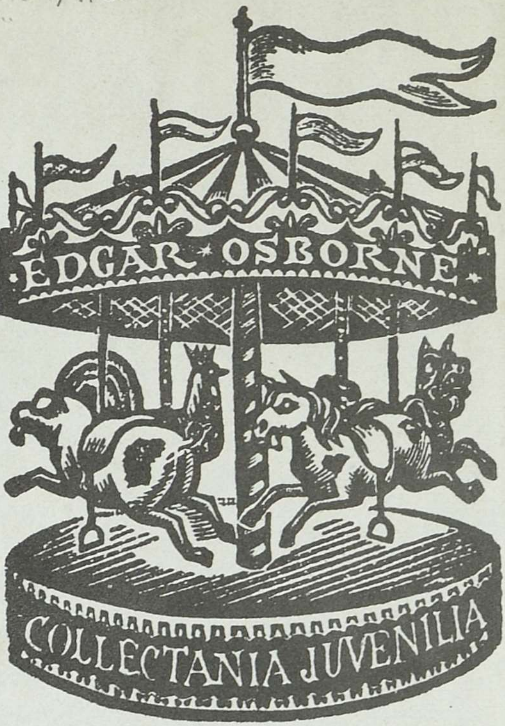
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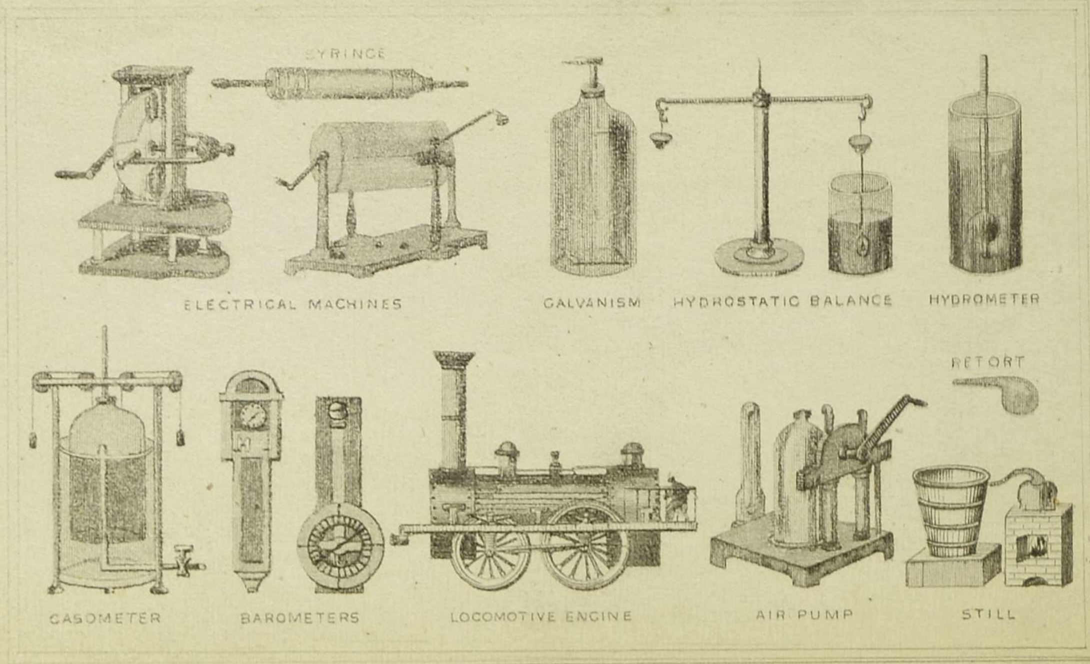

SYRINGE
ELECTRICAL MACHINES
GALVANISM
HYDROSTATIC BALANCE
HYDROMETER
RETORT
GASOMETER
BAROMETERS
LOCOMOTIVE ENGINE
AIR PUMP
STILL

THE NEW CABINET OF ARTS:

A SERIES OF

ENTERTAINING EXPERIMENTS

IN

VARIOUS BRANCHES OF SCIENCE,

NUMEROUS VALUABLE RECIPES,

AND

USEFUL FACTS;

COMPILED FROM AUTHENTIC SOURCES.

BY T. C. THORNTON.

LONDON:

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CONTENTS.

THE CABINET OF ARTS.

ON THE SUGAR CANE.

This plant has been considered by some historians to be originally a native of the East Indies; others have asserted that it is likewise a native of the islands and continent of America. With respect to my knowledge of it, I certainly am inclined to the West Indies. Without doubt it claims an eminent rank in the system of botany. For luxuriance, and general usefulness, it has I think, the pre-eminence of every foreign plant; and God himself it appears, would have condescended to receive the oblation of it, had the Israelites had generosity sufficient to have offered it in his worship; their illiberality is severely censured by the prophet Isaiah, chap. xliii. 24. "Thou hast brought me no sweet cane with money;" and their hypocrisy, by Jeremiah, even when they brought this oblation, Jer, vi. 23. "To what purpose cometh there to me incense from Sheba? and the sweet cane from a far country? your burnt-offerings are not acceptable, nor your sacrifices sweet unto me."

The sugar cane is a plant that comes to maturity in ten or twelve months, and it will produce a second and third crop from the old roots the succeeding years, without any material cultivation; but the crops are not a fourth part equal to the first. Hence, in order to procure a profitable crop, it requires to be re-planted every year, and, in order to render it very productive, it is necessary that the land be deeply harrowed, and richly manured. The general height of the cane including the top, is about ten feet, though sometimes considerably taller. A large field of well grown sugar cane, affords a beautiful prospect to the eye, especially if wafted to and fro with a moderate breeze; it is a striking representation of the majestic sea, when agitated to a degree of grandeur, and boisterous. The commonly received opinion in reference to sugar, is, that the cane is hollow and that the sugar in a matured state, is literally taken out of the inside of it. But this is a gross error. The process to produce sugar, manifests much ingenuity, and to manufacture it with considerable success, is an art that requires great and assiduous attention, and considerable experience. I have already observed, that the cane may be reckoned about ten feet high, three feet and a half, which constitutes the top, consisting of leaves, are taken off. The edges of these leaves are finely serrated, and terminate in an arrow, decorated with a fine downy brush. The top which is taken off, makes excellent fodder for horses and cattle. The parts intended for sugar, are cut down, tied in bundles, and carried in carts to the mills, where they are bruised, and the juice is extracted from them. These mills are, necessarily, very large and strong, for it requires considerable force to press the juice from the cane.

The mills consist principally of upright iron plated rollers, or cylinders, from thirty to forty inches in length, and from twenty to twenty five inches in diameter; and the middle one, to which the moving power is applied, turns the other two by means of cogs. Between these rollers the canes are compressed, and the juice extracted. The juice, which has a sweet taste, is a little thicker than apple juice. A common cart load, tolerably well packed will produce about one hundred and twenty gallons of liquor. The juice, as it flows from the mill, is supposed to contain eight parts of pure water, one part of sugar, and one part consisting of coarse oil and mucilaginous gum, with a portion of essential oil. Proper cisterns are provided to receive the liquor from the mill, and from thence it is conveyed by pipes, to the boiling house, to a large range of copper containing five or six hundred gallons. It is necessary to put about a pint of Bristol quick lime powder to every hundred gallons of liquor, to unite with the superabundant acid, which, for the success of the process, it is necessary to get rid of. After simmering in this copper for about an hour, under a slow fire, the fire is withdrawn, the liquor remaining undisturbed, till the scum naturally rises to the top, and a degree of sediment falls to the bottom; it is then drawn off, and conveyed to smaller coppers, under which a perpetual fire is kept up, and where two men are employed to take off the scum, as fast as it rises, till it be properly clarified. From thence it is conveyed to three smaller coppers, called teaces, in the last of which by going on the fire, it is brought to a proper consistency to be removed. It is then poured from the copper teace, into large shallow coolers, either made of wood or copper, about eleven or twelve inches deep. The sugar, remains in those coolers a shorter or longer time, according to the kind for which it is intended. If it be intended for clayed, or white sugar, it is put into an earthen mould (the form of a loaf of sugar) about an hour after it is taken off from the fire.

The brown sugar is cured and fit for exportation in eight or ten days after it is made; but the clayed sugar will take near three months before it is fit to be exported. It is worthy of notice that nothing is lost in a sugar cane. The sugar itself is a luxury, which we are all well acquainted with, and so palatable, salutary, and nourishing is the juice of the cane, that the good effects of it are soon visible in the poor negroes; many that were poor and meagre before the sugar crop began, soon revive, and become healthy when the crop begins to be taken; and it is surprising what a quantity of juice they will drink at a time, which they are not prevented from, unless their master be a complete tyrant. The cane, after the juice is extracted, makes excellent fuel for boiling the sugar, the green top of the cane, fodder for horses and cattle, the dry blades, or leaves, litter for the stable, the ashes make very good maure, and the scum, and all the washings of the various apparatus assist in the distillery for rum.

TO LAY ON GOLD IN ORDER FOR BURNISHING.

Let your frame, or other matter intended, be set on an eazle, place the gold leaf on a cushion, to be held in your left hand with the pallet and pencil. You must for this work have a swan's quill pencil, or a larger of camel's hair, if the work require it, dip it in water, and wet no more of your frame at a time than will take three or four leaves, make your beginning at the lower end, and so proceed upward, laying on whole leaves, or half ones as it requires; then wet such another part of your work, and lay on the gold with your pencil, or cotton, gently pressing it very close; and having gilded the upright sides, turn the frame, and proceed the same way with the ends, then survey the spots and places that are omitted, and cut small parts of gold to cover them, when wetted, with a smaller pencil than before; when it is so finished, let it stand twenty-four hours after you leave off.

TO BURNISH GOLD WORK.

Take a wolf or dog's tooth, if you cannot get pebbles formed in the same shapes, and burnish so much of the work as you design, leaving the ground of the carving untouched, and some other parts, as you see most convenient, which, in respect of burnishing, being rough, the better sets it off; that which is omitted to be burnished must be matted, or secured with seed lac varnish, or lacker; if you design it a deeper colour, then must your work be repossest, or set off with lacquer, mixed with saffron and dragon's blood, or the colour called annatto, and with a fine pencil dipped therein touch the hollowness of the carving, and the veins of the foldage or leaves; if you fancy it is not deep enough, you may by repetition cause it to be so, and it isdone.

TO LAY ON SILVER SIZE.

Warm the silver size, that is newly ground and mingled with weak size, do it once or twice, and let it dry, and try the silver leaf, if it will burnish on it, it is prepared for use, but if it will not, make an alteration in the size, and for the rest lay on the leaf silver, and do as you did by the gold, and it will answer.

Note, as farther rules, and observe them.

1. Let your parchment size be somewhat strong, keep it not long, lest it spoil.

2. Grind no more silver or gold size than just what you have occasion for.

3. Ever keep your work clean from dust, after it is sized and gilded, or else in the burnishing it will be full of scratches.

4. Do not whiten or burnish gold size in hard frosty weather, for then the whiting will be apt to peel off, and the gold straw.

TO STAIN WOOD, IVORY, BONE, ETC., DIFFERENT COLOURS.

TO DYE WOOD A CURIOUS RED.

The wood that takes this colour must be very white, and to begin it put a handful of alum in a moderate kettle of water, and cast your wood in it, and when well soaked, take it out, and put in two handsful of rasped Brazil wood, and when that has boiled well, put the wood in again for a quarter of an hour's boiling, and it will take the colour.

TO STAIN A CURIOUS YELLOW.

In this case, get the knotty ash or bur, that is very white, knotty and curled, smooth and rush it very well, and when it is well armed, wash it over with a brush dipped in aqua fortis, then hold it to the fire till it ceases smoking. Rush it again when dry, then polish it and varnish it with seed lac, and it will be a curious colour, not inferior to any out-landish wood; and if you put filings or bits of metal, as copper, brass, &c., each metal will produce a different incture.

TO STAIN BLACK WOOD.

Boil logwood in water or vinegar, and two or three times brush or stain your wood with it when very hot; then get nut galls and copperas, bruise them well, and boil them in water, and with it wash or stain your wood so often, till it be perfect black; or rather steep it in hot liquor, if you can put it in, and the dye will penetrate the better.

TO DYE WOODS FOR INLAYING FLOWERS.

Get moist new horse dung, and squeeze out the moisture through a cloth, put it into several small vessels, fit for your purpose, and dissolve gum arabic and rock alum, each the quantity of a walnut, and with these mix reds, greens, blue, or any other colour that is suitable to the work, stir them often three or four days, then get your wood, particularly pear tree for white, cut it into the thickness of half crowns, or so much as will suffice any inlaid work, and in a square or length, according to your desire, boil up the liquors or colours very hot, and put in the wood till the colour has taken well; some indeed take out sooner, that the colour being less strong, may agree with your party-coloured flowers, shading, &c.

TO STAIN IVORY, BONE, OR HORN, RED.

Soak some lime about twelve hours in fair rain water, then pour off the water from the settling through a linen cloth, and to each pint put half an ounce of rasped Brazil wood, and having boiled your materials in alum water, boil it in this, and it will give a curious tincture.

TO STAIN HORN, BONE, WOOD, OR IVORY GREEN.

Prepare your materials by first boiling in alum water, then grind the common thick verdigris, or Spanish green, a moderate quantity, adding half as much sal ammoniac, and put them into the sharpest wine vinegar, as also the materials you intend to stain, and let them stay there till they have a good tincture.

ON STAINING PAPER, PARCHMENT, ETC.

TO STAIN PAPER, &c., YELLOW.

Paper may be stained yellow by the tincture of French berries; but a much more beautiful colour may be obtained by using the tincture of turmeric, formed by infusing an ounce or more of the root of it, powdered, in a pint of spirit of wine. This may be made to give any tint of yellow, from the lightest straw, to the full colour called French yellow; and will be equal in brightness even to the best yellow died silks. If yellow be wanted of a warmer or redder cast, annatto, or dragon's blood, must be added to the tincture.

The best manner of using these, and the following tinctures, is to spread them even on the former, or parchment, by means of a broad brush in the manner of varnishing.

Paper, or parchment, may be stained red by treating it in the same manner as is directed for wood, or by red ink. It may also be stained of a scarlet hue by the tincture of dragon's blood in spirits of wine; but this will not be bright.

A very fine crimson stain may be given to paper, by a tincture of the Indian lake; which may be made by infusing the lake some days in spirits of wine; and then pouring the tincture from the dregs.

TO STAIN PAPER OR PARCHMENT GREEN.

Paper, or parchment, may be stained green, by the solution of verdigrease in vinegar; or by the crystals of verdigrease dissolved in water. As also by the solution of copper in aqua fortis, made by adding filings of copper gradually to the aqua fortis, till no ebullition ensues ; or spirit of salt may be used in the place of the aqua fortis.

TO STAIN PAPER OR PARCHMENT ORANGE.

Stain the paper or parchment, first of a dull yellow, by means of the tincture of turmeric, as before directed Then brush it over with a solution of flat alkaline salt, made by dissolving half an ounce of pearl ashes, or salt of tartar, in a quart of water, and filtering the solution.

TO STAIN PAPER OR PARCHMENT PURPLE.

Paper or parchment may be stained purple, by archal; or by the tincture of logwood, according to the method directed above for staining wood. The juice of ripe privet berries pressed will likewise give a purple dye on paper or parchment.

TO PUT A CURIOUS BLACK ON LEATHER.

Take two pounds of the inward bark of old elder, the same quantity of the rush or filings of iron, put these into two gallons of rain water, and close them tight up in a vessel, and when they have stood about six weeks, put in a pound of nutgalls, well bruised, a quarter of a pound of copperas, let them simmer a considerable time over a fire, and after twenty four hours standing, and often stirring, pour on the liquid part, and go over the leather with it warm, and it produces a curious German black.

FOR A VELVET CRIMSON.

Dissolve cake soap in fair water and bold ammoniac, each three ounces, place it over a gentle fire till the liquor grows clammy; then put in a little handful of grains of cochineal, two ounces of red lead, an ounce of lake, a a quarter of an ounce of vermillion, and a little piece of indigo, beat these over a gentle fire till they are thick as the glair of an egg; then go over the skin with a soft brush dipt in it, till the colour arises to your mind.

TO IMITATE TURKEY BLUE.

Take two ounces of smalt, a quarter of a pint of red wine, half a pint of vinegar, an ounce of white starch; incorporate these over a fire till they become of a moderate thickness, then steep the skin in alum water, add to the composition a pint of water wherein gum arabic has been dissolved, and stir it well; go over the skins three times, drying them 'twixt whiles, so when well dried, polish them over, to make them glossy.

MAHOGANY COLOURED CEMENT.

Melt together two ounces of bees wax, half an ounce of India red, and a small quantity of yellow ochre, to bring it to a proper colour.

CEMENT FOR METALS.

Take of gum mastic ten grains, rectified spirit of wine two drachms; add two ounces of strong isinglass glue made with spirit, and ten grains of gum ammoniac; dissolve all together, and keep it stopped in a phial. When intended to be used, set it in warm water.

TO MAKE GUNPOWDER.

There is a considerable difference in the composition of the gunpowder of different nations. The government powder of this country is the same for cannon as for small arms; the difference is only in the size of the grain. Gunpowder may be made in the following manner:—Take seventy five parts by weight, of nitre, fifteen of charcoal, and ten of sulphur: let these articles be reduced to a fine powder; then mix them thoroughly together, and form them into a stiff paste with a little water; when this has been done, press the mass, after it is a little dry, through a hair sieve, to cut it into irregular grains, of such a size as may be wanted, and suffer the grains to dry; the powder may then be sorted and separated from the dust by sieves of progressive perforations; and, lastly, dry it thoroughly in a warm place. The power of this powder will depend greatly on the intimate mixture of the ingredients, particularly on the equal diffusion of the nitre ; the more finely it is divided, and intimately blended with the sulphur and charcoal, the more instantaneous will be the combustion, and the expansive force greatly augmented.

TO CAUSE WATER TO BOIL BY THE APPLICATION OF COLD, AND TO CEASE TO BOIL BY THE APPPLICATION OF HEAT.

Half fill a Florence flask with water, place it over a lamp furnace, and let it boil briskly for a few minutes ; then cork the flask as expeditiously as possible, and tie a slip of moist bladder over the cork to exclude the air; the water, being now removed from the lamp, will keep boiling, and when the ebullition ceases, the boiling may be renewed by wrapping round the empty part of the flask a cloth wetted with cold water ; but if hot water be applied, the boiling instantly ceases ; in this manner ebullition may be renewed and again to cease alternately, by the mere application of hot water.

TO PRODUCE WHITE FIGURES UPON A BLACK GROUND.

Boil a piece of white muslin for a few minutes in a solution of sulphate of iron, composed of one part of green sulphate of iron and eight of water; squeeze it out and dry it; then imprint upon it spots, or any other pattern you choose, with lemon juice; render it dry again, and rinse it well in water. If the stuff be now boiled with logwood chips and water, it will exhibit white spots upon a black ground.

TO PRODUCE A CARMINE RED FLAME.

The flame of spirits of wine may be coloured by the addition of various bodies, which the spirit holds in solution, or which are mixed with it. And although the real causes which modify the colours of burning bodies are not sufficiently known, the phenomenon are in themselves sufficiently striking to deserve to be stated in this place. The flame of alcohol is tinged red in the following manner:—Put in a small iron ladle one part muriate of strontia, and pour over it three or four of alcohol; then set it on fire with a candle or piece of burning paper; it will burn with a bright carmine red flame, especially if the mixture be heated by holding the ladle over the flame of a candle or lamp, to cause the alcohol to boil rapidly. The muriate of strontia, left behind as residue, after being again thoroughly dried, may be used for the purpose repeatedly. The same holds good with all other materials employed for the production of coloured fire, which will be stated presently.

PREPARATION OF MURIATE OF STRONTIA.

Dissolve native carbonate of strontia in muriatic acid evaporating the solution, and suffering it to crystallize.

TO PRODUCE AN EMERALD GREEN FLAME.

Cause alcohol to burn in a ladle upon nitrate of copper. Preparation of nitrate of copper. Let copper clippings or filings be dissolved in a sufficient quantity of nitric acid of a moderate strength; when no further effervescence ensues, boil the acid gently upon a copper, until a pelicle appears: decant the solution, evaporate it slowly, and when a very strong pelicle is formed, suffer it to crystallize; the salt is of a fine blue colour.

THE ART OF BLEACHING.

Take one quart of chlorate of lime (oxymuriate of lime), put into a stone bottle, and pour over it eight parts of water. Let the mixture stand for twenty-four hours, during which time it ought to be now and then agitated; afterwards, decant the supernatent clear solution of chlorate of lime, dilute it with about three or four parts of water, and immerse into it any unbleached linen, which has acquired a yellow colour by age or frequent washing. If the steeped article, after having been in the bleaching liquor for four or five hours, be then rinsed in the water, it will have acquired a beautiful white colour.

Spots and stains produced by red port wine, tea, fruit, and coffee, become also discharged by the action of the bleaching fluid, from white linen and cotton goods.

TO PRESERVE POLISHED IRONS FROM RUST.

Polished iron work may be preserved from rust by a mixture, not very expensive, consisting of copal varnish intimately mixed with as much olive oil as will give it a degree of greasiness, adding thereto nearly as much spirit of turpentine as varnish. The cast iron work is best preserved by rubbing it with black lead. But where rust has begun to make its appearance on grate or fire irons apply a mixture of tripoly with half its quantity of sulphur, intimately mingled on a marble slab, and laid on with a piece of soft leather; or emery and oil may be applied with excellent effect; not laid on in the usual slovenly way, but with a spongy piece of the fig tree fully saturated with the mixture. This will not only clean, but polish, and render whitening unnecessary.

TO GILD WRITINGS, DRAWINGS, &c., ON PAPER OR PARCHMENT.

Letters written on vellum or paper are gilded in three ways: In the first a little size is mixed with the ink, and the letters are written as usual: when they are dry, a slight stickiness is produced by breathing on them, upon which the gold leaf is immediately applied, and by a little pressure may be made to adhere with sufficient firmness. In the second method, some white lead chalk is ground up with strong size, and the letters are made with this by means of a brush; when the mixture is almost dry, the gold leaf may be laid on, and afterwards burnished. The last method is, to mix up some gold powder with size, and to form the letters of this by means of a brush. It is supposed, that this latter method was that used by the monks in illuminating their missals, psalters, and rubrics.

TO GIVE SILVER PLATE A LUSTRE.

Dissolve alum in a strong ley; scum it carefully; then mix it up with soap, and wash your silver utensils with it, using a linen rag.

TO SUSPEND A RING BY A THREAD, AFTER THE THREAD HAS BEEN BURNED.

Soak a piece of thread in urine, or common salt and water. Tie it to a ring, not larger than a wedding ring. When you apply the flame of a candle to it, it will burn to ashes, but you sustain the ring.

TO STAIN HORN, BOX, OR IVORY, A CURIOUS BLACK.

To do this, put some pieces of Brazil wood into aqua fortis, and so continue them till they are green, then wash your materials in it, and boil logwood in water, into which put them whilst they are warm, and in a little time the ivory, &c., will be a curious black, so that being polished, it will appear like ebony or Japan; and if you would hav any part for flowers or the like remain white, draw them before straining with turpentine varnish, and the black wil not touch them, and clear up with oil and lamp black.

GLASS.

COMPOSITION OF FLINT-GLASS BY THE ADDITION OF ARSENIC AND COMMON SALT.

Take of white sand one hundred and twenty pounds, of red lead thirty pounds, of the best pearl-ashes twenty pounds, of nitre ten pounds, of common salt fifteen pounds, and of arsenic six pounds.

This glass will fuse with a moderate heat; but requires some time, to take off the milky appearance of the arsenic; this kind of glass is very soft; and may, therefore, be deemed the worst kind of flint glass that can be made preserving the appearance of good glass to the eye; which it will have equally with any other kind when properly managed.

CHEAP COMPOSITION OF GLASS BY MEANS OF COMMON SALT.

Take the proportion of the other ingredients given in the last; and omitting the arsenic, add in its stead fifteen pounds of common salt.

This will be more brittle than the last; and therefore cannot be recommended unless for the fabrication of such kind of vessels, or other pieces, where the strength is of little moment.

