aſcertain in what manner this event took place, I examined, very narrowly, the warehouſes and its appendages; and, from that examination, and from the accounts of the witneſſes, I have endeavoured to collect all the circumſtances of the event, which I ſhall now deſcribe.

The flour-warehouſe, which is ſituated above the back ſhop, is ſix feet high, ſix feet wide, and about eight feet long. It is divided into two parts, by a wall; an arched cieling extends over both, but the pavement of one part is raiſed about two feet higher than that of the other. In the middle of the wall is an opening of communica-

tion,

tion, two feet and a half wide, and three feet high; through it the flour is conveyed from the upper chamber into the lower one.

The boy, who was employed, in the lower chamber, in collecting flour to fupply the bolter below, dug about the fides of the opening, in order to make the flour fall from the upper chamber into that in which he was; and, as he was digging, rather deeply, a fudden fall of a great quantity took place, followed by a thick cloud, which immediately caught fire, from the lamp hanging to the wall, and caufed the violent explofion here treated of.

The flame fhewed itfelf in two directions; it penetrated, by a little opening, from the upper chamber of the warehoufe, into a very fmall room above it, where, the door and window-frames being well clofed and very ftrong, it produced no explofion; here the poor boy, already mentioned, broke his leg. The greateft inflammation, on the contrary, took place in the fmall chamber, and, taking the direction of a fmall ftaircafe, which leads into the back fhop, caufed a violent ex-

 plofion,

plosion, which threw down the frames of the window which looked in the street. The baker himself, who happened then to be in his shop, saw the room all on fire some moments before he felt the shock of the explosion.

The warehouse, at the time of the accident, contained about three hundred sacks of flour.

Suspecting that this flour might have been laid up in the warehouse in a damp state, I thought it right to enquire into that circumstance. I found, upon examination, that it was perfectly dry; there was no appearance of fermentation in it, nor was there any sensible heat.

The baker told me that he had never had flour so dry as in that year (1785), during which the weather had been remarkably dry, there having been no rain in Piedmont for the space of five or six months: indeed, he attributed the accident which had happened in his warehouse to the extraordinary dryness of the corn.

The phænomenon, however striking at the time it happened, was not entirely new to the baker, who told me that he had, when he was a boy, witnessed

witneſſed a ſimilar inflammation; it took place in a flour-warehouſe, where they were pouring flour through a long wooden trough, into a bolter, while there was a light on one ſide; but, in this caſe, the inflammation was not followed by an exploſion.

He mentioned to me ſeveral other inſtances, which I thought it my duty to enquire into; amongſt them, one which had happened to the widow Ricciardi, baker in this city, where (there being, on the other ſide of the wall of the flour-warehouſe, a lock-ſmith's forge) the flour was heated to ſuch a degree, that a boy who went into the warehouſe could not remain there, ſo much were his feet ſcorched by the heat; this flour was of a dark brown colour, and, whilſt the people were examining it, ſparks began to appear, and fire ſpread itſelf around, without producing any flame, like a true *pyrophorus* *.

He

* I was very anxious to aſcertain by experiments, whether it were poſſible to bring flour alone into the ſtate of pyrophorus, but it was in vain; for, though I calcined flour with a ſtrong heat, in a ſmall retort, with the ſame precau-

tions

He alſo informed me, that an inflammation like that above-mentioned had happened at the houſe of a baker in this city, called Joſeph Lambert; it was occaſioned by ſhaking ſome large ſacks, which had been filled with flour, near a lighted lamp, but the flame, though pretty briſk, did not do any miſchief.

According to the foregoing accounts, it appears to me, that it is not difficult to explain the phænomenon in queſtion. The following is the idea I have conceived of it: as the flour fell down, a great quantity of inflammable air, which had been confined in its interſtices, was ſet free; this, riſing up, was inflamed by the contact of the light; and, mixing immediately with a ſufficient quantity of atmoſpheric air, the exploſion took place on that ſide where there was the leaſt reſiſtance. As to the burning of the hair, and the ſkin, of the boy who was in the warehouſe, the cauſe of it

tios as are uſed in making other *pyrophori*, I never could ſucceed in making it take fire by expoſure to the air. By joining alum with it I obtained a true pyrophorus, as Lemery had already done.

muſt

muſt be attributed to the fire of the fine particles of the flour, which, floating in the atmoſphere, were kindled by the inflammable air, in the ſame manner as the powder from the ſtamina of certain vegetables, (particularly of the pine, and of ſome moſſes,) when thrown into the air, takes fire if any light is applied to it.