BEST GERMAN CHRYSTAL GLASS.

Take of the calcined flints of white sand one hundred and twenty pounds, of the best pearl-ashes seventy pounds of saltpetre ten pounds, of arsenic half a pound, and of magnesia five ounces.

If the pearl-ashes be pure and good, this glass will equal the best of this kind that ever was made. Borax has been often used also in the compositions of this sort of glass; but its great price without an equivalent advantage will deter from the employing it in large manufactures; as there is no sort of transparent glass in common practice, that of which looking-glass plates is made excepted, can bear the expense of it.

CHEAPER COMPOSITION OF GERMAN CHRYSTAL GLASS.

Take of calcined flints or white sand one hundred and twenty pounds of pearl ashes forty-six pounds, of nitre seven pounds, of arsenic six pounds, and of magnesia six ounces.

This composition requires a long continuance of heat, on account of the arsenic, for the reason before given. It produces a glass equally or more transparent, and colour-less, than the preceding, but somewhat more brittle. The arsenic is, however, so disagreeable an ingredient, and the deleterious qualities of the fumes, which will necessarily rise copiously till the effusion of the other ingredients check it, that, where the advantage is not more considerable than the saving arising from the difference of these two recipes, it is scarcely worth while to submit to the inconvenience of it.

TO COLOUR STEEL BLUE.

The steel must be finely polished on its surface, and then exposed to a uniform degree of heat. Accordingly, there are three ways of colouring, first, by a flame producing no soot, as spirit of wine; secondly, by a hot plate of iron; and thirdly, by wood ashes. As a very regular degree of heat is necessary, wood ashes for fine work bears the preference. The work must be covered over with them, and carefully watched; when the colour is sufficiently heightened, the work is perfect. The colour is occasionally taken off with a very diluted marine acid.

INVISIBLE RED INK.

To the pure spirit of vitriol or nitre, add eight times as much water.

To make the characters visible, which you write with this ink, pass a sponge over the paper, dipped in the following solution.

Take a quantity of the flowers of pansy, or the common violet, bruise them in a mortar with water, strain the liquor with a cloth, and keep it in a bottle.

ON THE NATURE OF THE DIAMOND.

The diamond is not more an object of attention to the jeweller than to the chemist; for it is as singular in its composition amongst the chrystals, as it is valuable, on account of its rarity and lustre, amongst the gems: having of late been fully ascertained to consist of nothing more than pure charcoal under a peculiar state of chrystallization. Upon this subject we shall copy Mr. Smithson Tennant's interesting papers, as communicated to the Royal Society.

Sir Isaac Newton having observed that inflammable bodies had a greater refraction, in proportion to their density, than other bodies, and that the diamond resembled them in their property, was induced to conjecture that the diamond itself was of an inflammable nature. The inflammable substances which he employed were camphire, oil of turpentine, all of olives, and amber; these he called "fat unctuous sulphureous bodies;" and using the same expression respecting the diamond, he says, it is probably an unctuous body coagulated." This remarkable conjecture of Sir Isaac Newton has been since confirmed by repeated experiments. It was found, that though the diamond was capable of resisting the effects of violent heat when the air was carefully excluded, yet that on being exposed to the action of heat and air, it might be entirely consumed. But as the sole object of these experiments was to ascertain the inflammable nature of the diamond, no attention was paid to the products afforded by its combustion; and it still therefore remained to be determined whether the diamond was a distinct substance, or one of the known inflammable bodies. Nor was any attempt made to decide the question till M. Lavoiser undertook a series of experiments for this purpose. He exposed the diamond to a heat produced by a large lens, and was thus enabled to burn it in close glass vessels. He observed that the air in which the inflammation had taken place had become partly soluble in water, and precipitated from lime water a white powder which appeared to be chalk, being soluble in acids with effervescence. As M. Lavoisier seems to had little doubt that this precipitation was occasioned by the production of fixed air similar to that which is afforded by calcareous substances he might, as we know at present, have inferred that the diamond contained charcoal; but the relation between that substance and fixed air, was then too imperfectly understood to justify this conclusion. Though he observed the resemblance of charcoal to the diamond, yet he thought that nothing more could be reasonably deduced from their analogy, than that each of these substances belonged to the class of inflammable bodies.

As the nature of the diamond is so extensively singular it seemed deserving of further examination, and it will appear from the following experiments, that it consists entirely of charcoal, differing from the usual state of that substance only by its chrystallized form. From the extreme hardness of the diamond, a stronger degree of heat is required to inflame it, when exposed merely to air, than can easily be applied in close vessels, except by means of a strong burning lens; but with nitre its combustion may be effected in a moderate heat. To expose it to the action of heated nitre free from extraneous matters, a gold tube was procured, which by having one end closed might serve the purpose of a retort, a glass tube being adapted to the open end for collecting the air produced. To be certain that the gold vessel was perfectly closed, and that it did not contain any unperceived impurities which could occasion the production of fixed air, some nitre was heated in it till it became alkaline, and afterwards dissolved out by water; but the solution was perfectly free from fixed air, as it did not affect the transparency of lime water When the diamond was destroyed in the gold vessel by nitre the substance which remained precipiated lime from lime water, and with acids afforded nitrous and fixed air; and it appeared solely to consist of nitre partly decomposed, and of ærated alkali.

In order to estimate the quantity of fixed air which might be obtained from a given weight of diamonds, 2½ grs. of small diamonds were weighed with great accuracy, and being put into the tube with ½ oz. of nitre, were kept in a strong red heat for about an hour and a half. The heat being gradually increased, the nitre was in some degree rendered alkaline before the diamond began to be inflamed, by which means almost all the fixed air was retained by the alkali of the nitre. The air which came over was produced by the decomposition of the nitre, and contained so little fixed air as to occasion only a very slight precipitation from lime water. After the tube had cooled, the alkaline matter contained in it was dissolved in water, and the whole of the diamonds were found to have been destroyed. As an acid would disengage nitrous air from this solution as well as the fixed air, the quantity of the latter could not in that matter, be acutely determined. To obviate this inconvenience, the fixed air was made to unite with calcareous earth, by pouring into the alkaline solution a sufficient quantity of a saturated solution of marble in marine acid. The vessel which contained them being closed, was left undisturbed till the precipitate had fallen to the bottom, the solution having been previously heated, that it might subside more perfectly. The clear liquor being found, by means of lime water, to be free from fixed air, was carefully poured off from the calcareous precipitate. The vessel used on this occasion was a glass globe, having a tube annexed to it, that the quantity of fixed air might be more accurately measured. After as much quicksilver had been poured into the glass globe containing calcareous precipitate as was necessary to fill it, it was inverted in a vessel of the same fluid. Some marine acid being then made to pass up into it, the fixed air was expelled from the calcareous earth; and in this experiment in which 2½ grs. of diamonds had been employed, occupied the space of a little more than 10.1 oz. of water. The temperature of the room when the air was measured, was 55°, and the barometer stood at about 29 8 inches.

From another experiment made in a similar manner with 1½ grains of diamonds, the air obtained occupied the space of 6.18 oz. of water, according to which proportion the bulk of the fixed air 2½ grs. would have been equal to 10.3 oz.

The quantity of fixed air thus produced by the diamond does not differ much from that which, according to M. Lavoiser, might be obtained from an equal weight of charcoal. In the Memoirs of the French Academy of Sciences, he has related the various experiments which he made to ascertain the proportion of charcoal and oxygen in fixed air. From those which he considered as most accurate, he concluded that one hundred parts of fixed air contain nearly twenty eight parts of charcoal and seventy-two of oxygen. He estimates the weight of a cubic inch of fixed air, under the pressure and temperature above mentioned, to be .695 parts of a grain. If we reduce the French weights and measures to English, and then compute how much fixed air, according to this proportion, $2\frac{1}{2}$ grs. of charcoal will produce, we shall find that it ought to occupy very nearly the bulk of ten ounces of water.

M. Lavoiser seems to have thought that the ærial fluid produced by the combustion of the diamond was not so soluble in water as that procured from calcareous substances. From its resemblance however in various properties, hardly any doubts remain that it consisted of the same ingredients: and I found on combining it with lime, and exposing it to heat with phosphorus, and it afforded charcoal in the same manner as any other calcareous substance.

Since the above account, M. Guyton de Morveau having burnt the diamond in oxygen gas, by the solar rays, and thereby obtained carbonic acid without residue, presumed that he had ascertained the diamond to consist of pure carbon, or the pure principal of charcoal, that which yields the pure acidifiable basis of the carbonic acid. But it was Clouet who composed the conclusive experiment of making soft iron pass to the state of steel, by cementing with the diamond. To this end he secured a diamond with some filings of iron, in a cavity bored in a block of soft iron. The whole properly included in a crucible, was exposed to the heat of a blast furnace, by which the diamond disappeared, and the metal was fused, and converted into a small mass or bottom of cast steel.

THE RAINBOW.

The rainbow had from the earliest times been an object of admiration to every spectator; but it was long before any observer knew the full extent to which that admiration ought to be carried, or even care to understand it. If it be unpardonable to shut our eyes to the most glorious spectacles in nature, it is doubly so to close our mental vision against that more perfect and more intimate perception of them which the knowledge of their causes affords. Amongst those that felt any interest in such enquiries, the rainbow was generally understood to arise in some way from the light reflected by the drops of rain falling opposite to the sun. Meurelycus suggested that the light in passing through the drop, so as to be reflected through from its back, somehow acquires colour from the refraction; but he suggested no farther than this idea. Others made suggestions which only tended to perplex the matter. Antonio de Dominis, Archbishop of Spalatro, approached very nearly to the complete explanation. Having placed a globular bottle of water opposite to the sun, and above his eye he saw coloured rays issue from the under side of the globe; the colours were different, according as it was more or less elevated and in order of the rainbow. He correctly traced the course of the rays refracting at entering and quitting the water, and reflecting at the back of it. The same would therefore hold good with a globular drop of water in a shower; and from the same angle being invariably required for each colour in a plane passing through the eye, the drop, and the sun, the circular form of the bow was accounted for. Still the actual origin or law of the connection between refraction and colour was totally unknown. The explanation, too, extended only to the primary or interior bow; in attempting that of the secondary the author failed. This investigation of De Dominis is the more remarkable, since he is not known for any other scientific work, "De Radiis Visus et Lucis," in 1611. Yet the treatise is in some points so faulty that Boscovich calls him "homo opticarum rerum supra id quod patiatur ea ætas impersissimus," (a man ignorant of optics to a degree even beyond what that age would endure.) This seems unduly severe upon a man who had been the first to propose an explanation so perfectly just and philosophical, as far as it went, of a very complex phenomenon: and if deficient in some points of detail, which was evinced in freedom and independence of opinions on theological subjects, extraordinary to be avowed by a dignitary of the Romish Church, and which as he had not the hypocrisy to disguise it, was, of course, heresy, and exposed him to a furious persecution. From this he found an asylum at the court of James I. of England, but returning to Italy was imprisoned, where he died and all his writings were condemned to the flames by the Inquisition.

THE PRESSURE OF WATER.

The pressure of water may be known to every one who will only take the trouble to look at the cock of a water butt when turned; if the tub or cistern be full, the water runs with much greater velocity through the cock, and a vessel will be filled from it in a shorter time than when it is only half full, although the cock, in both cases, is equally replete with the fluid during the vessel is filling. From this also is understood, how a hole or leek, near the keel of a ship, admits the water much quicker, and with greater violence, than one of the same size near what the mariners call the water's edge.

INTERESTING EXPERIMENT FOR THE MICROSCOPE.

The embryo grain of wheat, at the time of blossoming, being carefully taken out of the husk, will be found to have a small downy tuft at its extremity, which, when viewed in a microscope, greatly resembles the branches of thorn, spreading archwise, in opposite directions. By expanding a few of the grains, and selecting the most perfect, a very pretty microscopic object will be obtained for preservation.

CALCULATION OF THE MASS OF WATER CONTAINED IN THE SEA.

If we would have an idea of the enormous quantity of water which the sea contains, let us suppose a common and general depth of the ocean; by computing it only at 200 fathoms, or the tenth part of a mile, we shall see that there is sufficient water to cover the whole globe to the height of 503 feet of water: and if we were to reduce this water into a mass, we should find that it forms a globe of more than sixty miles in diameter.

DIFFERENT DEGREES OF HEAT IMBIBED FROM THE SUN'S RAYS BY CLOTHS OF DIFFERENT COLOURS.

Walk but a quarter of an hour in your garden, when the sun shines, with a part of your dress white and a part black; then apply your hand to them alternately, and you will find a very great difference in their warmth. The black will be quite hot to their touch, and the white still cool.

Try to fire paper with a burning glass; if it be white, you will not easily burn it; but if you bring the focus to a black spot, or upon letters written or printed, the paper will immediately be on fire under the letters.

Thus, fullers and dyers find black cloths, of equal thickness with white ones, and hung out equally wet, dry in the sun much sooner then the white, being more readily heated by the sun's rays. It is the same before a fire, the heat of which sooner penetrates black stockings than white ones, and so is apt sooner to burn a man's shins. Also beer much sooner warms in a black mug, set before the fire than in a white one, or in a small silver tankard.

Take a number of little square pieces of cloth from a tailor's pattern card, of various colours; say black, deep blue, lighter blue, green, purple, red, yellow, white, and other colours, or shades of colours; lay them all out upon the snow, in a bright sun-shiny morning; in a few hours, the black being most warmed by the sun, will be sunk so low as to be below the stroke of the sun's rays; the dark blue almost as low; the lighter blue not quite so much as the dark; the other colours less as they are lighter; and the white quite remain on the surface of the snow, as it will not have entered it at all.

ALTERNATE ILLUSION.

With a convex lens of about an inch focus, look attentively at a silver seal, on which a cypher is engraved. It will at first appear cut in, as to the naked eye; but if you continue to observe it some time, without changing your situation, it will seem to be in relief, and the lights and shades will appear the same as they did before. If you regard it with the same attention still longer, it will again appear to be engraved; and so on alternately.

If, while you are turned towards the light, you suddenly incline the seal, while you continue to regard it, those parts that seemed to be engraved will immediately appear in relief: and if, when you are regarding these seemingly prominent parts, you turn yourself so that the light may fall on the right hand, you will see the shadows on the same side from whence the light comes, which will appear not a little extraordinary. In the like manner the shadows will appear on the left, if the light fall on that side. If instead of a seal you look at a piece of money, these alterations will not be visible in whatever situation you place yourself.

THE CANDLE LIGHTED BY ELECTRICITY.

Charge a small coated phial whose knob is bent outwards so as to hang a little over the body of the phial; then wrap some loose cotton over the extremity of a long brass pin or wire, so as to stick moderately fast to its substance. Next roll this extremity of the pin, which is wrapped up in cotton, in some fine powdered resin; then apply the extremity of the pin or wire to the external coating of the charged phial, and bring as quickly as possible the other extremity, that is wrapped round with cotton, to the knob: the powdered resin takes fire, and communicates its flame to the cotton, and both together burn long enough to light a candle.

Dipping the cotton in oil of turpentine will do as well if you use a large sized jar.

CANDLE BOMBS.

Procure some small glass bubbles, having a neck about an inch long, with very slender bores, by means of which a small quantity of water is introduced into them, and the orifice afterwards closed up. This stalk being put through the wick of a burning candle, the flame boils the water into a steam, and the glass is broken with a loud explosion.

AUTOMATONS.

As automatons have been the favourite objects of mechanical contrivance from an early period, some account of these wonderful mechanical imitations, which have, at various times, amused and astonished the world, cannot fail to be interesting to our readers

The celebrated story of the statue of Memnon, (one of the wonders of ancient Egypt,) has some pretensions to lead the way in this historical sketch. We have positive testimony to the circumstance of the most beautiful sounds being emitted from this statue, at the rising and setting of the sun : and from the pedestal after the statue was overthrown. What was the contrivance in this case, it may be in vain to conjecture ; but automata are, by profession, a puzzling race. If a certain disposition of strings, be exposed to the rarefraction of the air, or to the morning and evening breezes, after the manner of our Æolian harps, produced these sounds ; or if any method of arranging the internal apertures so as to receive them from a short distance, were the artifice, a considerable acquaintance with the science of music, and acoustics generally will be argued. Wilkins quotes a musical invention of Cornelius Dreble, of similar pretensions, which "being set in the sunshine, would, of itself, render a soft and pleasing harmony, but being removed into the shade, would presently become silent."

Archytas' flying dove is another of the ancient automata. The inventor is said to have flourished about B. C. 400 and was a Pythagorean philosopher at Tarentum. It was made of wood, and the principal circumstance of its history is that, like some other birds of too much wing, when it alighted on the ground, it could not raise itself up again. Aulus Gellius, in his Noctes Atticæ, attempts to account for its flight, by observing, that it was "suspended by balancing, and moved by a secretly inclosed aura, or spirit !"

Friar Bacon, we all know, made a brazen head that could speak, and that seems to have assisted, in no small degree, in proclaiming him a magician. Albertus Magnus is also said to have devoted thirty years of his life to the construction of an automaton which the celebrated Thomas Aquinas broke purposely to pieces. It will not create surprise treated as these were by the age in which they lived, they had no encouragement to hope that any details of their labours would reach posterity.

Among the curiosities of his day, Walchius mentions an iron spider of great ingenuity. Its size did not exceed the ordinary inhabitants of our houses, and could creep or climb with any of them, wanting none of their powers, except, of which nothing is said, the formation of the web. Various writers of credit relate, that the celebrated John Muller, of Nuremberg, ventured a loftier flight of art. He is said to have constructed a self-moving wooden eagle, which descended towards the emperor Maximilian, as he approached the gates of Nuremberg, saluted him, and hovered over his person as he entered the town. This philosopher, according to the same authorities, also produced an iron fly, which would start from his hand at table, and after flying round to each of the guests, return, as if wearied, to the protection of his master.

An hydraulic clock, presented to the Emperor Charlemagne, by the Caliph Haroun Alraschid, merits record in the history of these inventions. It excited the admiration of all Europe at the period of its arrival. Twelve small doors divided the dial into twelve hours, and opened successively as each hour arrived, when a ball fell from the aperture on a brazen bell, and struck the time, the door remaining open. At the conclusion of every twelve hours, twelve mounted knights, handsomely caparisoned, came out simultaneously from the dial, rode round the plate, and closed the doors. Dr. Clark, in his last volume of travels, mentions a similar contrivance in a clock at Lubeck, of the high antiquity of 1405. Over the face is an image of Jesus Christ, on either side of which are folding doors which fly open every day as the clock strikes twelve. A set of figures, representing the twelve apostles, then march forth on the left hand, and bowing to our saviour's image as they pass in succession, enter the door on the right. On the termination of the procession, the doors close. This clock is also remarkably complete (for the age) in its astronomical apparatus, representing the place of the sun and moon in the ecliptic, the moon's age, &c.

Similar appendages in time pieces became too common at the beginning of the last century to deserve particular notice. We should not, however, omit some productions of the Le Droz family of Neufchatel. About the middle of the last century, the elder Le Droz presented a clock to the king of Spain, with a sheep and a dog attached to it. The bleating of the former was admirably correct, as an imitation; and a basket of loose fruit was placed in the custody of the dog. If any one removed the fruit, he would growl, snarl, gnash his teeth, and endeavour to bite until it was restored.

The son of this artist was the original inventor of the musical boxes, which have of late been imported into this country. Mr. Collison, a correspondent of Dr. Hutton's, thus clearly describes this fascinating toy in a letter to the doctor, inserted in his Philosophical and Mathematical Dictionary.

" When at Geneva," observes this writer, I called upon Droz, the son of the original Droz, of La Chaux de Fords, where I also went.) He shewed me an oval green snuff box, about, if I recollect right, four inches and a half long by three inches broad, an inch and a half thick. It was double, having an horizontal partition; so that it may be considered as one box placed upon another, with a lid of course to each box. One contained snuff; in the other, as soon as the lid was opened, there rose up a very small bird, of green enamelled gold, sitting upon a gold stand. Immediately this minute curiosity wagged its tail, shook its wings, opened its bill of white enamelled gold, poured forth, minute as it was, (being only three quarters of an inch from the beak to the extremity of the tail) such a clear melodious song as would have filled a room of twenty or thirty feet square with its harmony.

In Ozanam's Mathematical Recreations, we have an account, by the inventor, M. Comus, of an elegant amusement of Louis XIV. when a boy. It represented a lady proceeding to court, in a small chariot drawn by two horses, and attended by her coachman, footman, and page. When the machine was placed at the end of a table of proper size, the coachman smacked his whip, the horses started off with all the natural motions, and the whole equipage drove on to the farther extremity of the table; it would turn at right angles in a regular way, and proceed to that part of the table opposite to which the prince sat, when the chariot stopped, the page alighted to open the door, and the lady came out with a petition, which she presented to the bowing young monarch. After awaiting the pleasure of the prince for a short time, the lady courtsied again and re-entered the chariot, the page mounted behind, the coachman flourished his whip, and the footman, after running a few steps, resumed his place.

M. Vaucanson, a member of the Academie Royale of France, led the way to the unquestionable superiority of modern times, in these contrivances, by the construction of his automaton duck, a production, it is said, so exactly resembling the living animal, that not a bone of the body, and hardly a feather of the wings, seems to have escaped his imitation and direction. The radius, the cubitus, and the humerus had each their exact offices. The automaton ate, drank, quacked in perfect harmony with nature. It gobbled food brought before it with avidity, drank, and even muddled the water in the manner of the living bird.

Ingenious contemporaries of the inventor, who solved all the rest of his contrivances, could never wholly comprehend the mechanism of the duck. A chemical solution of the food was contrived to imitate the effect of digestion.

This gentleman is also celebrated for having exhibited at Paris, in 1738, an automaton flute player, whose powers exceeded all his ancestry; and for the liberality and good sense with which he communicated to the academy, in the same year, an exact account of its construction.

The figure was nearly six feet in height, and usually placed on a square pedestal four feet and a half high, and about three feet and a half broad. The air entered the body by three separate pipes, into which it was conveyed by nine pair of bellows, which were expanded and contracted at pleasure, by means of an axis formed of metallic substances, and which was turned by the aid of clock work. There was not even the slightest noise heard during the operation of the bellows: which might otherwise have discovered the process; by which the air was conveyed *ad libitum* into the body of the machine. The three tubes into which the air was sent by means of the bellows, passed again into three small reservoirs concealed in the body of the automaton. After having united in this place, and ascended towards the throat, they formed the cavity of the mouth, which terminated in two small lips, adapted to the performance of their respective functions. A small moveable tongue was inclosed within this cavity, which admitted or intercepted the passage of the air in the flute, according to the tune that was executed, or the quantity of wind that was requisite for the performance. A particular species of steel cylinder, which was turned by means of clock work, afforded the proper movements to the fingers, lips, and tongue. This cylinder was divided into fifteen equal parts, which caused the ascension of the other extremities; by the aid of pegs, which pressed upon the ends of fifteen different levers. The fingers of the automaton were directed in their movements by seven of these levers, which had wires and chains attached to their ascending extremities; these being fixed to the fingers, caused their ascensior in due proportion to the declension of the other extremity, by the motion of the cylinder: and, thus on the contrary, the ascent, or descent, of one end of the lever, produced a similar ascent in the fingers, that corresponded to the others; by which one of the holes was opened or stopped agreeable to the direction of four levers : one of which opened them in order to give the air a freer passage; the other contracted them, the third drew them back ; and by the different motions which have been already enumerated, regulated the tune in the requisite manner for execution. The direction of the tongue furnished employment for the remaining lever, which it moved in order that it might be enabled to shut or open the mouth of the flute.

The extremity of the axis of the cylinder was terminated on the right side by an endless screw, consisting of twelve threads, each of which was placed at the distance of a line and a half from the other. A piece of copper was fixed above this screw; and within it was a steel pivot, which was inserted between the threads of the screw, and obliged the cylinder above mentioned to pursue the threads. Thus instead of moving in a direct turn, it was perpetually pulled to one side; the successive elevation of the levers displaying all the different movements of a professed musician.

The same artist constructed another celebrated automaton, which played on the Provencal shepherd's pipe, and beat, at the same time, on an instrument called the tambour de basque. This was also a machine of the first order, for ingenious and difficult contrivance. The shepherd bore the flageolet in his left hand, and in the right a stick, with which he beats the tabor, or tambourine, in accompaniment. He was capable of playing about twenty different airs, consisting of minuets, rigadoons, and country dances. The pipe, or flageolet, which he was made to play, is a wind instrument of great variety, rapidity, and power of execution, when the notes were well filled and properly articulated by the tongue ; but it consists only of three holes, and the execution, therefore, mainly depends upon the manner in which they are covered, and the due variation of the force of the wind that reaches them.

To give the automatons power to sound the highest note, M. Vaucanson found it necessary to load the bellows, that supplied the air to this tone, with fifty six pounds weight, while that of one ounce supplied the lowest tone. Nor was the same note always to be executed by exactly the same force of air; it was necessary to pay the most accurate attention to its place on the scale, and to so many difficult circumstances of combination and expression that the inventor often declares himself to have been frequently on the point of relinquishing his attempt in its progress. In the tambourine accompaniment, too, there were numerous obstacles to overcome: the variations of the stroke, and particularly the continued roll of this instrument, was found to require no small ingenuity of construction.

All other exhibitions of mechanical skill, in imitation of the powers of human nature, were destined, however, to give way, in 1769, to the pretensions of the chess playing of M. Wolffgang de Kempelin, an Hungarian gentleman, and Aulic councellor of the Royal Chamber of the domains of the Emperor of Hungary.

Called in that year to Vienna by the duties of his station, this gentleman was present at some experiments on magnetism, made before the empress, Maria Theresa, when he ventured to hint, that he could construct, for her majesty, a piece of mechanism far superior to any of those which had been exhibited. His manner of remarking this, excited the attention of the Empress, who encouraging him to make the effort, the automaton chess player, which has since been exhibited in all the capitals of Europe, was, within six months after this period, presented at the imperial court. It is a presumption in favour of the pretensions of this contrivance to be a masterpiece of mere mechanism, that the original artist, after having gratified his exalted patroness and her court with the exhibition of it, appeared for many years indifferent to its fame. He engaged himself in other mechanical pursuits with equal ardour, and is said to have so far neglected this, as to have taken it partly to pieces, for the purpose of making other experiments. But the visit of the Russian Grand Duke Paul to the court of Joseph II. again called our automaton to life. It was repaired and put in order in a few weeks; and, from this period (1785) has been exhibited, at intervals, throughout Germany, at Paris, and in London; first by M. de Kempelin, and latterly by a purchaser of the property from his son; de Kempelin having died in 1803.

THE ART OF BRONZING.

Bronzing is that process by which figures of plaster of Paris, wood, &c. are made to have the appearance of copper or brass. The method is as follows:—

Dissolve copper filings in aqua fortis. When the copper has impregnated the acid, pour off the solution, and put into it some pieces of iron, or iron filings. The effect of this will be to sink the powder to the bottom of the acid. Pour off the liquor, and wash the powder in successive quantities of fresh water. When the powder is dry, it is to be rubbed on the figure with a soft cloth, or piece of leather; but observe, that previous to the application of the bronze powder, a dark blackish sort of green is first to be laid on the figure: and if you wish the powder to adhere stronger, mix it with glue water, lay it on like paint, with a camel's hair brush, or previously trace the parts to be bronzed with gold size, and when nearly dry, rub the powder over it.

TO SOFTEN HORN.

To one pound of wood ashes, add two pounds of quick lime; put them into a quart of water, Let the whole boil till reduced one third. Then dip a feather in, and if on drawing it out, the plume should come off, it is a proof that it is boiled enough, if not, let it boil a little longer. When it is settled, filter it off, and in the liquor thus strained put in shavings of horn. Let them soak for three days: and, first anointing your hands with oil, work the horn into a mass, and print or mould it into any shape you please.

ALARUM.

Against the wall of a room, near the ceiling, fix a wheel of twelve or eighteen inches in diameter; on the rim of which place a number of bells in tune, and, if you please, of different sizes. To the axis of this wheel, there should be fixed a fly to regulate its motion; and round the circumference there must be wound a rope, to the end of which is hung a weight.

Near to the wheel let a stand be fixed, on which is an upright piece that holds a balance or moveable lever, on one end of which rests the weight just mentioned, and to the other end must hang an inverted hollow cone, or funnel, the aperture of which is very small. This cone must be graduated on the inside, that the sand put in may answer to the number of hours it is to run. Against the upright piece, on the side next the cone, there must be fixed a check, to prevent it from descending. This stand, together with the wheel, may be inclosed in a case, and so contrived as to be moved from one room to another with very little trouble.

It is evident, from the construction of this machine, that when a certain quantity of sand is run out, the weight descends, and puts the wheel in motion, which motion will continue till the weight comes to the ground. If the wheel be required to continue longer in motion, two or more pullies may be added, over which the rope may run.

TO MAKE TOUCH PAPER.

Dissolve in some spirits of wine or vinegar, a little salt petre; then take some purple or blue paper, wet it with the above liquor, and when dry it will be fit for use. When you paste this paper on any of your works, take care that the paste does not touch that part which is to burn. The method of using this paper is, by cutting it into slips long enough to go once round the mouth of the serpent, cracker, &c. When you paste on these slips, leave a ltttle above the mouth of the case not pasted: then prime the case with meal powder, and twist the paper to a point.

CHINESE FOUNTAINS.

To make a Chinese fountain, you must have a perpendicular piece of wood seven feet long, and two inches and a half square. Sixteen inches from the top, fix on the front a cross piece one inch thick, and two and a half broad, with the broadsides upwards; below this fix three or more pieces of the same width and thickness, at sixteen inches from each other; let the bottom rail be five feet long, and the other of such a length as to allow the fire pumps to stand in the middle of the intervals of each other. The pyramid being thus made, fix in the holes made in the bottom rail five fire pumps, at equal distances; on the second rail, place four pumps; on the third, three; on the fourth, two; and on the top of the post, one; but place them all to incline a little forward, that, when they throw out the stars, they may not strike against the cross rails. Having fixed your fire-pumps, clothe them with leader, so that they may be all fired together.

MAGNETIC EXPERIMENTS.

1. If you present to a piece of iron, either the north or south pole of a magnet, the iron will be attracted; but if you present the middle of the magnet to the iron, the iron will not be attracted. This shows that the two poles of the magnet counteract each other's influence.

2. If you place a small magnet on a piece of cork, and a piece of iron on another piece of cork, and let the two float in a bason of water; you will find that the attraction between the magnet is mutual, or that the magnet moves towards the iron, as much as the iron towards the magnet.

3. You will find that the interposition of paper, wood, glass, or any other substance, excepting iron and bodies containing it, between two magnets, does not in the least degreee diminish the powers either of attraction or repulsion.

4. Take two soft pieces of soft iron wire, and tie to each the extremity of a piece of thread; hang the thread by the middle over a hook, so that the pieces of iron may hang down side by side, and apply to the latter the north pole of a magnet, the pieces of iron will then be repelled from each other, and will stand apart like two legs of a pair of

when open. This experiment is analogous to that of placing an electrified rod near a pair of suspended pith balls.

5. If you have a natural magnet of an irregular shape, and wish to find in which part of it the two poles are situated, immerse in it a quantity of iron filings; upon shaking it out, you will find it covered over with them, but, there will be two places diametrically opposite to each other which are the poles, where the filings are closer, and where the small oblong fragments stand as it were, upright, while in other parts they lie flat. A line drawn from one pole of a magnet to the other, is called the axis of the magnet.

6. Place a magnet upon a piece of pasteboard, and strew some iron filings about it: if you then give the pasteboard a few gentle taps, so as to shake the filings, you will see them range themselves round the magnet in curved lines, in a map of the world, and meet at the two poles. This remarkable experiment favours the opinions of those who think that the magnetic phenomena are owing to a peculiar fluid which issues from one of the poles of the magnet, and enters at the other, after having circulated in a certain sphere around it. This fluid is said to be the thing which gives the magnets their attractive and repulsive properties. In this experiment, every little particle of iron near the magnet is converted into a magnet, and becoming, consequently possessed of a north and south pole, it disposes itself after the manner of a regular magnet, and attracts with its extremities the contrary poles of other particles: hence the

formation of regular lines by the iron filings, intimating the direction of the magnetic current.

7. A very pretty experiment, similar to the preceding, consists in placing a bar magnetic on a table, laying a sheet of white paper over it, and sifting iron filings upon it through a gause sieve; the filings becoming magnetic, range themselves in very beautiful curves above the poles of the magnet. This experiment performed before any persons unacquainted with magnetism, will have an astonishing effect; for, as they will see no reason why the filings should so arrange themselves, they will be much surprised. This is one of that kind of experiments with which the adepts of by-gone days puzzled our forefathers, and which gained for many of them the romantic title of magician.

8 By adopting the following simple plan, a bar magnet may be made to carry a very great weight. Tie a piece of strong thread round the middle of it, and tie the other end of the thread to a cross string or beam. Leave the magnet to steady itself: it will traverse, that is to move round (from the position in which you left it) till it points directly north and south. You may now apply gently and gradually, to each end or pole a number of small iron keys, nails or bars; and the weight it will sustaiu will surprise you. And it is very remarkable, that the more weight you can make a magnet sustain, the stronger it gets. If you allow the magnet to remain for some days (in a dry place) in the position above described, you will find that every day it will bear an additional weight; and that this power will gradually increase, till it has reaehed a certain limit. On

the other hand, by disputing a magnet, by placing it in an improper situation, or by any other things which will be mentioned when we come to treat of the making of magnets, the power of them is diminished. By making a magnet red hot, its power is entirely destroyed. It is shown by this experiment, that the two magnetic poles together are capable of lifting a much greater weight than either of them itself. On this account natural magnets, in order to fit them for performing experiments of this nature, undergo a process termed arming. In this the two poles of such magnets are connected by three pieces of iron, one at each end, and the other along the bottom: the latter piece, serving only to concentrate the power by connecting the poles, it is not attached to the magnet, but the two end pieces are fastened to the magnet by a brass rim or box, and to the top of the magnet is affixed a ring to hang it up by. To the bottom of the third piece of iron a ring is affixed to hold the weights which the magnet is to raise. For the same purpose, and to avoid the armature, artificial magnets intended to raise weights are commonly made in the shape of a horse-shoe, having their poles in the two extremities. This kind of magnet is always more powerful than the bar kind.

9. The following simple experiment exhibits the attractive and repulsive powers of the magnet in a very curious manner. Dip the north pole of one magnet, and the south pole of another, into steel filings; each will assume when taken out, the appearance of a brush. Bring the two ends thus coated with filings near each other; the filings will unite

Next, dip the north poles of both magnets together in this case, the filings on the opposite magnet will repel each other.

HOW TO MAKE MAGNETS.

Artificial magnets are made of various shapes, according o the purposes they are intended to answer. For experimental purposes there may be obtained a few bars, five in length, half an inch in breadth, and the fourth of an inch in breadth, and the fourth of an inch in thickness. Magnets in the shape of a horse-shoe are sometimes used; they are better for raising weights than the bar magnets. A smith should be employed to furuish the bars, &c., which must be of hard steel, well polished; their angles must be perfect, and their several sides and ends completely flat. There should be a line drawn across one side of each bar near one end of it. This marked end of the bar is to be made the north pole of the magnet when the bar is touched; and the mark serves to distinguish the poles of the magnet which sometimes is very convenient When bar magnets are laid by for a time, they should be placed in a box with the opposite poles in contact, and must be kept in a dry place. If similar poles were placed together, or if the magnets got rusty, they would be spoiled. A single magnet should have a bit of iron at each end of it; and the ends of a horse shoe magnet should be connected by a piece of iron.

Every piece of iron when brought near a magnet, becomes a magnet itself. Soft iron is attracted by the magnet much more powerfully than hard iron or steel; but soft iron retains the magnetic virtue only as long as it continues near the magnet; while hard steel, when once converted into a magnet continues to be one, though removed to a distance from the magnet to which it was originally indebted for the communication of the magnetic quality. This shows the necessity of making the magnets of steel. A bar of steel may be converted into a magnet by simply stroking it with another magnet while it lies in an horizontal position. Thus, lay a bar of steel upon a table, take a magnet, apply the north pole of it to that end of the steel which is required to be made the south pole, (to the end which is not marked,) draw the magnet gently but firmly along the bar to the end of it, then carry away the hand to the distance of a foot; repeat the stroke several times, and your bar will soon become a magnet.

The following is another method of communicating magnetism to a steel bar, or compass needle; let it be placed horizontally, take a magnet in each hand, let the north pole of one, and the south pole of the other, be brought obliquely in contact, over the centre of the bar; draw them asunder, taking care to press firmly, and to preserve the same angle of inclination to the very ends of the bar, which should be supported by two magnets, whose ends ought to correspond in polarity with the intended poles of the bar. Observe to carry the magnets you press with, clear away from the bar, at least a foot therefrom: repeat the friction in the same manner several times, perhaps six eight, or ten times, and the bar will be permanently magnetized. By using other and stronger magnets in succession, the powers of the bar will be proportionably increased: but, as we have already stated, no effect will result from the friction if the bars be rusty, or indeed, not highly polished.

This mode of making magnets is more troublesome than that of simply touching or stroking the bars, but then the magnets when made are infinitely better than the others.

The earth is a great magnet. Hence iron, when placed in a proper position, becomes magnetical. We mean to say the magnetic virtue can be communicated to iron, without our touching it with any magnet, either natural or artificial. Paradoxical as this may appear, it is nevertheless true. The thing, indeed, in many ways; magnets may be made merely by rubbing together pieces of un-magnetized iron, nay, even without any friction at all. The following information on this very curious subject, we trust will be interesting to our readers.

A bar of soft iron three or four feet long, kept some time in a vertical position, will become magnetic, the lower extremity of it attracting south poles, and the upper extremity north. But if the bar be inverted, the polarity will be reversed. Bars of windows, and other iron bars which have been long in a perpendicular position, have frequently been found to be magnetical. Iron acquires a very perceptible degree of magnetism by hammering, or by undergoing any other process by which it is violently acted upon (without being changed in its nature). Electric shocks, and lightning, frequently render iron magnetical.

SIMPLICITY OF MAGNETIC APPARATUS.

The apparatus necessary for prosecuting the study of magnetism is very small, and procurable at but little expense: no objections can therefore be made to the pursuit of this science, on the score of economy. For those who do not intend to be very accurate, a common artificial bar magnet, a horse shoe magnet, and a few sewing needles, knitting needles, and pieces of soft iron wire, will be sufficient to furnish much amusement. But where greater accuracy is required, it will be necessary to have a set of bars, about six; a few small magnetic needles; a large needle in a box, with a graduated circle, or compass card; a dipping needle; and some pieces of steel wire; bars of soft iron, and a few other trifles which will be suggested to the student, by the perusal of the experiments we give.

TO MAKE CRACKERS.

Cut some stout cartridge-paper in pieces three inches and a half broad, and one foot long: one edge of each of three pieces fold down lengthwise about three quarters of an inch broad; then fold the double edge down a quarter of an inch, and turn the single edge half back over the double fold; open it and lay all along the channel, which is formed by the folding of the paper, some meal powder; then fold it over till all the paper is doubled up, rubbing it down at every turn; this being done, bend it backwards and forwards, two inches and a half, or thereabouts, at a time, as often as the paper will allow: hold all these folds flat and close, and with a small pinching cord, give one turn round the middle of the cracker, and pinch it close; bind it with packthread, as tight as you can; then in the place where it was pinched, prime one end, and cap it with touch paper. When these crackers are fired, they will give a report at every turn of the paper; if you would have a great number of bounces, you must cut the paper longer, or join them after they are made; but if they are made very long before they are pinched, you must have a piece of wood with a groove in it, deep enough to let in half the cracker; this will hold it straight while it is pinching.

TO MAKE SQUIBS AND SERPENTS.

First make the cases about six inches in length, by rolling slips of stout cartridge paper about three times round a roller, and passing the last fold; tying it near the bottom as tight as possible, and making it air tight at the end by sealing wax. Then take of gunpowder half a pound, charcoal one ounce, brimstone one ounce, and steel filings half an ounce, (or in like proportion) grind them with a muller, or pound them in a mortar. Your cases being dry and ready, first put a thimble full of your powder, and ram it hard down with a ruler; then fill the case to the top with the aforesaid mixture, ramming it hard down in the course of filling two or three times: when this is done, point it with touch paper, which should be pasted on that part which touches the case, otherwise it is liable to drop off.

SKY ROCKETS.

Rockets being of the fire works most in use, we shall give them the preference in description. As the performance of rockets depends much upon their moulds, they should be made according to the following proportions;—Taking the diameter of the orifice, its height should be equal to six diameter and two-thirds; the choke, one diameter and one-third of this model, will serve for every rocket from four ounces to six pounds. For instance; supposing the diameter of 1 lb. be 1 ½ inch, then its length being 6 diameters and two-thirds, the length of the case must be 10 ½ inches, and the choke 2¼ inches. Your rammer must have a collar of brass to prevent the wood from splitting.

METHOD OF ROLLING ROCKET CASES.—The cases must be made of the strongest cartridge paper, and rolled up dry. The case of a middling sized rocket will take up paper of four or five sheets thick; having cut your papers to a proper size, and the last sheet with a slope at one end, fold down one end, and lay your former on the double edge, and when you have rolled on the paper within two or three turns lay the next sheet on that part which is loose, and roll it all on. Then, in order to roll the case as hard as possible place it on a table, and with a smooth board roll it for some time forward on the table till it becomes quite hard and firm. This must be done with every sheet. You have next to choak the case, for which purpose draw your former a little distance from the bottom, then, with a cord once round the case, pull it rather easy at first, and harder, till you have closed the end. To make it easy, you may dip the ends of the inner sheets in water before rolling, then bind it with small twine.

Having thus pinched and tied the case so as not to give way, put into the mould without its foot, and with a mallet drive the former hard on the end piece, which will force the neck close and smooth. This done, cut the case to its proper length, allowing from the neck to the edge of the mouth half a diameter, which is equal to the height of the nipple, then take out the former, and drive the case over the piercer with a long rammer, and the vent will be of a proper size.

Having formed your cases, we will now proceed to the description of the ingredients necessary for the rocket.

Of mixing the composition.—The performance of the principal parts of fire works depends much on the compositions being well mixed, therefore, great care must be taken in this part of the work, particularly for the compositions of sky rockets. When you have four or five pounds of ingredients to mix, which is a sufficient quantity at a time, for a larger proportion will not do so well, first put the differen ingredients together, then work them about with your hands till you think they are pretty well incorporated: after put them into a lawn sieve with a receiver and top to it, and if, after it is sifted, any remains that will not pass through the sieve, grind it again till it is fine enough; and if it be twice sifted, it will not be amiss, but the composition for wheels and common works are not so material, nor need be so fine. But in all fixed works, from which the fire is, to play regular, the ingredients must be very fine, and great care taken in mixing them well together; and observe that in all compositions wherein are iron filings, the hand must not touch them; nor will any works which have either iron or steel in their charge keep long in damp weather.

To drive or ram rockets.—Rockets are filled hollow, otherwise they would not ascend, and there is not a part that requires greater attention than this stage of the process. One blow more or less of the mallet will spoil the ascent.

The charge of rockets must always be driven above the piercer, and on it must be rammed a thin head of clay; through the middle of which bore a small hole to the composition, and when the charge is burnt to the top, it may communicate its fire through the hole to the stars in the head.

To a rocket of four ounces, give to each ladleful of charge 16 strokes; to a rocket of 1 pound 28; to a 2-pounder, 36; to a 4-pounder, 42; and to a 6 pounder, 56; but rockets of a larger sort cannot be driven well by hand, but must be rammed with a machine made in the same manner as those for driving piles.

The method of ramming wheel cases, or any other sor in which the charge is driven solid, is the same as the sky rocket.

When you load the heads of your rockets with stars, rains, serpents, crackers, scrolls, or any thing else, according to your fancy, remember always to put a ladleful of meal powder into each head, which will be enough to burst the head, and disperse the stars, or whatever it contains.

Decorations foy sky rockets.—Sky rockets may be decorarated according to fancy. Some are headed with stars of different sorts, such as tailed, crilliant, white, blue, and yellow stars, &c. Some with gold and silver rains: others with serpents, crackers, fire-scrolls, and maroons; and some with small rockets and other devices, as the maker pleases.

LENGTH OF ROCKET STICKS.

	lb.	oz.		ft.	in.	
For rockets of	6	0	the stick must be	14	10	long
	4	0	....	12	10	
	2	0	....	9	4	
	1	0	....	8	2	
	0	8	....	6	6	
	0	4	....	5	3	

Having your sticks ready, cut on one of the flat sides of the top a groove the length of the rocket, and as broad as the stick will allow; then on the opposite flat side, cut two notches, for the cord, which ties on the rocket, to lie in: one of these notches must be placed near the top of the stick, and the other facing the neck of the rocket; the distance between the notches may be easily known, for the top of the stick should always touch the head of the rocket. When your rockets and sticks are ready, lay the rockets in the grooves in the sticks, and tie them on. We will now proceed to the charge for sky rockets:

ROCKETS OF FOUR OUNCES.

	lb.	oz.		lb	oz.
Meal-powder	1	4	Charcoal	0	2
Saltpetre	0	4			

SKY ROCKETS IN GENERAL.

	lb.	oz		lb.	oz
Saltpetre	4	0	Charcoal	1	12
Brimstone	1½	0	Meal-powder	0	2

BRILLIANT ROCKET STARS.

	lb.	oz.		lb.	oz.
Saltpetre	0	3½	Meal-powder	0	0½
Sulphur	0	0¼			

Worked up with spirits of wine only.

TO FIRE SKY ROCKETS UNDER WATER.

You must have stands made as usual, only the rails must be made flat instead of edgewise, and have holes in them for the rocket sticks to go through; for if they were hung upon hooks, the motion of the water would throw them off; the stands being made, if the pond is deep enough, sink them at the sides so deep, that, when the rockets are in, their heads may just appear above the surface of the water; to the mouth of each rocket fix a leader, which put through the hole with the stick; then a little above the water must be a board supported by the stand, and placed along one side of the rockets; then the ends of the leaders are turned up through holes made in the board, exactly opposite the rockets. By this means you may fire them singly, or all at once. Rockets may be fired by this method in the middle of a pond, by a Neptune, a swan, a water wheel, or any thing else you choose.

AIR PUMP.—RESISTANCE OF ARCHED BODIES.

Let two phials, the one a square the other a round one, be furnished with a valve stopper, and placed in the receiver. Exhaust the air therefrom, and the valves opening will have their respective phials in vacuum also: then turn the cock that re admits the air, the valves being closed, the pressure of the air will press upon and burst the square phial, whilst the round one withstands the pressure entire, by reason of its shape; and this, although, as is usually the case, the round phial be a blown one, and very thin, whilst square phials are always cast, and of thick materials.

The receiver itself is a proof of the same doctrine; but for its arched top the surrounding atmosphere would shiver it to pieces whenever its inside should be exhausted. The same effect would be produced by corking down the phials, so that the air cannot escape; the pressure from without being withdrawn, that within forces the barrier and the stopper flies out, or the square phial bursts.

HYDROGEN GAS, TO MANUFACTURE.

Let a phial be provided, which has a cork stopper with a hole in its centre, capable of admitting tightly the end of a tobacco pipe. Into the phial drop a few bits of zinc, steal filings, or scraps of iron. To this pour reduced oil of vitriol, prepared in another vessel by a simple admixture of water; and when the heat hereby occasioned, has subsided, introduce it to your metals in the phial, and cork it down with the stopper heretofore described Immediately the hydrogen contained in the liquid will begin to fly off, by reason of the attraction which resides in the metal, for the other component part of the liquid. The gas, thus liberated, ascends in a stream, and may be lighted with a candle, or conducted into the bladder fitted up with a tobacco pipe, as described in the last recreation.

For this purpose the end of the tobacco pipe, which projects from the neck of the bladder, is to be quickly thrust into the hole of the cork of your phial, and the bladder will be filled with the gas which arises from the decomposition that is going on in the phial.

BARS OR NEEDLES RENDERED MAGNETIC BY THE GALVANIC ART.