But it may be objected, that as the flour was not at all damp, and had not any ſenſible degree of heat, there ſhould not be any fermentation in it, and conſequently no inflammable air ſhould be produced: to this I anſwer:

Firſt. That flour is never entirely free from humidity, as is evidently ſhewn by diſtillation.

Secondly. That although the degree of heat was not ſo great as to ſet free inflammable air by fermentation, a ſufficient quantity was ſet free, by what may be called a mechanical mean, to inflame upon the contact of light; and to diſengage, at the ſame time, all that which communicated with the atmoſpheric air.

Thirdly. We muſt recollect that flour alſo furniſhes alkaline inflammable air, which is produced from the glutinous vegeto-animal part of the corn: and we know that this kind of inflammable air is of a very active nature.

After having defcribed this fingular event, I fhall beg leave to collect together, in this place, all the known facts refpecting fpontaneous inflammations produced by different fubftances. A circumftantial account of thefe phænomena cannot but be very interefting to thofe concerned in government; not only as it may tend to prevent the unhappy accidents which refult from them, but alfo as it may fometimes hinder the fufpicion and perfecution of innocent perfons, on account of events which are produced merely by natural caufes.

I fhall not mention the inflammations caufed by lightning, by fubterraneous fires, and by other meteors; they are not of the nature of thofe of which I mean to fpeak, but I fhall not pafs over in filence the fpontaneous combuftions of human bodies. Though events of this kind are very rare, yet we have fome examples of them recorded in the Philofophical Tranfactions, and in the memoirs of the academies of Paris and of Copenhagen.

gen. It is there related, that an Italian lady (the Counteſs Cornelia Bandi) was entirely reduced to aſhes, except her legs; that an Engliſh woman, called Grace Pitt, was almoſt entirely conſumed by a ſpontaneous inflammation of her viſcera; and, laſtly, that a prieſt of Bergamo was conſumed in the ſame manner. Theſe ſpontaneous inflammations have been attributed to the abuſe of ſpirituous liquors; but, though the victims of intemperance are indeed very numerous, theſe certainly do not belong to that number.

The ſpontaneous inflammation of eſſential oils, and that of ſome fat oils, when mixed with nitrous acid, are well known to philoſophers; ſo alſo is that of powdered charcoal with the ſame acid; (lately diſcovered by M. Prouſt;) and thoſe of phoſphorus, of pyrophorus, and of fulminating gold. Theſe ſubſtances are generally to be found only in the laboratories of chemiſts, who are perfectly well acquainted with the precautions which it is neceſſary to take, to prevent the unhappy accidents which may be occaſioned by them.

The conflagration of a frigate, belonging to the Empreſs of Ruſſia, in the harbour of Cron-

 ſtadt,

ſtadt, on-board of which there had been no fire, ſhews that lamp-black, by being moiſtened with hemp-ſeed oil, is capable of producing flame; this was proved by the experiments which the Academy of Peterſburgh made upon the ſubject, by order of the Empreſs; and, though the gentlemen of the academy could not ſucceed in producing inflammation in hemp or cordage, by wetting them with the forementioned oil, it is ſtill very probable that the terrible fire which happened in the great magazine of cordage at Peterſburgh was occaſioned by the ſpontaneous inflammation of theſe ſubſtances; and alſo that which happened at Rochefort in the year 1756.

The burning of a ſtore-houſe of ſails, which happened at Breſt, in the year 1757, was cauſed by the ſpontaneous inflammation of ſome oiled cloths, which, after having been painted on one ſide, and dried in the ſun, were ſtowed away while yet warm, as was ſhewn by ſubſequent experiments *.