A new method of communicating the polar attraction to the needle, is adverted to in the experiments of Mr. Oerstad. Sir A. Davy found that the conjunctive wire of platina was magnetic, from its attracting iron filings; and it was found capable of communicating permanent magnetism to steel bars, placed transversely; whilst the same bars, when placed to the wire, had temporary magnetism while in the vicinity of the apparatus. When the south pole of a magnetic bar received negative electricity, the power of attraction was destroyed in half a minute.

ACETATE OF LEAD WITH HYDROGEN.

Super acetate of lead and sulphurated hydrogen in contact, produce a colour, more or less, according to the amount used of the former; if in water which has been impregnated with sulphurated hydrogen gas, a drop or two of the acetate may be added, clouds will ensue of a dark brown colour, floating in varied evolutions.

Secondly, dip your pen in a diluted solution of super-acetate of lead, and write, nothing will be visible; but pass over the paper a sponge charged with water, impregnated as above, and the writing assumes a brilliant metallic appearance. The same effect may be produced by simply holding the writing over the vessel which contains the preparation of hydrogen gas.

CHLORINE.

Fill a small jar with chlorine, or oxymuriatic acid gas and transfer it into a basin, containing a solution of nitrate, or muriate of ammonia, a little warmed. The gas will shortly become condensed, the liquor rise up in the jar, and presently an oily liquid forms on its surface.

This increases and forms into small globules, and falls through the liquid, and forms the explosive compound of which we are in search; but when found, much danger exists in the means of gathering it together, many accidents have occurred of a frightful nature, substances most similar in their nature being affected very differently towards the oil; charcoal of wood seems uniformly innocent in tact with it, and therefore offers one of the safest vehicles for removing it. Mr. Kirk found it would not explode upon alcohol or ether, whilst fire heat at 212 deg. of Fahrenheit produced detonation, though not so loud, as when cold it were touched with inflammable bodies. In olive oil, for example, a quantity of the size of a pin's head will explode violently and loud, knocking the vessel, in which it takes place, to atoms.

Seeing that so much danger is found with this curious substance, the precaution of wearing a visor with glass eyes in it, and perhaps a pair of gloves, must be evidently necessary.

DETONATING POWDER.

To three grains of finely levigated chlorine; or hyperox-muriate of potash, add two grains of sulphur; mix them well in a clean dry mortar. Collect them together at its bottom, and with the pestle press the powder hard, by bringing it down at the sides of the mortar, suddenly, whereby friction against its bottom takes place. A loud detonation ensues, with a vivid flash. But if the pestle be turned briskly round, as is usual with druggists, after some time pounding any substance, repeated small reports will take place, attended with vivid flashes, not unlike what we see and hear in the electric shock. It is here worthy of remark, that if less sulphur be used, less friction is necessary to produce the several reports. Like most others of ts class, it may be conveyed about, when care is used, and suddenly ignited: in this case, by being struck with a hammer, its noise is equal to that of a horse pistol.

CO-EXPLOSION OF FULMINATING SILVER.

If small parcels of this preparation be laid out upon the table, or a train of considerable length, and one parcel be touched with sulphuric acid, the whole detonate spontaneously; which must arise from the compression of the atmosphere.

PROCESS OF SEPARATING SILVER AND COPPER.

Its cheapness is the principal recommendation of this method, which is also most effectual and complete in operation. Dissolve the substance in nitric acid, and evaporate the solution to dryness in a glass vessel. Place the salt in an iron spoon over a moderate fire, and keep the mixture in fusion until it entirely ceases to throw up bubbles, when it is to be poured off upon an oiled plate. To be certain that all the nitrate of copper is converted into the black oxide of copper, dissolve a small portion thereof in water, and test it with ammonia. If the solution, which ought to be at first clear and limpid, does not acquire the slightest tint of blue, it may be considered, that the nitrate of silver obtained is quite free from copper. If not so, the fusion must be continued a few minutes longer.

The black product is to be dissolved in cold water, and the solution being filtered, the nitrate of silver passes through in a state of purity. By washing the oxide which remains upon the filter, the small portion of nitrate of silver with which it may be impregnated will be removed; the oxide is then to be dried. The nitrate of silver is to be subjected to a different treatment, according to the use to which it is to be applied.

IGNUS FATUUS, OR WILL O' THE WISP.

To a small quantity of water, in a glass tumbler, add phosphoret of lime in two or three small lumps; shortly will arise little flashes of light, darting out like petty lightning, and ascending subsequently in clouds; these appearances continue some time, and constitute a lively illustration of the formation of the ignus fatuus, or light proceeding out of shallow pools of water.

LUMINOUS BOTTLE OR WATCH LIGHT.

A bit of phosphorus, the size of a pea, is to be put into a long glass phial, and boiling oil poured carefully over it, till the phial is one third filled. The phial is to be carefully corked, and when used, should be unstopped a moment to admit the external air, and closed again. The empty space of the phial will then appear luminous, and give as much light as a dull ordinary lamp, and just sufficient to see the face of a watch. Each time that the light disappears, on removing the stopper it will instantly re-appear. In cold weather, the bottle should be warmed in the hands before the stopper is removed. A phial thus prepared may be used every night for six months.

MAGIC FOUNTAIN.

Take a tall glass tube, hermetically sealed both at top and bottom, by means of a brass cap screwed on to a stop cock, and that to the plate of the pump. When the air is exhausted, turn the cock, take the tube off the plate, and plunge them into a basin of mercury or water. Then the cock being again turned, the fiuid, by the pressure of the air, will play upon the tube, in the form of a beautiful fountain.

CORK HEAVIER THAN LEAD.

Let a large piece of cork be pendant from one end of a balance beam, and a small piece of lead from the other; the lead rather preponderate. If this apparatus be placed under a receiver on the pump, you will find that when the air is exhausted, the lead which seemed the heaviest body will ascend, and the cork will outweigh the lead. Restore the air, and the effect will cease. This phenomenon is only on account of the difference of the size of the two objects. The lead, which owes its heaviness to the operation of the air, yields to a lighter because a larger substance when deprived of its assistance.

THE ILLUMINATED WATER.

Connect one end of a chain with the outside of a charged phial, and let the other end lay on the table. Place the end of another piece of chain at the distance of about a quarter of an inch from the former; and set a glass decanter of water on these separated ends. On making the discharge the water will appear perfectly luminous.

The electric spark may be rendered visible in water, in the following manner. Take a glass tube of about half an inch in diameter, and six inches long; fill it with water, and to each extremity of the tube, adapt a cork, which may confine the water, through each cork insert a blunt wire, so that the extremities of the wires within the tube may be very near one another; then, on connecting one of these wires with the coating of a small charged phial, and touching the other wire with the knob of it; the shock will pass through the wires, and cause a vivid spark to appear within their extremities within the tube. The charge in this experiment must be very weak, or there will be danger of bursting the tube.

TO SPIN SEALING WAX INTO THREADS BY ELECTRICITY.

Stitch a small piece of sealing wax on the end of a wire and set fire to it. Then put an electrical machine in motion, and present the wax just blown out at the distance of some inches from the prime conductor. A number of extremely fine filaments will immediately dart from the sealing-wax to the conductor, on which they will be condensed into a kind of net work, resembling wool.

If the wire with the sealing wax be struck into one of the holes of the conductor, and a piece of paper be presented at a moderate distance from the wax, just after it has been ignited, on setting the machine in motion, a net, work of wax will be formed on the paper. The same effect, but in a slighter degree, will be produced, if the paper be briskly rubbed with a piece of elastic gum, and the melted sealing wax be held pretty near the paper immediately after rubbing.

If the paper thus painted, as it were, with sealing wax be gently warmed by holding the back of it to the fire, the wax will adhere to it, and the result of the experiment will thus be rendered permanent.

SEVERAL DIFFERENT CARDS BEING FIXED ON BY DIFFERENT PERSONS, TO NAME THAT ON WHICH EACH PERSON FIXED.

There must be as many different cards shewn to each person, as there are cards to choose; so that, if there are three persons, you must shew three cards to each person, telling the first to retain one in his memory. You then lay those three cards down, and shew those others to the second person, and three others to the third. Next take up the first person's cards, and lay them down separately, one by one, with their faces upwards ; place the second person's cards over the first, and the third over the second's so that there will be one card in each parcel belonging to each person. You then ask each of them in which parcel his card is, and by the answer, you immediately know which card it is ; for the first person's will always be the first, the second person's the second, and third person's the third, in that parcel where each says his card is.

This amusement may be performed with a single person by letting him fix on three, four, or more cards. In this case, you must shew him as many parcels as he is to choose cards, and every parcel must consist of that number, out of which he is to fix on one, and you then proeeed as before, he telling you the parcel that contains each of his cards.

TO TELL THE AMOUNT OF THE NUMBERS OF ANY TWO CARDS DRAWN FROM A COMMON PACK.

Each court card in this amusement counts for ten, and the other cards according to the number of their pips. Let the person who draws the card add as many more cards to each of those he has drawn as will make each of their numbers twenty-five. Then take the remaining cards in your hand, and, seeming to search for some card among them, tell them over to yourself, and their number will be the amount of two cards drawn.

For example:—Suppose the person has drawn a ten and a seven, then he must add fifteen cards to the first make the number tweny-five, and eighteen to the last for the same reason; now fifteen and eighteen make thirty three, and the two cards themselves make thirty five, which deducted from fifty-two, leaves seventeen, which must be the number of the remaining cards, and also of the two cards drawn.

You may perform this amusement without touching the card, thus:

Let the person who has drawn the two cards deduct the number of each of them from twenty six, which is half the number of the pack, and after adding the remainders together, let him tell you the amount, which you privately deduct from fifty two, the total number of all the cards, and the remainder will be the amount of the two cards.

EXAMPLE:—Suppose the two cards to be as before, ten and seven; then the person deducting ten from twenty-six, there remain sixteen; these two remainders make thirty five, which you subtract from fifty two, and there must remain seventeen for the amount of the two cards, as before.

THE CARD CHANGED BY WORD OF COMMAND.

You must have two cards of the same sort in the pack, say the king of spades. Place one next the bottom card, [say seven of hearts] and the other at top. Shuffle the cards without displacing those three, and show a person that the bostom card is the seven of hearts. This card you dexterously slip aside with your finger, which you have previously wetted, and taking the king of spades from the bottom, which the person supposes to be the seven of hearts, lay it on the table, and tell him to cover it with his hand.

Shuffle the cards again, without displacing the first and last card, and shifting the other king of spades, from the top to the bottom, shew it to another person. You then draw that privately away, and taking the bottom card, which will then be the seven of hearts, you lay that on the table, and tell the second person (who believes it to be the king of spades) to cover it with his hand.

You then command the cards to change places; and when the two parties take off their hands, and turn up the cards, they will see to their great astonishment that your commands are obeyed.

THE CARD IN THE EGG.

Take a card, the same as your long card, and rolling it very close, put it into an egg, by making a hole as small as possible, and which you are to fill up carefully with white wax. You then offer the long card to be drawn; and when it is replaced in the pack, you shuffle the cards several times, giving the egg to the person who drew the card, and while he is breaking it, you privately withdraw the long card, that it may appear upon examining the cards, to have gone from the pack into the egg. This may be rendered more surprising by having several eggs, in each of which is placed a card of the same sort, and then giving the person the liberty to choose which egg he thinks fit.

This deception may be still further diversified, by having, as most public performers have, a confederate, who is previously to know the egg in which the card is placed; for you may then break the other eggs, and shew that the only one that contains a card is that in which you directed it to be.

THE HOUR OF THE DAY OR NIGHT TOLD BY A SUSPENDED SHILLING.

However improbable the following experiment may appear, it has been fully-proved by repeated trials:

Sling a shilling or sixpence at the end of a piece of thread by means of a loop. Then resting your elbow on a table, hold the other end of the thread betwixt the fore finger and thumb, observing to let it pass across the ball of the thumb, and thus suspend the shilling into an empty goblet. Observe your hand must be perfectly steady; and if you find it difficult to keep it in an immoveable posture, it is useless to attempt the experiment. Premising, however, that the shilling is properly suspended, you will observe, that when it has recovered its equilibrium, it will for a moment be stationary; it will then of its own accord, and without the least agency from the person holding it, assume the action of a pendulum vibrating from side to side of the glass; and after a few seconds, will strike the hour nearest to the time of day, for instance, if the time be twenty five minutes past six, it will strike six; if thirty five minutes past six, it will strike seven: and so on of any other hour.

It is necessary to observe, that the thread should lay over the pulse of the thumb, and this may in some measure account for the vibration of the shilling; but to what cause its striking the precise hour is to be traced, remains unexplained; for it is no less astonishing than true, that when it has struck the proper number, the vibration ceases, it acquires a kind of rotary motion, and at last becomes stationary as before.

ARTIFICIAL LIGHTNING.

Provide a tin tube that is larger at one end than it is at the other, and in which there are several holes Fill this tube with powdered resin; and when it is shook over the flame of a torch, the reflection will produce the exact appearance of lightning.

ARTIFICIAL THUNDER.

Mix two drachms of the filings of iron, with one ounce of concentrated spirit of vitriol, in a strong bottle that holds about a quarter of a pint; stop it close, and in a few minutes shake the bottle; then taking out the cork, put a lighted candle near its mouth, which should be a little inclined, and you will soon observe an illumination arise from the bottle, attended with a loud explosion.

To guard against the danger of the bottle bursting, the best way would be to bury it in the ground, and apply the light to the mouth by means of a taper fastened to the end of a long stick.

ARTIFICIAL ILLUMINATIONS.

A very pleasing exhibition may be made with very little trouble or expense, in the following manner: Provide a box, which you fit up with architectural designs cut out on pasteboard; prick holes in those parts of the building where you wish the illuminations to appear, observing that, in proportion to the perspective, the holes are to be made smaller; and on the near objects the holes are to be made larger. Behind these designs thus perforated, you fix a lamp or candle, but in such a manner, that the reflection of the light shall only shine through the holes; then placing a light of just sufficient brilliance to shew the design of the buildings before it, and making a hole for the sight at the front end of the box, you will have a very tolerable representation of illuminated buildings.

The best way of throwing the light in front is to place an oiled paper before it, which will cast a mellow gleam over the scenery, and not diminish the effect of the illumination. This can be very easily planned, both not to obstruct the sight, nor be seen to disadvantage. The lights behind the picture should be very strong; and if a magnifying glass was placed in the sight hole, it would greatly tend to increase the effect. The box must be covered in, leaving an aperture for the smoke of the light to pass through.

This exhibition can only be shown at candle light; but there is another way, by fixing small pieces of gold off the building instead of drilling the holes, which gives something of the appearance of illumination, but by no means equal to the foregoing experiment.

N. B —It would be an improvement, if paper of various colours, rendered transparent by oil, were placed between the lights behind, and the aperture in the buildings, as they would then resemble lamps of different colours.

ARTIFICIAL EARTHQUAKE AND VOLCANO.

Grind an equal quantity of fresh iron filings with pure sulphur, till the whole be reduced to a fine powder. Be careful not to let any wet come near it. Then bury about thirty pounds of it a foot deep in the earth, and in about six or eight hours the ground will heave and swell, and shortly after send forth smoke and flames like a burning mountain. If the earth be raised in a conical shape, it will be no bad miniature resemblance of one of the burning mountains.

TO PRODUCE BEAUTIFUL FIREWORKS IN MINIATURE.

Put half a drachm of solid phosphorus into a large pint Florence flask; holding it slanting, that the phosphorus may not break the glass. Pour upon it a gill and a half of water, and place the whole over a tea kettle lamp, or any common tin lamp, filled with spirit of wine. Light the wick, which should be almost half an inch from the flask; and as soon as the water is heated, streams of fire will issue from the water by starts, resembling sky rockets; some particles will adhere to the sides of the glass, representing stars; and will frequently display brilliant rays. These appearances will continue at times till the water begins to simmer, when immediately a curious aurora borealis begins, and gradually ascends, till it collects to a pointed flame, when it has continued half a minute, blow out the flame of the lamp, and the point that was formed will rush down, forming beautiful illuminated clouds of fire, rolling over each other for some time, which, disappearing, a splendid hemisphere of stars presents itself: after waiting a minute or two, light the lamp again, and nearly the same phenomenon will be displayed as from the beginning. Let the repetition of lighting and blowing out the lamp be made for three or four times at least, that the stars may be increased. After the third or fourth time of blowing out the lamp, in a few minutes after the internal surface of the flask is dry, many of the stars will shoot with great splendour from side to side, and some of them will fire off with brilliant rays; these appearances will continue for several minutes. What remains in the flask will serve for the same experiment several times, without adding many more water. Care should be taken, after the operation is over, to lay the flask and water in a cool secure place.

ARTIFICIAL RAIN AND HAIL.

Make a hollow cylinder of wood: let it be very thin at the sides, about eight or ten inches wide, and two or three feet in diameter. Divide its inside into five equal parts by boards of five or six inches wide, and let there be between them and the wooden circle, a space of about one-sixth of an inch. You are to place these boards obliquely. In this cylinder put four or fine pounds of shot that will easily pass through the opening. When turned upside down, the noise of the shot going through the various partitions will resemble rain; and if you put large shot, it will produce the sound of hail.

CHEMICAL LUMINATIONS.

Put into a middle sized bottle, with a short wide neck, three ounces of oil or spirit of vitriol with twelve ounces of common water, and throw into it, at different times, an ounce or two of iron filings. A violent commotion will then take place, and white vapours will arise from the mixture. If a taper be held to the mouth of the bottle, these vapours will inflame, and produce a violent explosion; which may be repeated as long as the vapours continue.

THE PHILOSOPHICAL CANDLE.

Provide a bladder, into the orifice of which is inserted a metal tube, some inches in length, that can be adapted to the neck of a bottle, containing the same mixture as in the last experiment. Having suffered the atmospheric air to be expelled from the bottle, by the elastic vapour produced by the solution, apply the orifices of the bladder to the mouth of the bottle, after carefully squeezing the common air out of it (which you must not fail to do, or the bladder will violently explode.) The bladder will thus become filled with the inflammatory air, which when forced out against the flame of a candle, by pressing the sides of the bladder, will form a beautiful green flame.

FULMINATING GOLD.

Put into a small long necked bottle, resting on a little sand, one part of fine gold filings, and two parts of aqua regia, (nitro muriatic acid.) When the gold is dissolved pour the solution into a glass, and add five or six times the quantity of water. Then take spirit of sal ammoniac or oil of tartar, and put it drop by drop into the solution, until the gold is entirely precipitated to the bottom of the glass. Decant the liquor that swims at the top, by inclining the glass: and having washed it several times in warm water, dry it at a moderate heat, placing it on paper capable of absorbing all the moisture.

If a grain of this powder, put into a spoon (it should be an iron one,) be exposed to the flame of a candle, it will explode with a very loud report.

THE MAGIC BOTTLE.

Take a small bottle, the neck of which is not more than the sixth of an inch in diameter. With a funnel, fill the bottle quite full of red wine, and place it in a glass vessel, similar to a shew glass, whose height exceeds that of the bottle about two inches; fill this vessel with water. The wine will shortly come out of the bottle, and rise in the form of a small column to the surface of the water; while, at the same time, the water entering the bottle, will supply the place of the wine. The reason of this is, that as the water is specifically heavier than the wine, it must hold the lower place, while the other rises to the top.

An effect equally pleasing will be produced, if the bottle be filled with water, and the vessel with wine.

THE GLOBULAR FOUNTAIN.

Make a hollow globe, of copper or lead, and of a size adapted to the quantity of water that comes from the pipe (hereafter mentioned) to which it is to be fixed, and which may be fastened to any kind of pump; provided it be so constructed, that the water shall have no other means of escape than through the pipe. Pierce a number of small holes through the globe, that all tend toward its centre, and annex it to the pipe that communicates with the pump. The water that comes from the pump, rushing with violence into the globe, will be forced out at the holes, and form a very pleasing sphere of water.

THE ENCHANTED BOTTLE.

Fill a glass bottle with water to thc beginning of the neck; leave the neck empty, and cork it. Suspend this bottle opposite a concave mirror, and beyond its focus, that it may appear reversed. Place yourself still further distant from the bottle; and instead of the water appearing, as it really is, at the bottom of the bottle, the bottom will be empty, and the water seen at the top.

If the bottle be suspended with the neck downwards, it will be reflected in its natural position, and the water at the bottom, although, in reality, it is inverted, and fills the neck, leaving the bottom vacant. While the bottle is in this position, uncork it, and let the water run gradually out; it will appear; that while the real bottle is emptying, the reflected one is filling. Care must be taken that the bottle is not more than half or three parts full, and that no other liquid is used but water, as in either of these cases the illusion ceases.

THE SOLAR MAGIC LANTERN.

Make a box, a foot high, eighteen inches wide, and about three inches deep. Two of the opposite sides of this box must be quite open, and in each of the other sides let there be a groove wide enough to admit a stiff paper or paste-board, You fasten the box against a window on which the sun's rays fall direct. The rest of the window should be closed up, that no light may enter.

Next provide several sheets of stiff paper, blacked on one side. On these papers cut out such figures as your fancy may dictate; place them alternately in the grooves of the box, with their blacked sides towards you, and look at them through a large and clear glass prism; and if the light be strong, they will appear painted with the most lively colours. If you cut on one of these papers the form of a rainbow, about three quarters of an inch wide, you will have a very good representation of the natural one.

For greater convenience, the prism may be placed on a stand on the table, made to turn round on an axis.

THE ARTIFICIAL RAINBOW.

Opposite a window into which the sun shines direct, suspend a glass globe, filled with clean water, by means of a string, that runs over a pulley, so that the sun's rays may fall on it. Then drawing the globe gradually up, you will observe, when it comes to a certain height, and by placing yourself in a proper situation, a purple colour in the glass; and by drawing it up gradually higher, the other prismatic colours, blue, green, yellow, and red, will successively appear; after which, the colours will disappear, till the globe is raised to about fifty degrees, when they will again appear, but in an inverted order, the red appearing first, and the blue or violet last; on raising the globe a little higher, they will totally vanish.

THE MAGNETIC WAND.

Bore a hole, three tenths of an inch in diameter, through a round stick of wood: or get a hollow cane about eight inches long, and half an inch thick. Provide a small steel rod, and let it be thoroughly impregnated with a good magnet; this rod is to be put in the hole you have bored through the wand, and closed at each end by two small ends of ivory that screw on, different in their shapes, that you may better distinguish the poles of the magnetic bar.

When you present the north pole of this wand to the south pole of a magnetic needle, suspended on a pivot, or to a light body swimming on the surface of the water, (in which you have placed a magnetic bar,) that body will approach the wand, and present that end which contains the south end of the bar; but if you present the north or south end of the wand, to the north or south end of the needle, it will recede from it.

THE MAGNETIC CARDS.

Draw a pasteboard circle; you then provide yourself with two needles, with their opposite points touched with the magnet. When you place that needle, whose pointed end is touched, on the pivot described in the centre of the circle, it will stop on one of the four pips, against which you have placed the pin in the frame; then take the needle off, and placing the other, it will stop on the opposite point.

Having matters thus arranged, desire a person to draw a card from the picked pack, offering that card against which you have placed the pin of the dial, which you may easily do, by having a card a little longer than the rest. I he should not draw it the first time, as he probably may not, you must make some excuse for shuffling them again, such as letting the cards fall, as if by accident, or some other manœuvre, till he fixes on the card. You then tell him to keep it close, and not let it be seen. Then give him one of the two needles, and desire him to place it on the pivot, and turn it round, when it will stop at the colour of the card he chose; then taking that needle off, and exchanging it unperceived for the other, give it to a second person, telling him to do the same, and it will stop at the name of the identical card the first person chose.

BOTTLES BROKEN BY AIR.

Take a square bottle of thin glass, and of any size. Apply it to the hole in the air pump, and exhaust the air. The bottle will sustain the weight of the external air as long as it is able, but at length it will suddenly burst into very small particles, and with a loud explosion.

An opposite effect will be produced, if the mouth of a bottle be sealed so close that no air can escape: then place it in the receiver, and exhaust the air from its surface. The air which is confined within the bottle, when the external air is drawn out, will act so powerfully as to break the bottle to pieces.

ÆERIAL BUBBLES.

Take a stone, or any other heavy substance, and putting it in a large glass with water, place it in the receiver. The air being exhausted, the spring of that which is in the pores of the solid body, by expanding the particles, will make them rise on its surface in numberless globules which resemble the pearly drops of dew on the tops of the grass. The effect ceases when the air is let into the receiver.

THE MAGIC BELL.

Fix a small bell to the wire that goes through the top of the receiver. If you shake the wire, the bell will ring while the air is in the receiver; but when the air is drawn off, the sound will by degrees become fainter, till at last not the least noise can be heard. As you let the air in again the sound returns.

THE CUP OF TANTALUS.

You place a cup of any sort of metal on a stool of baked wood or a cake of wax. Fill it to the brim with any liquor; let it communicate with the branch by a small chain; and when it is moderately electrified, desire a person to taste the liquor, without touching the cup with his hands, and he will instantly receive a shock on his lips. The motion of the wheel being stopped, you taste the liquor yourself, and desire the rest of the company to do so; you then give your operator (who is concealed in an adjoining room) the signal, and he again charges the cup; you desire the same person to taste the liquor a second time and he will receive a second shock.

DANCING BALLS.

Take a common glass tumbler or glass jar, and having placed a brass ball in one of the holes of the prime conductor, set the machine in motion, and let the balls touch the inside of the tumbler; while the ball touches only one point, no more of the surface of the glass will be electrified, but by moving the tumblers about so as to make the ball touch many points successively, all these points will be electrified, as will appear by turning down the tumbler over a number of pith or cork balls placed on a table. These balls will immediately begin to fly about.

THE ELECTRIC BALLOON.

Two balloons, made of the allantoides of a calf, are to be filled with hydrogen gas, of which each contains about two cubic feet. To each of these is to be suspended, by a silken thread about eight feet long, such a weight as is just sufficient to prevent it from rising higher in the air; they are connected, the one with the positive, and the other with the negative conductor, by small wires about 30 feet in length: and being kept nearly 20 feet asunder, are placed as far from the machine as the length of the wires will admit. On being electrified, these balloons will rise up in the air as high as the wire will allow, attracting each other, and uniting as it were into one cloud, gently descending.

FIRE-GLOBES FOR THE WATER.

Bowls for water globes ought to be very large, and the wheels of them of ten sides; on each side nail a piece of wood four or five inches long; and on the outside of each piece cut a groove, wide enough to receive about one fourth of the thickness of a four ounce case; these pieces of wood must be nailed in the middle of each face of the wheel, and fixed in an oblique direction, so that the fire from the cases may incline upwards; the wheel being thus prepared, tie in each groove a four ounce case, filled with a grey charge; then carry a leader from the tail of one case to the mouth of the other.

Globes for these wheels are made of two tin hoops with their edges outwards, fixed one within the other, at right angles. The diameter of these hoops must be rather less than that of the wheel. Having made the globe, drive in the centre of a wheel an iron spindle, which must stand perpendicular, and its length be four or six inches more than the diameter of the globe.

The spindle serves for an axis, on which is fixed the globe, which must stand four or six inches from the wheel: round one side of each hoop must be soldered little bits of tin, two inches and a half distance from each other; which pieces must be two inches in length each, and only fastened at one end, the other ends being left loose, to turn round the small portfires, and hold them on; these portfires must be made of such a length as will last out the cases on the wheel. There need not be any portfires at the bottom of the globe within four inches of the spindle: as they would have no effect but to turn the wheel: all the portfires must be placed perpendicularly from the centre of the globe, with their mouths outwards; and must be clothed with leaders, so as all to take fire with the second case of the wheel; and the cases must burn two at a time, one opposite the other. When two cases of a wheel begin together, two will end together; therefore the two opposite end cases must have their ends pinched and secured from fire. The method of firing such wheels is, by carrying a leader from the mouth of one of the first cases to that of the other; and the leader being burnt through the middle, will give fire to both at the same time.

ELECTRIFIED AIR.

Fix two or three pointed needles into the prime conductor of an electrical machine, and set the glass in motion so as to keep the prime conductor electrified for several minutes. If now, an electrometer be brought within the air that is contiguous to the prime conductor, it will exhibit signs of electricity, and this air will continue electrified for some time, even after the machine has been removed into another room. The air, in this case is electrified positively; it may be negatively electrified by fixing the needles in the negative conductor while insulated, and making a communication between the prime conductor and the table, by means of a chain or other conducting substance.

The air of a room may be electrified in another way. Charge a jar, and insulate it; then connect two or three more sharp pointed wires or needles, with a knob of the jar, and connect the outside coating of the jar with the table. If the jar be charged positively, the air of the room will seldom become positively electrified likewise; but if the jar be charged negatively, the electricity communicated by it to the air, will also become negative. A charged jar being held in one hand, and the flame of an insulated candle held in the other, being brought near the knob of the jar, will also produce the same effect.

ELECTRIFIED BALL.

Provide a ball of cork about three quarters of an inch in diameter, hollowed out in the internal part by cutting it in two hemispheres, scooping out the inside, and then joining them together with paste. Having attached this to a silk thread between three and four feet in length, suspend it in such manner that it may just touch the knob of an electric jar, the outside of which communicates with the ground. On the first contact it will be repelled to a considerable distance, and after making several vibrations will remain stationary; but if a candle be placed at some distance behind it, so that the ball may be between it and the bottle, the ball will instantly begin to move, and will turn round the knob of the jar, moving in a kind of ellipsis as long as there is any electricity in the bottle. This experiment is very striking, though the motions are far from being regular; but it is remarkable that they always affect the elliptical rather than the circular form.

THE SELF-MOVING WHEEL.

The self-moving wheel is made of a thin round plate of window glass, seventeen inches in diameter, well gilt on both sides, to within two inches of the circumference. Two small hemispheres of wood are then fixed with cement, to the middle of the upper and under sides, centrally opposite, and in each of them a thick strong wire, eight or ten inches long, making together the axis of the wheel. It turns horizontally on a point at the lower end of its axis, which rests on a bit of brass, cemented within a glass salt cellar. The upper end of its axis passes through a hole in a thin brass plate, cemented to a long and strong piece of glass; which keeps it six or eight inches distance from any non-electric, and has a small box of either wax or metal on its top.

In a circle on the table which supports the wheel, are fixed twelve small pillars of glass, at about eleven inches distance ,with a thimble on the top of each. On the edge of the wheel is a small leaden bullet, communicating by a wire with the upper surface of the wheel; and about six inches from it, is another bullet, communicating, in like manner, with the under surface. When the wheel is to be charged by the upper surface, a communication must be made from the under surface of the water.

When it is well charged it begins to move. The bullet nearest to a pillar moves toward the thimble on that pillar, and passing it, electrifies it, and then pushes itself from it. The succeeding bullet, which communicates with the other surface of the glass, more strongly attracts that thimble, on account of its being electrified before by the other bullet, and thus the wheel increases its motion, till the resistance of the air regulates it. It will go half an hour, and make, one minute with another, twenty turns in a minute, which is six hundred turns in the whole, the bullet or the upper surface giving in each turn twelve sparks to the thimbles, which makes seven thousand two hundred sparks, and the bullet from the under surface receiving as many from the thimble, these bullets moving in the time nearly two thousand five hundred feet. The thimbles should be well fixed, and in so exact a circle, that the bullets may pass within a very short distance of each of them.

If instead of four bullets you put eight, four communicating with the upper, and four with the under surface placed alternately, (which eight, at about six inches distance, complete the circumference,) the force and swiftness will be greatly increased, the wheel making fifty turns in a minute, but then it will not continue moving so long.

THE ELECTRIC KITE.

Make a small cross of two light strips of cedar, the arms so long as to reach to the four corners of a large thin silk handkerchief when extended; tie the corners of the handkerchief to the extremity of the cross; and you have the body of the kite, which being properly accommodated with a tail, loop, and string, will rise in the air like those made of paper; but this being of silk, is more adapted to bear the wet and wind of a thunder gust, without tearing. To the top of the upright stick of the cross is to be fixed a very sharp pointed wire, rising a foot or more above the wood. To the end of the twine, is to be tied a silk ribbon, and where the silk and twine join, the key may be fastened. This kite is to be raised when a thunder storm appears to be coming on; and the person who holds the string must stand within a door or window, or under some cover so that the silk ribbon may not be wet; and care must be taken that the twine does not touch the frame of the door or window. As soon as any of the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, while the loose filaments of the twine will stand out every way, and be attracted by an approaching finger.

When the rain has wetted the kite and twine, so that it can conduct the electric fire freely, you will find it stream out plentiful from the key, on the approach of your knuckle. At this key an electric phial may be charged; and from electric fire thus obtained, spirits may be kindled, and all the other electric experiments performed, which are usually done by the help of a rubbed glass or tube, and thereby the identity of the electric matter with that of lightning completely demonstrated.

THE MAGICAL MIRRORS.

Make two holes in the wainscot of a room, each a foot high, and ten inches wide, and about a foot distant from the other. Let these apertures be about the height of a man's head, and in each of them place a transparent glass in a frame, like a common mirror.

Behind the partition and directly facing each aperture, place two mirrors, inclosed in the wainscot, in an angle of forty five degrees. These mirrors are each to be eighteen inches square, and all the space between them must be enclosed with paste board painted black, and well closed, that no light can enter; let there be also two curtains to cover them, which you may draw aside at pleasure.

When a person looks into one of these fictitious mirrors, instead of seeing his own face, he will see the object that is in front of the other; thus if two persons stand at the same time before these mirrors instead of each seeing himself, they will reciprocally see each other.

There should be a sconce with a lighted candle, placed on each side of the two glasses in the wainscot, to enlighten the faces of the persons who look in them, or the experiment will not have so remarkable an effect.

A LAMP THAT BURNS WITHOUT FLAME.

Around the tube of a small alcohol lamp, twist a piece of platinum wire, one hundredth part of an inch in diameter, and form about ten or a dozen convolutions above the tube with the same piece. This may be done by previously twisting the wire around a tobacco pipe. Let the cotton wick be small, having its fibres loose, and standing perpendicular in the tube, but no higher than the third or fourth convolution. The coils towards the top should gradually become smaller as they approach it. The lamp should be a little more than half filled with alcohol, ether, or even camphor. Light the wick, and when the upper coils become red hot, blow it out: all the wire above the wick will now arrive at a white heat, and continue to give out a most brilliant light as long as the alcohol, &c. continues to ascend by the capillary attracted of the cotton. In a dark room, a gentle lambent light will be seen playing round the wire.

THE CHINESE SHADOWS.

Make an aperture in a partition wall, of any size; for example, four feet in length, and two in breadth, so that the lower edge may be about five feet from the floor, and cover it with white Italian gause, varnished with gum copal. Provide several frames of the same size as the aperture, covered with the same kind of gauze, and delineate upon the gauze different figures, such as landscapes and buildings, analogous to the scenes which you intend to exhibit by means of small figures representing men and animals. These figures are formed of pasteboard, and their different parts are made moveable according to the effects intended to be produced by their shadows, when moved backwards and forwards behind the frames, and at a small distance from them. To make them act with more facility small wires, fixed to their moveable parts, are bent backwards, and made to terminate in rings through which the fingers of the right hand are put, while the figure is supported by the left, by means of another iron wire: in this manner they may be made to advance or recede, and to gesticulate, without the spectators observing the mechanism by which they are moved; and as the shadow of these figures are not observed in the paintings, till they are opposite those parts which are not strongly shaded, they may thus be concealed, and made to appear at the proper moments, and others may be occasionally substituted in their stead. It is necessary, when the figures are made to act, to keep a sort of dialogue, suited to their gestures, and even to imitate the noise occasioned by different circumstances. The paintings must be illuminated from behind, by means of a reverberating lamp, placed opposite to the centre of the painting, and distant from it about four or five feet.

Various amusing scenes may be represented in this manner, by employing figures of any animals, and making them move in as natural a way as possible, which will in a great measure depend on the address and practice of the person who exhibits them.

TO MAKE A CAMERA OBSCURA.

Make a circular hole in the shutter of a window from whence there is a prospect of the fields or street, or any other object not too near; and in this hole place a convex glass, either double or single, whose focus is at the distance of five or six feet.

Take care that no light enter the room but by this glass; at a distance from it, equal to that of its focus, place a pasteboard, covered with the whitest paper: which should have a black border to prevent any of the side rays from disturbing the picture. Let it be two feet and a half long, eighteen or twenty inches high, bend the length of it inwards, to form a part of a circle, whose diameter is equal to double the focal distance of the glass. Then fix it on a frame of the same figure, and put it on a moveable foot, that it may be easily fixed at the exact distance from the glass where the objects paint them to the greatest perfection.

When it is thus placed, all the objects that are in the front of the window will be painted on the paper, in an inverted position, with the greatest regularity and in the most natural colours. If a moveable mirror be placed without the window, by turning it more or less, all the objects that are on each side of the window will appear on the paper. If instead of placing the mirror without the window you place it in the room, and above the hole (which must then be made near the top of the shutter,) you may receive the representation on a paper placed horizontally on a table; and draw, at your leisure, all the objects that are there painted.

Nothing can be more pleasing than this experiment, especially when the objects are strongly enlightened by the sun, and not only land prospects, but a sea-port, when the water is somewhat agitated, or at the setting of the sun, presents a very delightful appearance. This representation affords the most perfect model for painters, as well for the tone of colours, as for that gradation of shades, occasioned by the interposition of the air which has been so justly expressed by some of our modern painters.

The paper must have a circular form; for otherwise, when the centre of it is in the focus of the glass, the two sides will be beyond it, and consequently the image will be confused. If the frame were contrived of a spherical figure, and the glass were in its centre, the representation would be still more accurate. If the object without be at the distance of twice the focal length of the glass, the image in the room will be of the same magnitude with the object.

The lights, the shades, and colours, in the camera obscura, appear not only just, but, by the images being reduced to a smaller compass, much stronger than in nature. Add to this, that these pictures exceed all others, by representing the motions of the several objects: thus we see the animals walk, run, or fly; the clouds float in the air; the leaves quiver; the waves roll, &c., and all in strict conformity to the laws of nature. The best situation for a dark chamber is directly north, and the best time of the day is noon.

The inverted position of the images may be deemed an imperfection, but it is easy remedied; for, by standing above the board on which they are received, and looking down on it, they will appear in their natural position: or by standing before it, and placing a common mirror against your breast in an oblique direction, upon looking down in it, the images will appear erect, and will receive an additional lustre from the reflection of the glass. This also may be done by placing two lenses in a tube that draws out. And by placing a large concave mirror at a proper distance before the picture, the figures will appear before the mirror, in the air, and in an erect position.

To magnify small objects by the sun's rays, let the rays of light that pass through the lens in the shutter, be thrown on a large concave mirror, properly fixed in a frame. Then take a slip or thin plate of glass; and sticking any small object on it, hold it in the incident rays, at a little more than the focal distance from the mirror; and the image of that object will appear on the opposite wall, amidst the reflected rays, very large and extremely clear and bright. This experiment never fails to give the spectator the highest satisfaction.

CONSTRUCTION OF THE MAGIC LANTERN.

This ingenious instrument is so well known, that it is almost needless for us to explain its object, which is, to represent, in a dark place, on a white wall or cloth, a succession of enlarged figures, of remarkable, natural, or grotesque objects. Nothing, perhaps, ever excited more wonder than this instrument, when first exhibited. Even to this day, it is a popular instrument of domestic entertainment; and is a source of profit to many wonder working foreigners, who perambulate the country, amusing the king's people by the astonishing exhibition of the Galanti show.

The magic lantern consists of a tin box, six inches square, or any other similar dimensions, with a funnel on the top, and a door on one side of it. This funnel being bent, it serves the double purpose of letting out the smoke, and keeping in the light. In the middle of the bottom of the box is placed a moveable tin lamp, which must have two or three good lights, at the height of the centre of the polished tin reflector. In the front of the box, opposite the reflector, is fixed a tin tube, in which there slides another tube. The sliding tube has at its outer extremity a convex lens, of about two inches diameter; the other tube has also a convex lens fixed in it, of three inches diameter. The focus of the smaller of these lenses may be about five inches. Between the fixed tube and the lamp, there must be a slit or opening to admit of the passage of glass sliders, mounted in paper or wooden frames; upon which sliders it is that the miniature figures are painted, which are intended to be shewn upon the wall.

The distinctness of the enlarged figures depends not only upon the goodness of the magnifying glasses, but upon the clearness of the light yielded by the lamp.

Such is the construction of the magic lantern, an instrument which is capable of yielding much amusement, which may be easily made, or may be bought ready made, with a set of painted slides, at any price.

HOW TO RESTORE A DEAD FLY TO LIFE.

This wonderful experiment, like many others, is very simple. Take a fly that has been drowned in water or spirits, place it in the sun, and cover it with salt or pounded chalk; in a short time (sometimes in a few minutes, at others in an hour), it will revive and fly away. It is necessary that the fly be not squeezed when it is taken from the water.

TO MAKE A CARD PASS FROM ONE HAND INTO THE OTHER.

Take two aces, the one of spades, the other of hearts; then put on that of spades the mark of hearts, and that of hearts, the mark of spades: which you will easily do, by splitting a card of each colour, which you are to cut out with dexterity, in order that the mark may be very neat: then rub lightly on the back of the spade and heart that you have cut, a little soap, or very white pomatum; then put the mark of spades on the ace of hearts; taking care to cover them completely, and to make all your preparations before you begin your experiment.

Divide your pack of cards in two parcels, and under each parcel you must put one of your two aces thus prepared afterwards, take with your right hand the parcel under which is the ace of hearts, and with your left that where your ace of spades is.

You will then shew to the company that the ace of hearts is on the right hand, and the ace of spades on the left; when every body is convinced of it, you are to say, ladies and gentlemen, I am going to command the ace of hearts, which is in my right hand, to pass to my left, and the ace of spades to take its place. You may even propose to have both your arms tied, to prevent their joining and communicating.

All the secret consists only in making a movement and stamping your foot, when you give your command; during this movement and stamping of your foot, you slip with dexterity your little finger on each of the marks, in order to rub off, and make the marks of spades and hearts, that were sticking on the cards by the means explained before, fall, without any body perceiving it; then you will shew to the company that the cards have obeyed your command, by passing from the right to the left, and from the left to the right, without your hands communicating.

This trick, done with dexterity and subtilty, will appear singular, although it is in reality very simple.

TO RENDER HIDEOUS THE FACES OF ALL THE COMPANY.

Dissolve some salt and saffron in some spirits of wine; dip a little tow in it, and set fire to it. At this light, those who are of a fair complexion will appear green, and the red of the lips and cheeks will turn to a deep olive colour.

HOW TO MAKE A BAROMETER.

The common barometer consists of a glass tube about thirty four inches in length, and from one fourth to one half of an inch in width, the wider the better: the top of this is closed and the bottom is open. The tube should be new, and perfectly clean within, and in order that this may be the case, it should be hermetically sealed at both ends, at the glass house, when it is made; when it is to be filled, one end of it can be easily taken off with a file. Supposing you to have the tube, the next thing required is pure mercury, without which it is impossible to make a barometer worth any thing. To fill the tube, take a small funnel of glass or paper, and pour the mercury through it in a fire continued stream, till it reaches within an inch of the top:

; s the tube fills, bubbles of air will gather in various parts, which it is impossible to avoid. It is possible, however, to clear these bubbles away: to do this, apply the finger hard against the open end of the tube, when you have nearly filled it as above directed, and slowly invert it. This proceeding causes the air in the open end to rise gradually through the mercury, gathering in its way all the air in the tube. Then slowly turn up the tube, and observe if any bubbles remain, should there be any, the inverting of the tube must be repeated till that is the case no longer. When the air is all out of the tube, the filled part will appear like a fine polished steel rod. When this operation is completed, pour in more mercury to fill the tube to the top; then, stopping the orifice again with the finger, invert the tube, and immerse the finger and end, whilst stopped, in a basin of mercury; which basin, like the tube, is the better the wider it is. When the end of the tube is perfectly plunged under the mercury, the finger must be taken away, and the mercury in the tube will subside till its surface is from twenty eight to thirty one inches above the surface of the mercury in the basin. The exact height varies according to the pressure of the atmosphere at the time. The space at the top of the tube is a perfect vacuum. The next step is to fix this tube, with the basin below it, in the best manner you are able, to a suitable frame. Then measure from the surface of mercury in the basin, twenty eight inches upwards, and draw a line on the frame; measure also thirty one inches from the mercury, and make another mark; then divide the space of three inches between the two marks, into inches and tenths and hundredths of inches; and let there be a sliding index to point to these divisions.

This scale will answer all the ordinary purposes of a stationary barometer. The chief things to be attended to by those who wish to have a good barometer are the following:—

To have a wide tube and a wide basin; to have the mercury pure and the glasses clean; that the bottom of the tube be cut off obliquely, in order that when it rests on the bottom of the basin there may be a free passage for the mercury; that, to have the quicksilver quite free from air, it is best to boil it in the tube.

TO FORETELL THE CHANGES OF THE WEATHER BY THE BAROMETER.

Notwithstanding that the phenomena of the barometer are extremely various, yet its action has in a great measure been reduced to rules, by the careful observance of which we are enabled to foresee the changes which, within some short time are to take place in the weather.

1. The rising of the mercury presages, in general, fine weather; and its falling, foul weather, as rain, snow, high winds, and storms.

2. In very hot weather, the falling of the mercury indicates thunder.

3. In winter the rising presages frost; and in frosty weather, if the mercury falls three or four divisions, there will certainly follow a thaw. But in a continued frost, if the mercury rises, it will certainly snow.

4. When the weather happens to be fair soon after the falling of the mercury, expect but little of it; and on the contrary, expect but little fair weather when it proves fair shortly after the mercury has risen.

5. In foul weather, when the mercury rises much and high, and so continues for two or three days before the foul weather is quite over, then you may expect a continuance of fair weather to follow.

6. In fair weather, when the mercury falls much and low, and thus continues two or three days before the rain comes; then expect a great deal of wet, and probably high winds.

7. The unsettled motion of the mercury denotes uncertain and changeable weather.

8. You are not so strictly to observe the words engraved on the plates, as the mercury's rising and falling; though in general it will agree with them. For if it stands at much rain and then rises up changeable, it presages fair weather; though not to continue so long as if the mercury had risen higher. And so, on the contrary, if the mercur stood at fair, and falls to changeable, it presages foul weather; though not so much as if it had sunk lower.

From the most accurate observation of the motions of the barometer, and consequent changes of the air in this country, the following conclusions have been drawn.

1. In winter, spring, and autumn, the sudden falling of the mercury for a large space, denotes high winds and storms; but in summer it denotes heavy showers, and often thunder; and it always sinks lowest of all for great winds, though not accompanied with rain; though it falls more for wind and rain together than for either of them alone.

2. After rain if the wind changes to any part of the north, with a clear dry sky, and the mercury rise, it is a certain sign of fair weather.

3. After very great storms of wind, when the mercury has been low, it commonly rises again very fast. In settled fair dry weather, except the barometer sinks much, expect but little rain: for its small sinking then is only for a little wind, or a few drops of rain; and the mercury soon rises again to its former station. In a wet season, suppose in hay time or harvest, the smallest sinking of the mercury must be minded; for when the constitution of the air is much inclined to showers, a little sinking in the barometer then denotes more rain, as it never then stands very high. And if in such a season, it rises suddenly very fast and high, expect not fair weather more than a day or two, but rather that the mercury will fall again very soon, and rain immediately follow; the slow gradual rising, and

keeping on for two or three days, being most to be depended on for a week's fair weather; and the unsettled state of the quicksilver always denoting uncertain and changeable weather, especially when the mercury stands any where about the word changeable on the scale.

4. The greatest heights of the mercury in this country, are found upon easterly and north easterly winds; and it may often rain or snow, the wind being in these points, and the barometer sinks little or none, or it may even be in a rising state, the effect of those winds counteracting. But the mercury sinks for wind, as well as rain, in all the other points of the compass; but rises as the wind shifts about to the north or east, or between those points; but if the barometer should sink with the wind in that quarter, expect it soon to change from thence; or else, should the fall of the mercury be much, a heavy rain is then to ensue, as it sometimes happens.