Vegetables boiled in oil or fat, and left to themſelves, after having been preſſed, inflame in

* See *Mémoires de l' Académie de Paris.* 1760.

the

the open air. This inflammation always takes place when the vegetables retain a certain degree of humidity; if they are firſt thoroughly dried, they are reduced to aſhes, without the appearance of flame. We owe the obſervation of theſe facts to MM. Saladin and Carette *.

The heaps of linen rags which are thrown together in paper manufactories, the preparation of which is haſtened by means of fermentation, often take fire if not carefully attended to.

The ſpontaneous inflammation of hay has been known for many centuries; by its means, houſes, barns, &c. have been often reduced to aſhes. When the hay is laid up damp, the inflammation often happens; for, the fermentation is then very great. This accident very ſeldom occurs to the firſt hay, (according to the obſervation of M. de Bomare,) but is much more common to the ſecond; and if, through inattention, a piece of iron ſhould be left in a ſtack of hay in fermentation, the inflammation of that ſtack is almoſt a

* *Journal de Phiſique.* 1784.

certain consequence. On this subject, an excellent memoir of M. Sennebier * may be consulted. Corn, heaped up, has also sometimes produced inflammations of this nature; Vanieri, in his *Prædium rusticum*, says,

Quæ vero (gramina) nondum satis insolata recondens
Imprudens, subitis pariunt incendia flammis.

Dung also, under certain circumstances, inflames spontaneously.

We have likewise examples of spontaneous inflammations in the productions of the animal kingdom. Pieces of woollen cloth, which had not been scoured, took fire in a warehouse. The same thing happened to some heaps of woollen yarn; and some pieces of cloth took fire in the road, as they were going to the fuller. These inflammations always took place where the matters heaped up preserve a certain degree of humidity, which is necessary to excite a fermentation; the heat resulting from which, by drying the oil, leads them

* *Journal de Physique.* 1781.

in-

infenfibly to a ftate of ignition; and the quality of the oil, being more or lefs deficcative, very much contributes thereto.

The mineral kingdom alfo often affords inftances of fpontaneous inflammation. Pyrites heated up, if wetted and expofed to the air, take fire. Pit-coal alfo, laid in heaps, under certain circumftances, inflames fpontaneoufly. M. Duhamel has defcribed two inflammations of this nature, which happened in the magazines of Breft, in the years 1741 and 1757 *.

Boats loaded with quick lime have taken fire as they failed along; and lime, by being wetted, has often fet fire to fubftances which happened to be near it.

Cuttings of iron, which had been left in water, and were afterwards expofed to the open air, gave fparks, and fet fire to the neighbouring bodies. For this obfervation we are obliged to M. de Charpentier.

The explofion of a powder-mill, which happened in the year 1784, in the royal manufactory

* *Mémoires de l' Académie.*

of

of Turin, the caufe of which could not be dif-covered, may perhaps have been occafioned by the fpontaneous inflammation of the ingredients of which gunpowder is made, as Count de Saluces fufpected. I do not however deny the poffibility of its having been caufed by the meteor which was fuppofed to have been the occafion of it; for, there is a kind of hepatic air continually arifing from thofe ingredients, when wetted with water, and the leaft flame is fufficient to kindle this aëri-form vapour.

It is very evident, from the facts which I have related, that, fpontaneous inflammations being very frequent, and their caufes very various, too much attention and vigilance cannot be ufed to prevent their dreadful effects. And confequently it is impoffible to be too careful in watching over public magazines and ftorehoufes, particularly thofe belonging to the ordnance, or thofe in which are kept hemp, cordage, lamp-black, pitch, tar, oiled cloths, &c. which fubftances ought never to be left heaped up, particularly if they have any moifture in them. In order to pre-

vent

vent any accident from them, it would be proper to examine them often, to take notice if any heat is to be obferved in them, and, in that cafe, to apply a remedy immediately. Thefe examinations fhould be made by day, it not being advifable to carry a light into the magazines, for, when the fermentation is fufficiently advanced, the vapours which are difengaged by it are in an inflammable ftate, and the approach of a light might, by their means, fet fire to the fubftances whence they proceed.

Subftances in fermentation are very often unable to inflame of themfelves, but the fimple contact of flame is fufficient to kindle them rapidly, as many examples demonftrate; fo that we might make a feparate clafs of thofe fubftances in which inflammation cannot take place of itfelf, but which are fet on fire by the approach of flame; of this we have an example in the accident which happened in the flour-warehoufe.

Ignorance of the fore-mentioned circumftances, and a culpable negligence of thofe precautions which ought to be taken, have often caufed more misfortunes and loſs than the moſt contriving malice: it is therefore of great importance that theſe facts ſhould be univerſally known, that public utility may reap from them every poſſible advantage.

In addition to the foregoing paper, we think it proper to obſerve (what the author of it appears not to have known) that the lamp-black which occaſioned the burning of the Ruſſian frigate, mentioned in p. 425, was of a *vegetable* kind, prepared from the ſmoke of fir, or other reſinous vegetables. It appeared, by ſubſequent experiments, made in London, that a mixture of oil and *animal* lamp-black, ſuch as is commonly uſed here, would not take fire ſpontaneouſly; whereas, a ſimilar mixture, made with the fore-mentioned vegetable lamp-black, ſome of which was procured from Ruſſia, for the ſake of experiment, never failed to inflame and to burn with great violence.

END OF VOL. II.

INDEX

TO THE

SECOND VOLUME.

A

Page

AID, oxygenated muriatic. On the method of bleaching with it, - - - - 354

——— *vitriolic*, its use in purifying water, - 64

Adrianople red, process for dying, - - 202. 249

Alkali, fossil. Patent for separating it from common salt, 14

Alum. On making it from its constituent principles, 134. 208

Anderson, James, LL. D. Method of bringing boats from one canal into another, - - 21

——————— Description of an implement for taking levels for watering ground, - 317

Animal substances, patent for preserving, - 1

Animals. Patent for applying them to machinery, - 361

Ants, water for destroying, - - - 285

Attar of roses, process of making, - - 187

Austin, The Rev. Gilbert. Method of cutting very fine screws, - - - - 399

Page

B

Barclay, *Mr. Robert*. Patent for making printing types, &c. which cannot be counterfeited, - - 4
Basins, patent for making, for filtering water, &c. - 230
Batson, *Robert*, *Esq*. On the dry rot in timber, - 112
Belfour, *Mr. John Daniel*. Patent for a machine for making ropes and cordage, - - 145
Berthollet, *M*. Analysis of wool, silk, and cotton, - 56
——— Addition to the method of bleaching cloths and thread, - - - 354
Blagden, *Charles*, *M.D*. On ancient inks, and on recovering the legibility of decayed writings, - 389
Bleaching cloths and thread. Addition to the former account of, - - - - 354
Boats. Method of bringing them from one canal into another, - - - - - 21
Bramah, *Mr. Joseph*. Patent for an engine on a rotative principle, - - - - 73
Browne, *Mr. Henry*. Description of a furnace for drying salts, &c. - - - - 36

C

Cadet, *M*. Process to deprive treacle of its disagreeable taste, - - - - 215
Calves. On the method of castrating them, - 101. 104
Canals. Method of bringing boats from one into another, 21
——— Patent for a machine for conveying vessels from one to another, - - - 235
Carding machines. Improvement in mills which move them, - - - - 19
Casks, cement for lining, - - - 141
Cast-steel. Patent for making edge-tools from it and iron united, - - - - 368
Caterpillars, water for destroying, - - 285

Page
Cattle mills, improvement in, - - - 19
Cement, compofition of, for lining cafks, &c. - 141
Chaptal, M. On making alum from its conftituent principles, - - - 134. 208
Character, univerfal, propofal for, - - 307
Charcoal. Its ufe in purifying water, - - 64
——— Its ufe in depriving treacle of its difagreeable tafte, 215
Charnock, John, Efq. Defcription of a fea-gage for founding in currents, &c. - - 180
Cinders. Their ufe in purifying water, - - 72
Clark, Mr. John. On the gut-tie in oxen and calves, 98
Cloth hangings refembling damafk, lace, &c. patent for 87
Cordage, patent for making, - - - 145
Cotton. On dying it, - - 41. 116. 192. 249
——— Analyfis of, - - - 56. 57
Cranes. Improvement propofed in their conftruction, 312
Cunningham, Mr. William. Patent for preparings rags for making paper, - - - 222