It is to be observed, that it is not so much the absolute height of the mercury in the tube that indicates the weather, as its motion up and down, and therefore, to pass a right judgment of what weather is to be expected, we ought to know whether the mercury is actually rising or falling; to which end the following rules are of use.

1. If the surface of the mercury is convex, standing higher in the middle of the tube than at the sides, it is a sign that the mercury is then rising.

2. But if the surface is concave, or hollow in the middle, it is then sinking.

3. If it be plain, or rather a very light convex, the mercury is stationary; for mercury being put into a glass tube, especially a small one, naturally has its surface a little convex, because the particles of mercury attract one another more forcibly than they are attracted by glass.

4. If the glass be small, shake the tube; then if the air be grown heavier, the mercury will rise about half a tenth of an inch higher than it stood before; but if it be grown lighter, it will sink as much.

CALCULATIONS OF THE PRESSURE OF THE ATMOSPHERE UPON A MAN'S BODY.

A column of mercury of twenty nine and a half inches high, and one inch in thickness, weighs just fifteen pounds, consequently, the air presses with a weight equal to fifteen pounds upon every square inch of the earth's surface; and 144 times as much or 2160 pounds, upon every squaie foot.

Reckoning the surface of a middle sized man to be about 14 square feet, he sustains a pressure from the air equal to 30,240 lbs. troy, or 11 tons 2 cwt. and 18½ lbs. It may be asked how it happens that we are not sensible of such a great pressure? The reason is, that such pressures only are perceived by us, as they move our fibres, and put them out of their natural situations. Now the pressure of the air is equal on all parts of the body, and it is balanced by the spring of the air contained in the body; therefore it cannot possibly displace any of the fibres, but, on the contrary, braces and keeps them all in their relative situations. But if the pressure be removed from any particular part, the pressure on the neighbouring parts immediately becomes sensible.

Thus, if we take a receiver open at the top, and cover it with the hand, upon exhausting the receiver, and thereby taking off the pressure from the palm of the hand, we shall feel it pressed down by an immense weight, so as to give pain that would soon be insupportable, and endanger the breaking of the hand.

A SIMPLE BAROMETER.

Take a common phial, and cut off the rim and part of the neck. This may be done by a piece of whip cord, twisted round it, and pulled to and fro quickly, in a sawing position, by two persons; one of whom holds the phial firmly in his left hand. Heated in a few minutes by the friction of the string, and then dipped suddenly into cold water, a bottle will be decapitated more easily than by any other means.

Let the phial be now nearly filled with common pump-water, and, applying the finger to its mouth, turn it quickly upside down; on removing the finger it will be found that only a few drops will escape.—Without cork, or stopper of any kind, the water will be retained within the bottle by the pressure of the external air; the weight of air without the phial being greater than that of the small quantity of water within it. Now let a bit of tape be tied round the middle of the phial, to which the two ends of a string may be attached, so as to form a loop to hang on a nail: let it be thus suspended, in a perpendicular manner, with the mouth downwards; and this is the barometer.

When the weather is clear, and inclined to be so, the water will be level with the section of the neck, or rather elevated above it, and forming a concave surface. When disposed to be wet, a drop will appear at the mouth, which will enlarge till it falls, and then another drop, while the humidity of the atmosphere continues.

TO MAKE SUGAR FROM OLD RAGS.

The conversion of starch, wood, and even rags, into sugar, will no doubt surprise persons unacquainted with chemical research, but nothing can be more true. The chemical constituents of these different substances differ but little. The abstraction of a small portion of the carbon and hydrogen from starch converts it into sugar. By digesting potatoes with diluted oil of vitriol, for a day or two, at a temperature of 212° Fahrenheit, afterwards removing the acid by chalk, and concentrating the strained liquor by evaporation, chrystals of sugar will be obtained.

Saussure produced 110 parts of sugar from 100 parts of starch, from which he concluded that sugar was a peculiar compound of water and starch. Mr. Braconnet treated elm dust with oil of vitriol in the same manner as starch, neutralizing the acid with chalk, and obtained a liquor which became gummy on evaporation. By triturating linen rags in a glass mortar with sulphuric acid, a similar gum is produced. If the gummy matter is boiled with diluted oil of vitriol, a chrystallizable sugar is obtained.

THE DIVING BELL.

The invention of the diving-bell is generally assigned to the sixteenth century. Those who had no idea of this machine, Mr. Beckman says, might have been easily led to it by the following experiment. If a drinking glass inverted be immersed in water, in such a manner that the surface of the water may rise equally round the edge of the glass, it will be seen that the glass does not become filled with water, even when pressed down to the greatest depth; for when there is air, no other body can enter, and by the above precaution the air cannot be expelled by the water. In like manner, if a bell of metal be constructed, under which the diver can stand on a stool suspended from it, so that the edge of the bell may reach to about his knee, the upper part of his body will be secured from water; and he can, even at the bottom of the sea, breathe the air inclosed in the bell.

The oldest information which we have respecting the use of the diving bell in Europe, is the relation of an exhibition at Toledo, before the emperor Charles Vth., in 1538; when two Greeks, in the presence of several thousand spectators, let themselves down under water, in a large inverted kettle, with a burning light, and rose up again without being wetted. It is described more than once in the works of Lord Bacon, who explains its effects; and remarks, that it was invented to facilitate labour under the water.

In the latter part of the seventeenth century, the diving bell appears to have been employed in undertakings of importance; particularly in attempts to recover various articles from the remains of that portion of the Spanish armada which was wrecked on the western coast of Scotland. In the year 1665, a person was so fortunate as to bring up some cannon, which, however, were not sufficient to defray the expenses. Of these attempts, and the kind of diving bell used, an account was given by a Scotch writer of the name of Sinclair.

Some years after, attempts of the like kind were renewed. A man of the name of Phipps, formed a project for searching and unloading a rich Spanish ship, which had been sunk upon the coast of Hispaniola; and represented his plan so successfully to Charles II. that the king gave him a ship, and furnished him with every thing necessary for the undertaking. He set sail in 1683, but returned without success, though with a firm conviction of the possibility of his scheme In 1687, Phipps, under new patronage, made another endeavour, and at last succeeded in weighing so much treasure, that he returned to England with the value of £200,000. sterling.

The attention of the learned in different countries, was now turned to the diving bell, the construction and use of which appears to have been understood by one Witzen, in 1671.

The great improver of diving-bells, however, in this country, was Dr. Edmund Halley. The bell which he constructed about 1717, was three feet broad at the top, five feet at the bottom, and eight feet in height: forming a cavity of sixty three cubit feet. It was covered with lead, and was so heavy that it sunk to the bottom, even when entirely empty: weights also were disposed round the lower edge, so as to insure its sinking in a perpendicular direction. In the top was fixed a piece of strong glass to admit light, and likewise a valve to give a passage to the air corrupted by the breath. Around the inner circumference of the bell was placed a seat for the divers; and a stool fixed on ropes hung below, on which they could stand in order to work. The whole was suspended from a cross-beam made fast to the mast of a ship. That the bell might be supplied with fresh air, under the water, large vessels, filled with air, and which had an opening below, through which the water compressed the enclosed air, were let down by ropes. In the top of these vessels were leathern pipes besmeared with oil, through which the diver introduced air from the vessels into the bell. The bell was thus supplied in such abundance, that Dr. Halley, and four other persons, remained under water for an hour and a half, at the depth of ten fathoms, without suffering the least injury. When the empty air vessels were drawn up, the Doctor sent his order written upon a sheet of lead with an iron spike. Dr. Halley also invented a leaden cap, in the shape of a bell, which being placed so as to cover the diver's head, enabled him to leave the greater bell when at the bottom. A thick pliable pipe, which conveyed air from the greater bell, served also as a clue to the divers to find the way back.

The last great improvement of the diving-bell was by Mr. Spalding, of Edinburgh, by whose contrivance several defects, which appeared in the construction of Dr. Halley's bell, were remedied. The sinking or raising of the bell was made no longer to depend entirely upon the people at the surface of the water; and the contrivance of a balance weight obviated the danger of being overset by the rugged prominences of concealed rocks, to which Dr. Halley's bell was liable.

BIRD LIME.

The common method is to peel a good quantity of holly bark about midsummer, fill a vessel with it, put spring water to it; boil it till the grey and white bark arise from the green, which will require twelve hours boiling; then take it off the fire, drain the water well from it, separate the bark, lay the green bark on the ground in some cool cellar, covered with any green rank weeds, such as dock thistles, hemlock, &c., to a good thickness, let it lie fourteen days, by which time it will be a perfect mucilage; then pound it well in a stone mortar till it becomes a tough paste, and none of the bark be discernible; next after wash it well in some running stream, as long as you see the least motes in it: then put it into an earthen pot to ferment, scum four or five days as often as any thing rises, and when no more comes, change it into an earthen pipkin, add a third part of capon's or goose grease to it, well clarified, or oil of walnuts, which is better; incorporate them on a gentle fire, and stir it continually until it is cold, and thus it is finished.

HOW TO USE BIRD LIME.

When lime is cold, take your rods and warm them a little over the fire; then take your lime and wind it about the top of your rods, then draw your rods asunder one from another and close them again, continually plying and working them together, till, by smearing one upon another, you have equally bestowed on each rod a sufficient proportion of lime.

OF CATCHING SMALL BIRDS IN BUSHES WITH LIME TWIGS.

The great lime bush is best for this purpose, which you must use after this manner; cut down the main branch or bough of any bushy tree, whose branch and twigs are long, thick, smooth, and straight, without either pricks or knots, of which the willows or birch trees are the best; when you have picked it and trimmed it from all superfluity, making the twigs neat and clean, then take the best bird lime, well mixed and wrought together with goose grease, which being warmed, lime all your twigs therewith within four fingers of the bottom.

A SECRET TO HINDER PIGEONS FROM QUITTING A PIGEON HOUSE.

Take the head and feet of a gelt goat, and boil them together till the flesh separates from the bone; take this flesh and boil it again in the same liquor, till the whole is consumed; bruise in this decoction, which is very thick, some potter's earth, out of which you are to get all the stones, vetch, dung, hemp, soot, and corn; the whole must be kneaded together, and reduced to a paste or dough, which form into small loaves about the thickness of two fists, and dry them in the sun or oven, and take care they do not burn; when they are baked, lay them in several parts of the pigeon house, as soon as they are set there the pigeons will amuse themselves by pecking them, and finding some taste therein which pleases them, they will keep so close to it that they will not afterwards leave it but with regret. Others get a handful of salt, which they candy, and afterwards put into the pigeon house. Some take a goat's head and boil it in water, with salt, cummin, hemp, and urine; and then expose it in the pigeon house, with which they amuse themselves. Lastly there are those who fry millet in honey, and add a little water thereto to prevent its burning; this preparation is a repast to them, and will cause them to have such an affection for their ordinary habitation, that they will be so far from abandoning themselves, that they will draw strange pigeons to it.

BIRD AND FOWL OF ALL SORTS.

Get seeds, (all sorts that fowls love) and lay them to soak in lees or mother of wine, strew it where they come, and it will fox them, so that you may take them with your hands.

TO GIVE SILVER THE COLOUR OF GOLD.

Dissolve in common aqua fortis as much silver as you please. To eight ounces of silver take four ounces of hepatic aloes, six ounces of turmeric, and two ounces of prepared tutty, that has been several times in urine. Put these to the solution of the silver; they will dissolve, but rise up in the glass like a sponge; the glass must therefore be large to prevent it running over. Then draw it off and you will have ten ounces of silver, as yellow as gold.

THE ART OF PAINTING IN OIL.

WHITES.

The principal of all whites is white lead. Of this colour there are two sorts, the one called ceruse, which is the most pure and clean part, the other is called by the plain name of white lead.

Besides white lead and ceruse, there is another sort to be met with sometimes, which they call flake white.

BLACKS.

Lamp black. Lamp, or candle black. Ivory black. Willow charcoal.

REDS.

Vermilion is the most delicate of all light reds, being of itself a perfect scarlet colour.

Lake, especially the richest sort, is the best of all dark reds, being a most pure crimson.

Red lead is the lightest of all leads now in use: it is a sandy, harsh colour, and such a one as is not easily ground very fine, although you bestow much labour on it.

Spanish brown is a dark dull red, of a horse flesh colour; it is an earth, being dug out of the ground, but there is some very good colour, and pleasant to the eye, considering the deepness of its colour; it is of great use among the painters, being generally used as the first or priming colour, that they lay upon any sort of work, being cheap and plentiful, and a colour that uses well, if it be ground fine, as you may do with less labour than some better colours require; the first sort is the deepest colour, and free from stones; the other sorts are not so good as to give a colour to the eye, but yet they serve as well as any other for a priming colour.

YELLOWS.

Yellow ochre is of two sorts, one called plain ochre, the other spruce ochre, the one is a much lighter colour than the other.

Pink yellow.

Orpiment is that colour which some call yellow arsenic.

Masticote is a good light yellow for many uses, especially in making greens, of which several sorts may be framed out of this colour, being mixed with blue.

GREENS.

Verdigrease is the best and most useful green of all others.

Green bice is of a sandy nature, and therefore not much used: green verditer is also of a sandy colour; neither of them bear any good body, and are seldom used but in landscapes, where variety is required.

BLUES.

Blue bice bears the best body of all bright blues used in common work, but it is the palest colour.

Blue verditer is a colour of no good body, but something sandy, and of no very good colour itself, being apt to turn greenish, and being mixt with a yellow produces a good green.

Indigo is a deep blue, if wrought by itself, to remedy which, whites are usually mixt, and then it is but a very faint blue.

Note, that the longer this colour is ground, the more beautiful it looks.

Smalt is the most lovely blue of all others. Of this colour there are two sorts, the finest is that called oil smalt.

Umber is a colour that really has no affinity with the others above mentioned, being neither white, black, red, yellow, blue or green, yet it is a colour of as great use as any of the rest used in common painting.

THE PRACTICE OF WORKING OIL COLOURS, AND PAINTING TIMBER WORK AFTER THE MANNER OF COMMON PAINTING.

That which is here called common painting is only the way and manner of colouring all manner of wainscoat, doors, windows, posts, rails, pales, &c., or any materials that require either beauty or preservation from the violence of the rain, or injury of weather; the method of doing which, I shall lay down as plain as I can. Suppose then, that there be a set of palisadoes, or a pair of gates, or some posts and rails to paint, and are to be finished in a stone colour, first look over the work, and take notice whether the joints be open in the gates, or if there be any large clefts in the posts, for if these are not secured, the wet will insinuate itself into these defects, and make the quicker dispatch in ruining the whole: let the first business therefore be, to stop up these places smooth and even, with a putty made of whitening and linseed oil, well beaten together on the grinding stone with a wooden mallet, to the consistency of a very stiff dough, and with this let all the crannies, clefts, and other defects be perfectly filled up, that it may be equal to the surface of the stuff, then proceed to the priming of the work with some Spanish brown well ground and mixed with some very thin linseed oil; with this do the whole over, giving it as much oil as it will drink up; this in about two days will be indifferently dry, then if you would do it substantially, do it over again with the same priming colour; when this is thoroughly dry, then with the white lead, well ground and tempered up not too thin, for the stiffer you use it, the better body will be laid on, and the thicker coat of colour that your timber is covered withal, the longer it will last; let this coat of colour be well rubbed on, and the whole surface be so entirely covered that there remain no creek or corner bare, which you may easily do by jobbing in the point of a bristle brush; let the first colouring dry, and then go over it a second time, and if you please a third also; the charge will be a little more, but the advantage will be much greater.

Now he that is able to bring the work thus far on, has proceeded to the highest pitch of common painting, and which aims at preservation as well as beauty; but this is not all, for he that has arrived thus far is in a fair way to the other perfections in the art of painting; but the panelling of wainscoat with its proper shadows, and for imitating olive and walnut wood, marble, and such like, these must be obtained by ocular inspection, it being impossible to deliver the manner of the operation by precept without example, and I am bold to affirm, that a man shall gain more knowledge by one day's experience than a hundred spent to acquire it some other way.

I advise therefore all those who desire any insight into this business, to be a little curious, if opportunity offers, in observing the manner of a painter's working, not only in grinding his colours, but also in laying them on, and working them in; in all these observing the motion of his hand in managing any kind of tool, and by this means, with a little imitation, joined to the directions here given, I doubt not but in a short time you may arrive to great proficiency in the business of common painting.

Note, that if when you have made use of your colours, there be occasion for a small cessation till the whole is finished; in this case it is best to cover the colours in your pot with water, for that will prevent their drying, even in the hottest time.

And for your pencils, they ought so soon as you have finished, to be well washed out in clean linseed oil, and then in warm soap suds; for if either oil or colours be once dried in the brush or pencil it is spoiled for ever.

It has been observed, that timber laid over with white when it has stood some time in the weather, the colour will crack and shrink up together, just as pitch does, if laid on any thing that stands in the sun; the cause of this is, that the colour was not laid on with a stiff body, able to bind itself on firm and fast.

If you have at any time occasion to use either brushes that are very small, or pencils, as in many cases there will be occasion, you ought then to dispose of the colours you use upon a pallet, (which is a wooden instrument, easy to be had at any colour shop) and there work and temper them about with your pencil, that the pencil may carry away the more colour; for you are to note, that if a pencil be only dipt into a pot of colour, it brings out no more with it than what hangs on the outside, and that will go but a little way; whereas, if you rub the pencil about the colour on the pallet, a good quantity of colour will be taken up in the body of the pencil; and besides all this you may bring your pencil better to a point on a pallet, than you can in a pot: the point of a pencil being of the greatest use in divers cases, especially in drawing lines and all sorts of flourishing.

WHAT COLOURS ARE SUITABLE AND SET OFF BEST ONE WITH ANOTHER.

By setting off best, I mean their causing each other to look more pleasant, for two of some particular colours put together, or one next the other, shall add much to the beauty of each other, as blue and gold, red and white, and so on; but green and black put together, are not so pleasant, neither doth black and umber, or haw colour, appear well.

All yellows then set off best with blacks, and blues, and with reds.

All blues set off best with whites and yellows.

Greens set off well with blacks and whites.

Whites set off well enough with any other colour.

Reds set off best with yellows, whites and blacks.

Gold looks well upon a white ground, especially if the matter to be gilt is carved.

Gold and black shews also very well.

Gold on timber colour shews also very well.

So does gold and horse flesh colour, made with the brightest Spanish brown.

But the most splendid grounds of all others for gold, are vermillion red, the smalt blue, and the lake laid on a light ground.

OF SOME COLOURS THAT ARISE FROM MIXTURE.

Ash colour is made of white lead and lamb black, if a deep ash colour, then take the more black, if a light one, then but little black, and most white.

A lead colour is made of indigo and white.

A colour resembling new oaken timber, is made of umber and white lead.

A flesh colour is compounded of lake, white lead and a little vermillion.

A buff colour, yellow ochre and red lead.

For a light willow green, verdigrease and white.

For a grass green, verdigrease and pink.

A carnation is made of lake and white.

Orange colour, yellow ochre and red lead.

A light timber colour, mix spruce ochre and white, and a light umber.

Brick colour, red lead, white and yellow ochre.

For a straw colour, white lead and a little yellow ochre.

Olive wood is imitated with ochre and a little white, veined over with burnt umber.

Wall-nut tree is imitated with burnt umber and white, veined over with the same colour alone, and in the deepest places with black.

Pales and posts are sometimes laid over with white, which they call a stone colour.

Window frames are laid in white, if the building be new, but if not they are generally laid in lead colour, or indigo and white, and the bars with red lead.

Doors and gates, if painted in panels, then the shadows of a white ground are umber and white, but if laid in lead colour, then the shadows are listed with black.

'Tis not possible to set down all those varieties of colours that may be produced by mixture.

GILDING.

TO MAKE GOLD AND SILVER SIZE.

The operation is thus for making gold size; get yellow ochre, and grind it on a stone with water till it be very fine, afterwards lay it on a chalk stone to dry; this is the common way; or wash your ochre, for when it is washed, be sure nothing but the purest of the colour will be used; besides, it is done with less daubing.

When your oil and ochre are thus prepared, you must grind them together as you do other oil colours, only with fat drying oil, but it is somewhat more laborious, and must be ground very fine, even as oil itself; for the finer it is, the greater lustre your gold carries that is laid on it.

Here note, that you must give it such a quantity of your fat oil, that it may not be so weak as to run when you have laid it on; nor so stiff that it may not work well; but of such a competent body, that after it is laid on, it may settle smooth and glossy, which is the chief property of well made gold size.

Silver size is made by grinding white lead with fat drying oil, some adding a little verdigrease to it.

TO GILD WITH GOLD, EITHER LETTERS OR FIGURES.

Whatever you would gild must be drawn with good size, according to the true portion of what you would have gilt, whether figure, letter, or whatever else it be, when you have thus drawn the true proportions of what you would have gilt, let it remain till it be sufficiently dry to gild upon, (which you know by touching it with the end of your finger,) for if your finger sticks a little to it, and yet the colour comes not off, then it is dry enough, and must be let alone longer ; for if you then lay your gold on, it would so drown it, that it would be worth nothing; but if your size should not be so dry as not to hold your finger as it were to it, then it is too dry, and the gold will not take for which there is no remedy but new sizing; therefore you must watch the true time, that it is not too wet or too dry; both extremes being not at all convenient.

When your size is ready for gilding, get your book of gold leaf, and opening a leaf of it, take it out with your cane plyers, and lay it on your gilding cushion, and if it lie not smooth, blow on it with your breadth, which will lay it flat and plain, then with a knife of cane, or for want of it, an ordinary pocket knife, that has a smooth and sharp edge; with this (being wiped very dry on your sleeve, that the gold stick not to it) let your leaf gold be cut into such suitable pieces or forms as your judgment shall think most suitable to your work.

When you have thus cut your gold into convenient forms, then take your gilding pallet, ('tis a flat piece of wood, about three inches long and an inch broad, upon which is glued a piece of fine woollen cloth of the same length and breadth.) and breathe upon it to make it dampish, that the gold may stick to it; with this tool take your gold, (by clapping it down according to discretion,) and your gold must afterwards be pressed down smooth with a bunch of cotton, or a hare's foot; and thus you must do piece by piece till you have covered all your gold size; and after it is fully dried, .then with your hare's foot brush off all the loose gold, so your gilding will be fair and beautiful.

If your work to be gilt be large, open your book of leaf gold, and lay the leaf down on your work without cutting it into pieces, and so do leaf by leaf till you have covered quite over what you intend to gild; and if some particular place should miss there, take up with a small piece of cotton, a piece of gold leaf, cut to a fit size, and clap it on, that the whole may be entirely covered; if the gold is to be laid in the hollows of carved work, you must take it up on the point of a camel hair pencil, and convey it in, and with the said pencil dab it down till it lie close and smooth.

HOW TO GILD WITH SILVER.

In laying on silver upon an oily substance, the same method in all respects is required as for gilding with gold, save only in this, that the size upon which silver is laid, ought to be compounded of a very little yellow ochre, and much white lead; for the size being of a light colour, the silver laid on it will look more natural, and retain its own colour better, the whiter the size is.

Note, That the common painters do not generally, in gilding, use more silver than gold, in most works that are not much exposed to the air, to which they afterwards give the colour of gold with lacquer varnish, made of gum lake, dissolved in spirits of wine, and laid over it.

THE ART OF PAPER-MAKING.

The origin of the art of paper making is involved in considerable obscurity; but from the closest investigation into the subject by antiquarians, it would appear that it was known and practised in China upwards of two thousand years ago. From China it is said to have found its way into Persia, from Persia to Arabia, and from Arabia to Spain, into which it was introduced by the Moors. From Spain, a knowledge of the art spread to France, about the year 1260, in Germany in 1312, and it was known to have been in England about the year 1320.

The Chinese made their paper of silk or bamboo reduced to pulp ; the Arabs did not follow this practice, but formed their paper of cotton; and the Spaniards were the first who tried the process with linen substances.

In the present day the greater part of the writing and printing paper in this and other countries is manufactured from linen rags, cut down, and reduced with water to a pulp. Papers of a coarser fabric are made from old ropes, cotton waste, and other vegetable matter ; lately we saw a remarkable fine specimen of brown packing paper made from the refuse of mangel wurzel. The rags forming the basis of nearly all the best English and Scotch papers are imported in bags from Bremen and Hamburgh, also from their appearance they seem to have composed the garments of the females in those countries whence they are derived. The rags composing the paper on which the present work is printed are imported from Bremen and Hamburgh, to which places they have been brought by travelling jew merchants and others from most parts of the north of Europe.—English rags are generally less substantial in fabric and sell at a much lower price than those of the above places ; they consequently make a paper weaker in fabric, and this insubstantiality is sometimes farther increased by the admixture of cotton and other inferior substances.