D

Dendrometer. Idea of an inftrument fo called, - 238
Dickinfon, Mr. Thomas. Patent for an engine on a rotative principle, - - - 73
Diftances, inftrument for meafuring, - - 238
Donaldfon, Mr. John. Patent for preferving animal and vegetable fubftances, - - 1
Dry rot in timber, obfervations on, - - 112
Dying, confiderations on, - - 41. 116. 192. 249

E

Eckhardt, Mr. Anthony George. Patent for applying animals to machinery in general, - - 361
——— *Mr. Francis Frederick*. Patent for cloth-hangings refembling damafk, lace, &c. - - 87

Page

Eckhardt, Mr. Francis Frederick. Patent for paper-hangings, reſembling damaſk, lace, &c. - 90
Edge-tools. Patent for making them from caſt-ſteel and iron united, - - - - 368
Eggs. Patent for preſerving them, - - 177
Egyptians. Remarks on their art of dying, - 43
Engine. Patent for one on a rotative principle, - 73
Evaporator, deſcription of, - - - 36
Exploſion. Account of one in a flour-warehouſe, - 416

F

Filtering-veſſels, patent for making, - - 230
Fleet, Mr. Thomas. Patent for preventing the rot in ſheep, 305
Flour-warehouſe. Account of an explosion in one, - 416
Furnace. Deſcription of one for drying ſalts, &c. - 36

G

Gibbes, George Smith, B. A. On the converſion of animal muſcle into a ſubſtance reſembling ſpermaceti, 105
Glenny, George, Eſq. Patent for obtaining from wood aſhes a greater quantity than uſual of pot and pearl aſhes, - - - - 178
Gunpowder, obſervations on, - - 276. 320
Gut-tie. On the method of preventing and curing it, in calves and oxen, - - - 98

H

Hangings reſembling damaſk, lace, &c. Patents for, 87. 90
Harris, Mr. Joſeph. Method of preventing and curing the gut-tie in calves and oxen, - - 98
Hawkſley and Wright, Meſſrs. Patent for a machine for combing and preparing wool, - - 217
Hay. Remarks on its ſpontaneous inflammation, - 427

Hempel,

Page

Hempel, Mrs. Johanna. Patent for making veſſels for filtering water, &c. - - 230

Henry, Mr. Thomas. Conſiderations on wool, ſilk, and cotton, as objects of the art of dying, 41. 116. 192. 249

Higgins, Bryan, M. D. Patent for a water cement, or ſtucco, for plaſtering walls, &c. - 289

Hodſon, Mr. George. Patent for ſeparating foſſil alkali from common ſalt, - - 14

Hooper, Mr. Samuel. Patent for manufacturing leather and paper from leather-cuttings, &c. - 371

Horſes. Deſcription of a ſpring-ſtaple, to prevent their being caſt in the halter, - - 17

I

Inflammations, ſpontaneous, obſervations on, - 416

Inks. On ancient ones, &c. - - 389

Inſects. Water for deſtroying them, - - 285

J

Jayne, Mr. William. Patent for preſerving eggs, - 177

K

Kelp. Patent for ſeparating foſſil alkali from it, - 14

L

Lamp-black. Remarks on its ſpontaneous inflammation, 432

Leather. Improved method of tanning it, 341. 382

——. Patent for making, from leather-cuttings, &c. 371

Leſlie, Mr. Robert. Deſcription of a ſhort pendulum, and of a nautical watch, - - 92

Levels for watering ground, implement for taking, 317

Locks. Method of avoiding them in canals, - 21

Lowe, Robert, Eſq. On the cultivation of willows, 376

Lowitz, Mr. On the purification of corrupted water, 61

M

Page
Macbride, David, M. D. Improved method of tanning leather, - - - - 341. 382
Machine. Patent for one on a rotative principle, - 73
——— for conveying vessels from one canal to another, 235
Machinery, patent for, for combing wool, &c. - 216
——— patent for applying animals to, - 361
Mills. Improvement in them, - - 19
Monro, Donald, M. D. Method of making otter of roses, 185
Mordants, remarks on, - - - 133
Morozzo, Count. Account of an explosion in a flour-warehouse at Turin, &c. - - - 416
Muscle, animal. On its conversion into a substance resembling spermaceti, - - 105

N

Napier, The Honourable George. Observations on gunpowder, - - - 276. 320
Neuman. Analysis of wool, silk, and cotton, - 55
Northmore, Thomas, Esq. Proposal for an universal character, or pangraph, - - 307

O

Oak-leaves. On their use in tanning, - 406
Oils. Patent for preparing them for making hard soap, 8
Otter of roses, method of making, - - 185
Oxen. Method of curing the gut-tie in them, - 100

P

Pangraph. Proposal for, - - - 307
Paper. Patent for preparing rags for making it, - 222
——— Patent for making, from leather-cuttings, &c. 371
——— *hangings* resembling damask, lace, &c. Patent for, 90
Pearl-ashes. Patent for obtaining them in greater quantity, 178

Page

Pendulum. Description of a short one, - 92
Pitt, William, Esq. Idea of a dendrometer, or instrument for measuring distances, - 238
Polier, Lieutenant Colonel. Process of making attar of roses, 187
Pot-ashes. Patent for obtaining them in greater quantity, 178
Preserving animal and vegetable substances, patent for, 1
Printing types. Patent for making such as cannot be counterfeited, - - - 4
Pugh, Mr. Samuel. Patent for preparing oils for making hard soap, - - - 8
Pump. Patent for one on a new construction, - 301

R

Rags. Patent for preparing them for making paper, 222
Red, Adrianople or Turkey, process for dying, 202. 249
Rooms. Cement for lining them, - - 141
Ropes, patent for a machine for making, - - 145
Roses, otter or attar of, process for, - - 185. 187
Rot in sheep, patent for preventing, - - 305
— *dry* in timber, observations on, - - 112

S

Salt. Patent for separating fossil alkali from it, - 14
Salts. Furnace for drying them, - - 36
Screws. Method of cutting very fine ones, - 399
Sea-gage, for sounding in currents, &c. - 180
Sheep, patent for preventing the rot in them, - 305
Silk. On dying it, - - 41. 116. 192. 249
—— analysis of, - - - 55. 56
Skeys, Mr. John. Patent for a pump on a new construction, 301
Soap, hard. Patent for preparing oils for making it, 8
Sounding in currents, &c. Machine for, - 180
Spermaceti. On the conversion of animal muscle into a substance resembling it, - - 105

Page

Staple. Defcription of one to prevent horfes being caft in the halter, - - - 17

Stucco for plaftering walls, &c. Patent for, - 289

Swayne, the Rev. George. On the ufe of oak-leaves in tanning, 406

T

Tanning, improved method of, - - 341. 382

——— on the ufe of oak-leaves in, - 406

Tatin, C. Compofition of a water for deftroying infects, 285

Timber. On the dry-rot in it, - - 112

Treacle. Procefs to deprive it of its difagreeable tafte, 215

Turkey red, procefs for dying, - - 202. 249

Types. Patent for making fuch as cannot be counterfeited, 4

V

Vegetable fubftances, patent for preferving, - 1

W

Watch, nautical, defcription of, - - 94

Water. Patent for making veffels for filtering it, 230

——— for deftroying infects, - - 285

——— *corrupted*, on the purification of, - 6.

Water-cement for plaftering walls, &c. patent for, 289

Watering ground, implement for taking levels for, - 317

Weldon, Mr. Robert. Patent for a machine for conveying veffels, &c. from one canal to another, - 235

Wilde, Mr. Arnold. Patent for making edge-tools from caft-fteel and iron united, - - 368

Willows. On the cultivation of them, - 376

Wool. On dying it, - - 41. 116. 192. 249

——— analyfis of, - - - 55. 57

——— Patent for machinery for combing and preparing it, 217

Worm. Propofed to be ufed in cranes, - 312

Wright and Hawkfley, Meffrs. Patent for machinery for combing and preparing wool, &c. - 217

Writings, on recovering the legibility of decayed ones, 389