Until comparatively recent times, all kinds of paper were made by tedious and expensive process. The rags being reduced to a pulp, the matter was lifted in sieves by the hands of a workman, sheet after sheet, a practice now entirely disused except in coarse and some descriptions of writing paper. The greater part of writing, and almost the whole of the printing papers manufactured in Great Britain, are now made by machines, according to a method invented by the Messrs Fourdrinier, who may be considered the Arkwrights of paper making, which is as follows:—

After the rags have arrived in the premises, the first operation is that of picking and sorting them into different heaps, according to the quality of the paper intended to be made from them. They are then cut into small pieces of as equal a size as possible, being four or five inches square. This is done by the hand, by large broad knives fixed into a board or table, like that on a joiner's workshop. The back of the knife is towards the cutter, and is placed in a sloping position backwards from the heel to the point. This operation as well as the previous ones, is executed by women, and cutting a hundred weight is reckoned a fair day's work. After being cut, the rags are put into the dusting machine, a large circular wire sieve, which being made to revolve rapidly, effectually cleanses the rags from any dust or loose matter adhering to them. After this they are put into troughs and boiled for a certain time (according to the size of the boiler), both to cleanse them more thoroughly, and to soften them: and from thence they are lifted with a copper grate, and carried in boxes to the first washing machine The latter consists of a large oblong stone trough, into which, during the process of manufacturing, a continued stream of water is allowed to run, and being permitted to escape at the same time by a different outlet, it is kept in a manner always fresh and pure. On one side of the trough is erected the machine, which, as it serves the purpose both of washing and grinding the rags, is termed by the operatives the breaking in engine. It is of very simple construction, consisting of a roller revolving by machinery horizontally over the surface of a closely and sharply grooved plate, by which the rags are torn in shreds. The continued gush of water into one end of the trough keeps the contents continually revolving, while at the bottom are placed agitators for preventing any part subsiding to the bottom: and the whole is gradually and equally reduced to a sort of pulp. After being sufficiently ground and washed in this manner, which occupies about an hour and a half, the stuff is passed down by boxes communicating with the trough to the bleaching boxes, each of which is formed to hold a hundred weight of rags after being reduced to the state described. And we ought perhaps before to have mentioned, that the rags being all exactly weighed when dry, and previous to being subjected to any process whatever, the proper quantity of stuff is afterwards easily regulated in passing from one department to another. It has been found that a quantity of stuff which in its original state would have amounted to one hundred weight of rags, is found more suitable for bleaching. The bleaching-liquor consists simply of a strong solution of lime.

After bleaching for twelve hours, the stuff is again put into a washing machine, for the purpose of cleansing it thoroughly from the bleaching liquor. This process is exactly similar to that previously described, the only difference being, that in the latter the roller (which is in both regulated by a screw) is brought closer to the horizontal plate above described, and thus reduces the stuff to a finer quality. It is here also that the size—the addition or the want of which, as is well known, constitutes the chief difference between paper for the reception of ink and the other sorts—is added to the stuff, with the exception of that intended for the finer sorts of writing paper, which is all sized by the hand (called tub sizing) after being manufactured.

From the second washing machine the stuff is passed down to a large tun, like a brewer's vat, called the staff-chest? being merely a reservoir for holding the liquid, which now bears the closest resemblance to soured or curdled milk, preparatory to being let into the machine, where it is made into paper. In the bottom of it are agitators, which keep the liquid continually mixing, and thus preserving it in a uniform degree of thickness. From the chest the stuff is let out by a sluice into a pipe, which leads it to one end of the machine, by which it is converted into paper; the opening from whence it finally issues corresponding exactly in breadth to the machine. The quantity and thickness of the stuff admitted into the latter is regulated according to the kind of paper to be made, and this must be entrusted entirely to the experience of the workman.

The first part of the machinery upon which the stuff comes is a bass wire cloth, of so fine a texture that there are seventy wires in the inch. It is woven, we understand, exactly in the same manner as linen. This wire cloth may be described as a sort of belt without a break in it, which is kept continually revolving, but in such a way that the upper side, upon which the stuff is received, preserves a a flat horizontal surface. After passing between a pair of rollers, where it delivers the stuff, it is led backwards under the frame, and so goes on in a continuous revolution. Upon the upper surface of the wire are placed moveable sides, which, by being approached to, or drawn back from each other, regulate the breadth of the sheet to be manufactured; so that it can be made either the whole breadth of the wire cloth, or otherwise, at pleasure. By an ingenious contrivance, too, an agitated horizontal motion, similar to that given to the sieve of a pair of fanners, is communicated to the wire cloth on receiving the stuff, by which it is more equally distributed over the surface, and renders the paper of a uniform strength and thickness.

The first pair of rollers through which the stuff passes, are called the crouching rollers. The under roller is simply cast iron, while the upper one is rolled round with woollen cloth of a peculiar texture, manufactured for the purpose. It is upon this upper end that the stuff is delivered; and there are men stationed behind, where the wire leaves the rollers with small sponges, to lick it up from the wire and fix it to the roller, when the machinery is first set a going, and after which it adheres of itself. In going through the rollers, the stuff only undergoes a slight degree of compression; and it will be evident, from their different kinds of surfaces, that it can only be pressed smooth on one side. To render both sides alike, therefore, what may now be called the sheet is transferred to another pair of rollers of the very same description, where the process is simply reversed by the rough side of the paper being pressed by the cast iron roller. These last rollers are considerably closer than the first, and thus render the sheet more dry and firm. It often happens, when the sheet is passing from these rollers to the others that succeed them, that it breaks, and adheres to the wooden roller; in which event, should the broken parts be carried round on the surface of the roller, they would inevitably injure the part of the sheet that follows. In order to avert this casuality, there is affixed lengthwise along the upper surface of the roller, a large knife, resembling in breadth and sharpness a common scythe, the edge of which, being placed in a sloping manner, like the blades of a wright's plane, is brought so close to the roller, as effectually to shave off any substance that may chance to adhere to it.

This instrument is called the "doctor" and is found of the utmost utility.

After passing through one or two other pillars of rollers besides those just described, the sheet is passed on to the drying cylinders, of which there are two. They are hollow, and heated by steam, introduced through pipes at each end of their axis. By various ingenious contrivances, they are ready means of letting off the extra steam, as well as for throwing out the water that gathers within the cylinder. The latter object is accomplished by means of an instrument shaped like a corkscrew, and is wrought by machinery. The first of these cylinders is of a cooler temperature than the one behind it, in order that the paper may be dried gradually. When either of them are too hot, it is at once seen by the shrivelling of the paper, when the temperature is immediately lowered by letting out the steam. From the last cylinder the sheet is forthwith transferred, after passing through an intervening pair of rollers to smooth it after drying, to the rolling frame, upon which it is wound, and the process is complete—the paper fit for immediate use.

It has taken us some time to detail the different operations of this beautiful and extraordinary machine, although the whole process is gone through, almost with the speed of thought. Some idea of its expedition moy be gathered from the fact, that when working paper of the full breadth of the machine, a quantity of stuff equivalent to six and twenty feet of what is called common demy paper, is let into it in the course of a minute. The whole machine is not more than twelve or fourteen feet in length, into one end of which we see a white liquid resembling butter milk running in, and from the other comes forth a finished fabric, now become almost as important to mankind, in its various uses, as the art of printing itself; and without which, indeed, the latter art would lose its chief value.

It is to be observed that no break or stop takes place during the process, unless what may happen from accidents. The whole goes on continuously and uninterruptedly, with scarcely the smallest exertion of manual labour. When we beheld so great a triumph of mechanical art, one may almost be pardoned for doubting whether the wonderful machine jocularly hinted at by the Author of Waverley, where undressed flax is put in at one end and comes out at the other in the shape of finished ruffled shirts, washed, dressed, and all, be altogether chimerical.

Another remarkable fact attending this invention remains to be added, namely, that the sheet of paper can be made of any given length—fifty miles at a stretch, if such an article were necessary, and did the size of the reel admit of it. From a paragraph, indeed, which not long since appeared in the public prints, noticing a commission lately sent to a papermaker to manufacture and send ten miles of a particular sort, it seems not at all improbable that orders may soon come to be generally given and executed on such terms.

The reeling process is not behind in any other department for ingenuity. It is a double reel, moveable upon an axis, and so contrived that when one reel has received a proper quantity of paper the empty one is turned round into its place. The reeling process thus goes on uninterruptedly, while the operatives cut the paper upon the full reel into the suitable lengths and breadths, and thus have it ready for again receiving another complement. The method for ascertaining when the usual stated quantity has been put upon one reel, is by a signal given by a small machine, not bigger than a watch, the mechanism of which is connected with the reel By hands on the dial plate, too, it can be seen when the half, quarter, and so forth, of the reelful has been wound on, so that any given quantity of paper, and no more, may thus, when required, be cut off.

When the paper has been cut off the reel, it is carried to the finishing-house. Here it is first pressed, generally by a force-pump water press. It is then carefully examined, and all the dirty or broken sheets picked out and put aside. It is afterwards assorted into quires and reams, and pressed over again ; after which the parcels are ready for receiving the stamp of the exciseman. The fine writing paper is hot-pressed by placing a metal plate heated by steam betwixt every sixty or seventy sheets. A glazed pasteboard is put betwixt each sheet. After being taken out, it is carefully cut round the edges with an instrument used by book binders, called a plough, and put up in separate reams.

The best writing-papers are, we believe, made in Kent, a district in which the water is pure, or free from particles of iron, which, when they occur, mark the sheets with brown spots. Good printing papers are now made in all parts of Great Britain. Of late years great improvements have taken place in this branch of the manufacture, and we now rarely see a volume printed on bad paper. Paper making in Scotland is of a comparatively modern date: but in the present day the printing-papers made in this part of the United Kingdom compete with any manufactured in the south. One of the chief seats of the Scottish paper manufacture is on the river Esk, in Mid-Lothian.

METHOD OF SOFTENING CAST-IRON.

It consists in placing it in a pot surrounded by a soft red ore, found in Cumberland and other parts of England, which pot is placed in a common oven, the doors of which being closed, and but a slight draught of air admitted under the grate; a regular heat is kept up for one or two weeks, according to the thickness and weight of the castings. The pots are then withdrawn, and suffered to cool; and by this operation the hardest cast metal is rendered so soft and malleable, that it may be welled together, or, when in a cool state, bent almost into any shape by a hammer or vice.

ELECTRICITY OF PLANTS.

It is very easy to kill plants by means of electricity. A very small shock, according to Cavallo, sent through the stem of a balsam, is sufficient to destroy it. A few minutes after the passage of the shock, the plant droops, the leaves and branches become flaccid, and its life ceases. A small Leyden phial, containing six or eight square inches of coated surface, is generally sufficient for this purpose, which may even be effected by strong sparks from the prime conductor of a large electrical machine. The charge by which these destructive effects are produced, is probably too inconsiderable to burst the vessels of the plant, or to occasion any material derangement of its organization; and, accordingly, it is not found, on minute examination of a plant thus killed by electricity, that either the internal vessels or any other parts have sustained perceptible injury.

THE ÆOLOPHON.

In shape, size, and compass, the Æolophon is the counterpart of a cabinet piano forte, having six octaves of keys extending from F F to F; and its sounds are produced by a series of metallic springs, set in vibration by the action produced from a bellows. It has three pedals—one for filling the wind chest, and the others regulating the swell. The tone of this instrument, particularly in the middle and lower parts of its compass, is among the most beautiful we have ever heard, and much superior, both in body and quality, to that of any chamber organ of equal size ; added to which the Æolophon has the inestimable advantage of never varying its pitch, or getting out of tune.

From the nature of this instrument, it will be readily conceived that its best effects are displayed in slow movements, and the sustaining and swelling long notes: but, to our surprise as well as pleasure, we found that a running passage, even of semitones, could be executed upon it, if not with all the distinctness of a Drouet or a Nicholson, with as much clearness as on any organ. As an accompaniment to the piano forte, it would be found an admirable substitute for the flute, clarionet, oboe, bassoon, or even the violincello; but suppose its widest range of usefulness will be discovered in small orchestras, the effects of any, or even all of which, may be supplied by one or two performers on the Æolophon leading from the score, or even from separate parts.

WONDROUS EFFECTS OF CHEMISTRY.

Not to mention the impulse which its progress has given to a host of other sciences, what strange and unexpected results has it not brought to light in its application to some of the most common objects! Who, for instance, would have conceived that linen rags were capable of producing more than their own weight of sugar, by the simple agency of one of the cheapest and most abundant acids?—that dry bones could be a magazine of nutriment, capable of preservation for years, and readily to yield up their sustenance in the form best adapted to the support of life, on the application of that powerful agent, steam, which enters so largely into all our processes, or of an acid at once cheap and durable?—that saw dust itself is susceptible of conversion into a substance bearing no remote analogy to bread; and though certainly less palatable than that of flour, acts no way disagreeable, and is both wholesome and digestible, as well as highly nutritrive.

HUMAN TIME-PIECE.

J D. Chevalley, a native of Switzerland, has arrived at an astonishing degree of perfection in reckoning time by an internal movement. In his youth he was accustomed to pay great attention to the ringing of bells, and vibration of pendulums, and by degrees he acquired the power of continuing a succession of intervals exactly equal to those which the vibrations or sounds produced. Being on board a vessel, on the Lake of Geneva, he engaged to intimate to the crowd around him the lapse of a quarter of an hour, or as many minutes and seconds as any one chose to name, and this during a conversation the most diversified, with those standing by; and farther to indicate, by the voice, the moment when the hand passed over the quarter, minutes, or any other sub-division previously stipulated, during the whole course of the experiment. This he did without mistake, notwithstanding the exertions of those about him to distract his attention, and clapped his hands at the conclusion of the time fixed. His own account of it is thus given.—"I have acquired, by imitation, labour, and patience, a movement which neither thought, and labour, nor any thing can stop; it is similar to that of a pendulum, which, at its motion of going and returning, gives me the space of three seconds, so that twenty of them make a minute—and these I add to others continually."

TO RESTORE TAINTED GAME, OR MEAT, SO AS TO BE FIT FOR USE

Prepare it for cooking, then wrap the game in a fine linen cloth closely sewed in every part, so as to prevent any dust or cinders getting in; when this is done, take a fire shovel full of hot charcoal or live coal, and throw into a bucket of cold water, and dip the game into it, and allow it to remain five minutes; and, upon taking it out, all the offensive smell will be removed, and it will be perfectly fit for use, but it must be dressed immediately.

RECIPE FOR BURNS.

For a burn by vitriol or by any similar cause, apply the white of eggs, mixed with powdered chalk, and lay it over the burnt parts with a feather, and it will afford immediate relief. This has been tried most successfully on a child who had accidentally taken some vitriol into its mouth.

RECIPE FOR THE STING OF A WASP, BEE, OR OTHER INSECT.

Wet the part stung, and rub a piece of indigo upon it, which will instantly remove the pain.

TO MAKE COFFEE.

There are various recipes for preparing and refining coffee; the following is the best that has ever come under our view, and is available in all places Procure your coffee fresh roasted and not too brown, in the proportion of a quarter of a pound for three persons. Let it be Mocha, and grind it just before using. Put it in a basin, and break into it an egg yolk, white, shell and all. Mix it with a spoon to the consistence of mortar, place it with warm—not boiling—water in the coffee pot, let it boil up and break three times, then stand a few minutes, and it will be as clear as amber, and the egg will give it a rich taste.

USE OF SALT TO PREVENT STAINS.

If red wine, fruit, jams, &c. &c., be spilt on a table cloth, the anti-economical mode of removing them is either to apply bleaching liquor at home, or if we are too idle, or too much occupied, or too careless about the matter, we give general directions to our laundress, and she either extracts the stains or not, "as it may happen;" and too often, if the former, it is done with so little caution, that the liquor is spilled where it is not required, and not being noticed, cannot be washed out, and the consequence is, that beautiful table linen is frequently found with holes that are perfectly unaccountable to the owner of them; and blame attaches, in consequence, to every one, from the bleacher to the shopkeeper, when she alone is in fault. Bleaching liquid is very seldom required to be used in a family if due attention be paid to a stain. The moment it is made, let salt (common table salt) be rubbed on the spot before it have time to dry. The use of the salt is to keep it damp till the cloth is taken to the wash, when, without any further trouble or attention, it will entirely disappear by the usual process of washing. If the stain have had time to dry, the application of salt will too often fail in the effect intended; and then the use of bleaching liquor will probably be required. This if cautiously rinsed out from the linen, will not injure cotton or linen goods.

ECONOMISING OF STEAM POWER.

Of late years, considerable efforts have been made by practical engineers to economise the powers exerted by steam engines. The attempts at improvement have only in a small degree been directed to the make or form of engines, for that appears to have reached almost as high a degree of perfection as is consistent with our existing knowledge; the main object has been to economize heat, or to produce a greater revolution and expansive force of steam, without increasing the consumption of fuel. This is an age of saving; what is more necessary to save than the expensive material, coal, the grant, agent of heat to the steam engine? Of such consequence is it to economise fuel, that in some districts every thing may be said to depend on it; and the nearer we can bring the expense of steam to water power, so much more scope is there given for planting manufactories in situations where water power is deficient.

Various plans have been adopted for saving heat. One consists in constructing the boiler, with its furnace and flues, of such a form as will extract and use the largest quantity of the heat envolved. The boiler best suited for receiving heat before passing off, is that which is of a long and round shape, and against not only the lower but the side parts of which the fire has room to act. This exact form, however, is well known to engine makers. Fully as necessary a requisite is the regulation of the admission of air to the fire; and, as far as we can judge, the intensity of heat is increased, without additional expense, by allowing waste steam to be injected into the furnace, either above or below the bars, thus furnishing a supply of oxygen in an easy and effective form. Another point requiring attention is to surround the whole of the exterior part of the boiler, or the building in which it is encased, with non conducting substances. No part of any boiler should ever be open to the air, though below a roof. All parts should be well covered. In the case of high pressure steam engines, the disengaged or waste steam is usually blown away into the atmosphere, which is a voluntary loss of heat.

If not required for any other purpose, such as heating a house, the waste steam should be condensed by blowing it into a water cistern, and so raising the temperature of the water before being pumped into the boiler. It would be easy in this way to raise the temperature of the cold water to boiling pitch, but this is not desirable, for a pump will not work in water above a certain temperature; if the water be heated beyond this, the action of the sucker draws a vapour from the fluid, insteading of causing the required vacuum, and, consequently, the pump labours at its work, which labour is a decided loss of power to the engine.

If the water in the cistern be raised to eighty or ninety degrees, there will be a gain of from twenty to thirty degrees of heat, and there will be a corresponding saving of fuel. The heating of the water, by the agency of waste steam in an enveloping pipe, on its passage from the pump to the boiler, is a still more effectual means, when properly managed, of elevating the temperature; the water may in this way be raised to 180 degrees before it be injected; of course, if steam, not waste, is employed in this process, the gain is met by a corresponding loss.

These, at best, are but superficial observations on the economising of heat in reference to steam, and we wish we could point to any definite and well considered rules on the subject. A series of experiments was lately made by Dr. Andrew Fyfe on the evaporative powers of different kinds of coal, a notice of which appears in the Edinburgh New Philosophical Journal for April; but not being sufficiently practical, the experiments tend to scarcely any useful purpose. He observes—"Numerous methods have been recommended for securing the perfect combustion of all the gaseous matter, such as the cautious introduction of the fuel near the front of the furnace, instead of throwing it carelessly over the whole heap in a state of combustion, by which the gradual discharge of the volatile matter is occasioned, and which, being thus expelled and passed over the ignited fuel, should be burned, provided air in sufficient quantity is present. Many others have also been proposed, such as that patented by Mr. Williams of Liverpool, which consists in allowing air to flow by small streams into the furnace behind the bridge, by which the volatile matter that has escaped combustion is to be consumed. Another is that lately introduced by Mr. Ivison of this place. It consists in throwing in small jets of steam at the front of the furnace, immediately over the surface of the fuel, at the same time admitting air, at the furnace-door or otherwise, also over the fuel. Keeping out of view these and other contrivances of a similar nature, it is evident that the power of anthracite [coal] is far beyond that of other kinds of fuel, more particularly when it is of good quality, that is, rich in fixed carbon, simply because there being little, indeed in some kinds of it we may say no volatile inflammable matter, the whole of the combustible substance is consumed, and the only loss of heat arises from that which must pass up the chimney and by which a draft is secured, besides what is given off in the flues and otherwise by communication, through the materials of the furnace."—*From Chambers's Edinburgh Journal.*

IMPROVEMENT IN THE MANUFACTURE OF PAPER HANGINGS.

In the extensive paper works of Messrs. J. Evans and Co., at Alder Mills, near Tamworth, there is an ingenious and very beautiful piece of mechanism, the invention of Messrs. Evans, for the printing of paper-hangings, which cannot fail to produce a complete change in this department of our manufactures, from its superiority over the ordinary method of block printing. The Messrs Evans would have brought their invention into practical operation many years ago, had it not been for the heavy duties imposed on the manufacture of stained papers, which, by limiting the consumption, rendered their invention comparatively useless; a fact which supplies another argument against the imposition of heavy duties upon the manufacturing skill and industry of the country. In connection with the present invention, we may here state that the Messrs. Evans took out a patent in February last for an important improvement in the manufacture of paper, by the application of a pneumatic pump in the compression of the moisture from the pulp, by which means the substance is almost instantaneously converted into paper. By this invention they are, we understand, enabled to manufacture a continuous sheet of paper six feet in width, and nearly two thousand yards in length, every hour. This paper, as it is taken off the reel, is in every respect fit for immediate use, and is conveyed on rollers to another part of the mill, in which the printing machinery is erected, through which it is passed with great rapidity, and receives the impression of the pattern intended to be produced, with all the precision and beauty of finish which machinery alone can effect.

In order to connect the operations of the paper making and printing machines, the Messrs. Evans have enlarged their premises, and are consequently enabled to print, glaze, and emboss the most complicated and delicate patterns in pager hangings, in every variety of shade or colour, as rapidly as the paper can be manufactured. Some idea may be formed of the power of the machinery, and the importance of the invention, when we state that the machinery is capable of working at a rate which will produce sixteen hundred and eighty yards per hour, consisting of two very beautiful patterns, the only hand labour necescessary being that of one man to superintend the machinery, and four girls to roll up the paper in pieces of the required length.

The whole process of manufacturing the paper from the pulp, and impressing it with the complicated patterns, is carried on within a comparatively small space, and with a precision and rapidity which affords another instance of the progress and triumph of science, of mechaniaal skill in supplying the necessaries and comforts of civilised life.

DOUBLE STARS.

There are certain stars, which, though appearing single to the naked eye, are found to be double on examination with a telescope. The first idea with respect to these was, that their proximity was apparent only, arising from their being both so placed as to present themselves nearly in one line to the eye, while the smaller are really at a vast distance behind the larger. The inquiries of Sir William Herschell showed that this notion was erroneous, and that the most of the double stars are systems, in which the lesser revolves round the larger, as a planet moves round the sun, or that the two stars revolve round a common centre of gravity, serving as suns to each other.

That eminent astronomer made a catalogue of 500 which has since been greatly increased. M Struve, a continental astronomer, has given a list of 3057, which he ascertained by an examination of 120,000 stars. It hence appears that about one star in forty may be considered double; but the proportion is greatest in the large ones. Among 2374 stars from the first to the sixth magnitude in one region of the heavens, Struve found 230 double ones, or about one in ten. As the two stars generally differ much in brightness, the presumption, is, that the double stars appear more numerous in those of higher magnitudes, only because the distance of the other is too great to permit the secondary or smaller stars to be seen. When the southern hemisphere is fully explored, it is anticipated that the number of double stars will be found to amount to 5000 or 6000. There are also triple stars, of which fifty-two have been noted.

The two stars usually exhibit different intensities of light, and different colours. The larger or brighter is generally white, yellow, or red; the smaller is in a few cases green, but most commonly blue. The blue tint is believed to be generally what is called an "accidental colour;" in other words it is analogous to the blue shade which a feeble white light shade assumes when brought near a strong red one. There are cases, however, where the colour cannot be explained by contrast; and it is believed that blue is the real colour of some of these stars.

It is remarkable, that, of sixty or eighty thousand stars, whose positions are assigned in catalogues, the colours are all classed as white, red, or yellow; and that blue stars are only found in those binary groups which have but lately excited attention. The ancient writers speak only of white and red stars; and it is curious that Sirius, which is now white, is ranged by them among the red stars. An extremely brilliant star, which appeared in 1572, was first perfectly white, then yellow, next red, lastly, a "livid white," like Saturn, which tint continued till it disappeared. As it was only observed with the naked eye, it is possible that it may have ultimately assumed the blue tint, though the means of detecting its existence in this state were then wanting.

It has been supposed that the blue or green stars may be suns which are in the process of waning; or that these shades may indicate combustion, proceeding with different degrees of intensity: or that the blue or green colour may be developed by the action of the light of the more brilliant stars on an atmosphere in the smaller, possessing an absorbent power.

By taking the angles of position with a telescope, the periods of revolution cannot be discovered. There are eight binary groups in which the element has been determined. The shortest is 43 years, and the next 58, the next 88, and the others vary from 253 to 1200 years. The eccentricity which in the larger planets of our system is less than one-tenth, is found to vary from about five tenths to eight tenths, in several of these groups where it has been ascertained; so that, while the orbits of our planets approach to circles, those of the double stars are eclipses very greatly elongated. Very little is yet known of the triple stars; but in Zeta of the Crab, the two inferior stars are found to revolve round the principal one; and in Psi of Cassiopeia, which consists of one brilliant star and two smaller ones, it is conjectured that the latter revolve round each other, and at the same time round their more brilliant companion—a combination of motions similar to what takes place between the earth and the moon, and the sun. The phenomena of these double and triple stars assures us of what was only matter of conjecture before, that the same law of attraction operating in the inverse ratio of the squares of the distances, which governs the motions of our solar system, extends to the utmost boundaries of the visible universe.

The study of the double stars has brought us to the verge of new discoveries of surpassing interest and grandeur. We know at present the extent and boundaries of the solar system; we know, at the same time, that it is but a minute speck in the visible creation; but science has hitherto failed us in our attempts to connect, by appreciable measurements, our sun with those millions of kindred bodies which are spread around us in the depths of celestial space.

M. Arago shows that the double stars, when carefully observed for a greater length of time, will afford us data to determine, first, their distance from the earth; and, secondly, what is still more wonderful, their masses. We shall be able, in fact, to weigh those distant bodies, as we have already weighed the planets of our system. "The day in which the distance of a double star shall be determined, will be the day on which it may be weighed, in which we shall know how many millions of times it contains more matter than the globe. We shall thus penetrate into its internal constitution, though it may be removed from us more than 120,000,000,000,000 of leagues!' There are, two methods by which this knowledge can be obtained. The first is, the method of parallaxes, depending on the space the observer is carried through in the annual motion of the earth round the sun. By a telescope with a necrometer, a change even so small as the tenth of a second may be measured in the distance of two independent stars, whose apparent places are within two or three minutes of one another. Now, if the one is really at a great distance behind the other, as must be the case in some instances, the annual change of the observer's position will produce an appreciable difference in the space which separates the stars; and data may be procured in this manner when attempts to measure absolute change of angular elevation in any particular star, give no certain results from being confounded with errors caused by variations in the instrument.

The other method, which is novel in conception, and highly curious, depends on the progressive motion of light. If the orbit of a revolving or satellite star presents near its edge to the observer's eye, it is evident that during one half of its revolution it is constantly receding from the observer, and during the other half constantly approaching him. Supposing its light to take thirty days in travelling to the earth from the nearest point to its orbit, it will require more than thirty days to reach the earth from the farthest point. Hence it will appear to spend more time in one half of its orbit than the other; and the difference betwixt the calculated and the apparent time of its transit through the nearest and farthest points of its orbits supplies the astrometer with the data he requires. The two observed semi revolutions differ from each other by the double of the time which the light takes to pass across the star's orbit. Hence half the difference of time expressed in seconds, and multiplied by 200,000, the number of miles which light travels in a second, will give the diameter of the orbit. This element known, the distance from the earth is easily known.

Thus a new feature in the mechanism of the heavens in unfolding itself. It was conjectured that the stars were suns; and the conjecture is not only confirmed, but we already know the periodic times of some of the bodies which revolve round them. But as our solar system includes eleven planets, not one of which would be visible from the nearest star with such telescopes as ours, we may infer with safety, that only a very few of the largest of those revolving stars are or can be known to us with our present instruments, while numberless bodies, like planets, are performing their course unseen by us, many of them doubtless accompanied by satellites or moons, which we can still have less hope of bringing within the sphere of our vision. Every advance astronomy makes, discloses new views of the immensity and grandeur of the universe, and sinks into greater insignificance this little globe of ours, which, in the eye of the uninstructed man, is the only large and stable body in the creation. Nothing shews man so "noble in reason, so infinite in faculties," as astronomy.

CEMENTS.

Cements require to be of very various compositions, and different with respect to the nature of the ingredients, according to the manner in which they are to be applied; and the substances they are to conjoin. The kinds of cement used for common purposes pass under the denomination of glues, sizes, pastes, and lutes: but some, that are used for extraordinary occasions, retain only the general name of cements.

COMMON GLUE.

Common glue is formed by extracting the gelatinous parts of cuttings or scraps of coarse leather, or the hides of beasts, by means of long boiling with water: but this being carried on as a gross manufacture by those who make it their proper business, the giving a more particular account of the method practised would be deviating from the proper design of this work.

ISINGLASS GLUE.

Isinglass glue is made by dissolving beaten isinglass in water; and, having strained it through a coarse linen cloth, evaporating it again to such a consistence, that being cold the glue will be perfectly hard and dry.

A great improvement may be made in this glue by adding spirit of wine or brandy to it after it is strained, and then renewing the evaporation till it gain the due consistence. Some soak the isinglass in the spirit or brandy for some time before it is dissolved, in order to make the glue, and add no water, but let the spirit supply the place of it.

The isinglass glue is far preferable to common glue for nicer purposes: being much stronger, and not so liable to be softened either by heat or moisture.

STRONG COMPOUND GLUE.

Take common glue in very small or thin bits, and isinglass glue: and infuse them in as much spirit of wine as will cover them, for at least twenty four hours. Then melt the whole together; and while they are over the fire add as much powdered chalk as will render them an opake white.

GLUE THAT WILL RESIST MOISTURE.

Dissolve gum sanderac, and mastic, of each two ounces, in a pint of spirit of wine; adding about an ounce of clear turpentine. Then take equal parts of isinglass, and parchment glue, (formed by treating parchment in the manner above directed for the isinglass, only allowing six quarts of water to a pound of the parchment; and giving a proportionable time for the boiling,) and, having beaten the isinglass into small bits, as for common uses, and reduced the glue to the same state, pour the solution of the gums upon them; and melt the whole in a vessel well covered; avoiding so great a heat as that of boiling water. When melted, strain the glue through a coarse linen cloth; and then putting it again over the fire, add about an ounce of powdered glass.

This preparation may be best managed in balneo mariæ, which will prevent the matter burning to the vessel; or the spirit of wine from taking fire: and indeed it is better to use the same method for all the nicer glues, and sizes; but, in that case, less water than the proportion directed, should be added to the materials.

A very strong glue, that will resist water, may also be made by adding half a pound of common glue or isinglass to two quarts of skimmed milk, and then evaporating the mixture to the due consistence of the glue.

GLUE FOR CEMENTING PAPER, SILK, &c.

Take of isinglass, and parchment glue, each one ounce, of sugar candy, and gum tragacanth, each two drachms. Add to them an ounce of water, and boil the whole together, till the mixture appears, when cold, of the proper consistence of glue. Then form it into small rolls, or any other figure, that may be most convenient.

This glue being wet with the tongue, and rubbed on the edges of the paper, silk, &c., that are to be cemented, will, on their being laid together, and suffered to dry, unite them as firmly as any other part of the substance.

SIZES.

Common size is manufactured in the same manner, and generally by the same people, as glue. It is indeed glue left in a moister state, by discontinuing the evaporation before it is brought to a dry consistence: and therefore further particulars respecting the manufacture of it are needless here.—Isinglass size may also be prepared, in the manner above directed for the glue, by increasing the proportion of the water for dissolving it; and the same holds good of parchment size; and a better sort of the common size, which may be made by substituting cuttings of glover's leather instead of the parchment.

PASTES.

Paste for cementing is formed principally of wheaten flour boiled in water till it be of a glutinous or viscid consistence.

It may be prepared of these ingredients simply for common purposes: but when it is used by bookbinders, or for paper hangings to rooms, it is usual to mix a fourth, fifth, or sixth of the weight of the flour of powdered resin; and where it is wanted still more tenacious, gum arabic, or any kind of size, may be added.

In order to prevent the paste used for hanging rooms with paper, or where it is employed in any other way that may render it subject to such accidents, from being gnawed by rats and mice, powdered glass is sometimes mixed with it: but the most effectual and easy remedy is to dissolve a little sublime, in the proportion of a drachm to a quart, in the water, used for making the paste; which will prevent, not only rats and mice, but any other kind of vermin and insects from preying on the paste.

LUTES.

Lutes are cements employed for making good the joints of glasses put together, or other such like purposes, in chemical operations. In a general view the preparation of them conmonly belongs to the art of chemistry only; but as they are nevertheless sometimes used in other arts, it may be expedient to shew here the manner of compounding them.

In the making good junctures, where the heat is not sufficient to burn paper or vegetable substances, a mixture of linseed meal or wheaten flour and whiting, in the proportion of one part of the first to two of the last, tempered with a solution of gum Senegal or arabic in water, and spread upon the joint, a narrow piece smeared with the same being put over it and pressed close, will be found effectual; or a piece of bladder smeared with gum water, or the glair of eggs, and fitted to the glasses over the joint, will answer the same purpose; but in the rectification of spirit of wine or other such volatile substances, where the waste made by the escape of the vapour may be material, a stronger lute formed of quick silver, tempered to a proper consistence with drying oil, should be used. This mixture should be made at the time that it is wanted, as it very soon becomes dry and untractable; and great care must be taken where it is employed, to manage the heat in such a manner, that the vapour may not rise so fast as to heat the vessels beyond the due point; for this lute renders the glasses joined together by it as one entire body ; and will resist the expansive force of the paper to so great a degree, that the glasses will frequently burst before it will give way.

Where lute is to be used in places liable to be so heated as to burn vegetable or animal substances, it should be compounded of two parts of green vitriol calcined to redness, and one part of the scoria or clinkers of a smith's forge well levigated, with as much Windsor loom or Stourbridge clay dried and powdered, tempered to a proper consistence with the blood of any beast; some short hair, of which the proportion may be as a twentieth part to the whole, being beaten up with them.

In cases of little importance, a composition of sand, clay, and dung of horses may be used.

CEMENT FOR JOINING BROKEN GLASSES, CHINA, &c.

The cement, which has been most approved for uniting glass, or earthen ware, as also the parts of metalline bodies (where soldering is not expedient) is thus prepared.

Take two ounces of good glue, and steep it for a night in distilled vinegar; boil them together the next day; and having beaten a clove of garlic with half an ounce of ox gall into a soft pulp, strain the juice through a linen cloth, using pressure, and add it to the glue and vinegar. Take then of sanderac powdered, and turpentine, each one drachm, and of sarcocol, and mastic, powdered, each half a drachm; and put them into a bottle with an ounce of highly rectified spirit of wine. Stop the bottle: and let the mixture stand for three hours in a gentle heat; frequently shaking it. Mix this tincture also with the glue while hot; and stir them well together with a stick or tobacco-pipe, till part of the moisture be evaporated; and then take the composition from the fire; and it will be fit for use.

When this cement is to be applied, it must be dipt in vinegar; and then melted in a proper vessel, with a gentle heat; and when stones are to be cemented, it is proper to mix with it a little powdered tripoli or chalk; or, when glass is to be conjoined, powdered glass should be substituted.

I see no reason why common vinegar should not be equally proper for this purpose with the distilled; nor indeed am I very certain that vinegar improves in the least the cementing property of the composition.

For the uniting the parts of broken china or earthenware vessels, as also glass where the rendering the joint visible is not of consequence, the following composition, which is much more easily prepared, may be substituted for the foregoing.

Take an ounce of Suffolk cheese, or any other kind devoid of fat, grate it as small as possible; and put it, with an equal weight of quicklime, into three ounces of skimmed milk.

Mix them thoroughly together: and use the composition immediately.

Where the broken vessels are for service only, and their appearance is not to be regarded, the joints may be made equally strong with any other part of the glass, by putting a slip of thin paper, or linen, smeared with this cement over them, after they are well joined together by it. This method will make a great saving in the case of glasses employed for chemical, or other similar operations.

Drying oil with white lead is also frequently used for cementing china, and earthen ware: but where it is not necessary the vessels should endure heat or moisture, isinglass glue with a little tripoli or chalk is better.

CEMENT FOR JOINING MARBLE, ALABASTER, &c.

Take of bees-wax two pounds, and of resin one pound. Melt them; and add one pound and a half of the same kind of matter powdered, as the body to be cemented is composed of; stewing into the melted mixture, and stirring them well together; and afterwards kneading the mass in water, that the powder may be thoroughly incorporated with the wax and resin. The proportion of the powdered matter may be varied, where required, in order to bring the cement nearer to the colour of the body on which it is to be employed.

This cement must be heated when applied; as must also the parts of the subject to be cemented together; and care must be taken likewise, that they be thoroughly dry.

It appears to me that the proportion of the bees-wax is greater than it ought to be; but I receive this recipe from too good an authority to presume to alter it. When this composition is properly managed, it forms an extremely strong cement, which will even suspend a projecting body of considerable weight, after it is thoroughly dry and set: and is therefore of great use to all carvers in stone, or others who may have occasion to join together the parts of bodies of this nature.

CEMENTS FOR ROCK-WORK, RESERVOIRS, AND OTHER SUCH PURPOSES.

A variety of compositions are used as cements for purposes of this kind: in the application of which, regard should be had to the situation where they are employed with respect to moisture, and dryness; as well as to the magnitude of the bodies to be conjoined together, or the vacuities or fissures that are to be made good.

Where a great quantity of cement is wanted for coarser uses, the coal ash mortar (or Welsh terras as it is called) the cheapest and best; and will hold extremely well, not only where it is constantly kept wet: but where it is liable to be exposed to wet and frost, it should, at its being laid on, be suffered to dry thoroughly before any moisture have access to it; and, in that case, it will also be an improvement to temper it with the blood of any beast.

This mortar or Welsh terras must be formed of one part of lime and two parts of well-sifted coal ashes; and they must be thoroughly mixed by being beaten together; for, on the perfect commixture of the ingredients, the goodness of the composition depends.

Where the cement is to remain continually under water, the true tarras is commonly used; and will very well answer the purpose. It may be formed of two parts of lime, and one of plaster of Paris; which should be thoroughly well beaten together; and then used immediately.

For the fixing of shells, and such other nice purposes putty is generally used; but, it may be formed of quick, lime, and dry oil, mixed with an equal quantity of linseed oil; or, where the drying quick is not necessary, it may be made with lime and crude linseed oil, without the drying oil.

The stone cement, prepared as above of the bees-wax and resin, is also an extremely good composition for this purpose; but resin, pitch, and brick dust, in equal parts melted together and used hot, are much the cheapest cement for shell-work; and will perform that office very well, provided the bodies they are to conjoin be perfectly dry when they are used.

SEALING WAX.

SEALING WAX IN GENERAL.

Sealing wax is a cement formed of the resins, gum resins, or bodies of a similar nature, tinged with some pigment to give the colour desired : which cement ought to be capable of resisting moisture, and of being melted or growing soft by a gentle heat, and becoming hard and tenacious on its again growing cold.

Most of the resinous bodies, as seed and shell lac, mastic, sandarac, gum gutta, gamboge, resin, turpentine, and bees wax, have been applied to this purpose, and even sulphur (though improperly, from its disagreeable fumes on burning) has been added.

There are two kinds of sealing wax in use, the one hard, intended for sealing letters, and other such purposes, where only a thin body can be allowed : the other soft, designed for receiving the impressions of seals of office to charters, patents, and other instruments of writing.

As there is with respect to the hard sort of wax a better

HARD GREEN SEALING WAX.

Proceed as in the above; only, instead of vermillion, use verdigris, powdered; or, where the colour is required to be bright, distilled or crystals of verdigris.

HARD BLUE SEALING WAX.

As the above; only changing the vermillion for smalt well powdered; or, for a light blue, verditer may be used; as may also a mixture of both.

HARD YELLOW SEALING WAX.

As the above; only substituting masticot; or where a bright colour is desired, turpeth mineral, instead of the vermillion.

HARD PURPLE SEALING WAX.

As the red; only changing half the quantity of the vermillion for an equal or greater proportion of smalt, according as the purple is desired to be blue or redder.

UNCOLOURED SOFT SEALING WAX.

Take of bees wax one pound, of turpentine three ounces, and of olive oil one ounce. Place them in a proper vessel over the fire, and let them boil for some time; and the wax will then be fit to be formed into rolls or cakes for use.

COMPOSITION OF RED, BLACK, GREEN, BLUE, YELLOW, AND PURPLE, SOFT SEALING WAX.

Add to the preceding composition, while boiling, an ounce or more of any ingredients directed above for colouring the hard sealing wax; and stir the matter well about, till the colour be thoroughly mixed with the wax.

The proportion of the colouring ingredients may be increased, if the colour produced by that here given, be not found strong enough.

THE MANNER OF FORMING SEALING WAX INTO STICKS, BALLS, ROLLS, OR CAKES; AND PERFUMING IT.

The hard sealing wax is generally formed into sticks, as the most expedient figure for sealing letters; but for par ticular purposes it is also made up in balls. The soft wax is promiscuously wrought into rolls, or cakes; as either are equally suitable to the use it is applied to.

In order to form hard sealing wax into sticks, a copper plate, or stone, big enough to allow of its being rolled out to a due length, with a rolling board lined with copper or block tin, having a proper handle, is wanting; as likewise a small portable earthen furnace or stove for burning charcoal. The copper plate, or stone, must have a very smooth surface; and may be in dimensions from two to three feet long, and about two feet broad; and it must be so fixed, as to admit of its being kept of a moderate heat while it is used. The rolling board may be about a foot long, and about eight or ten inches in breadth; and the lining of block tin or copper, ought to be used. The rolling board may be about a foot long, and about eight or ten inches in breadth; and the lining of block tin or copper, ought to be polished.

The furnace or stove for the charcoal used for this purpose, is made in the shape of a water pail, with bars near the bottom for supporting the coal, and notches at the top of the sides for putting the wax over the fire; but it is needless to be more particular with regard to the construction of these furnaces or stoves; because they are to be had ready at the earthen-ware shops.

The manner of using these several implements for forming the wax into sticks, is thus:—Take a proper quantity of the wax out of the vessel in which it is prepared; as soon as the ingredients appear duly commixed; and put it on the plate or stone; where having drawn it out into a longish figure, it must be rolled with the board upon the plate or stone, till it be of the thickness of which the sticks are required. It must then be cut into proper lengths or sticks; and it will be fit to receive the fire polish.

The fire polish is performed by putting one of the sticks through the notches in the furnace or stove, over a fire of charcoal, which must be previously made in it; where it must be continued and turned about, till the wax be so melted on the surface, that it becomes fluid as water, and run to a perfectly smooth and shining surface; when being taken out of the heat, and suffered to cool till it can be handled without affecting the polish, the other end must be put over the fire, and turned about in the same manner till the whole be well polished.

The difficulty of this operation lies in adjusting properly the heat of the plate or stone on which the wax is rolled, so as to keep it of a due consistence without softening or melting it to such a degree as to make it run, or adhere to the plate or rolling board; as also in regulating properly the fire in the furnace or stove for giving the fire-polish. It is so difficult to fix a standard for degrees of heat in these cases, that no positive rules can be laid down in points of this nature; but the conduct must be left in a great measure to the judgment of the operator; who may, nevertheless, soon find by trial how to accommodate these matters properly.

Hard sealing-wax may be formed into balls by putting a proper quantity on the plate or stone; and having fashioned it into a round form, rolling it with the board till it be smooth.

The soft wax is easily formed into rolls, or cakes, by pouring the melted mass of the ingredients, as soon as they are duly prepared, into cold water; and then, while they are yet so soft with the heat as to admit of, working them with the hands into any figure desired.

Sealing wax either hard or soft, may be scented by most of the perfuming ingredients, used for other purposes; and the quantity, choice, and proportion to each other of the respective ingredients, are entirely arbitrary, and dependent on taste or fancy. I will, however, give a recipe or two, in order to show the manner of using each kind of ingredient; beginning with the most complex.

Take in proportion to a pound of the wax of Benjamin half an ounce, of oil of rhodium one scruple, of musk ten grains, and of civet and ambergrise, each five grains. Powder the Benjamin, musk, civet, and amber grise together; and then rub the oil of rhodium among them; and when the wax is ready to be wrought into sticks, sprinkle in the mixture; and stir it well about, that it may equally diffuse among the wax.

The following is, however, a simple composition; but will be found much more grateful to most persons; as there are many to whom the scent of musk and civet are very disagreeable.

Take of Benjamin one ounce, of oil of rhodium one scruple and a half, and of ambergris five grains. Treat them as the foregoing.

In perfuming the soft wax, the Benjamin may be omitted; as it requires a considerable heat to produce the scent to any effectual degree; but that alteration being made, either of the preceding compositions may be used; as in the case of the hard wax; and the ingredients may be added to the olive oil, before it be mixed with the bees wax and turpentine; or to the mass after it has boiled a due time; or to prevent the dissipation of the scent which heat occasions, the perfuming mixture may be worked or kneaded into the wax, by the hand; keeping it soft by holding it in a gentle warmth before the fire.

TO MAKE BLACKING.

Three ounces of ivory black; two ounces of treacle; half an ounce of vitriol; half an ounce of sweet oil; a quarter of a pint of vinegar, and three quarters of a pint of water. Mix the oil, treacle, and ivory black gradually to a paste; then add the vitriol, and, by degrees, the vinegar and water. It will produce a beautiful polish.

PATENT STOP WATCH.

Mr. P. F. Goughy, late of Paris, has, in conjunction with Mr. French, of London, patented an improved stop watch, which the editor of the "Mechanics Magazine" considers to be "one of the most ingenious and useful contributions to horological mechanism," which has been made within his recollection. It enables us, for the first time, to determine with infinitessimal exactness, by means of a common pocket watch (the improvement, of course, being applied to it,) the precise instant of time at which any particular occurrence takes place; such as an eclipse or occultation of any of the heavenly bodies, the transit of a racer past the winning post; or of a railway locomotive going at four times the speed of the swiftest racer, past any given point of its course. The bearer of the watch has but to press, with his finger, a small projecting knot at the outer case, at the moment the moving object crosses his vision, and the information is obtained. On referring to the dial plate, he sees the instant at which the event took place, indicated by a supplementary second hand, previously concealed from view, by being placed exactly under the ordinary second-hand, and revolving with it, but now made (by the pressure on the outer knot), fixed and stationary, until the observation is written off, when by another pressure of the finger, this supplementary hand is made instantly to resume its original position, and to rotate with the other hand as before—the second wheel continuing, in the meantime perfectly undisturbed. The patentee describes, in his specification, seven different methods of carrying the principle of this admirable invention into effect. The details of the first and best methods will be found, illustrated with engravings, in the "Mechanic's Magazine," No 882

GLASS WEAVING.

Few are aware that glass is now woven into silk, although its brittle nature would appear to render such a method of manufacturing it impossible. The fact, however is indisputable, the new material being substituted for gold and silver thread, than either of which it is more durable, possessing besides the advantage of never tarnishing.

What is technically called the warp, that is, the long way of any loom manufactured article, is composed of silk which forms the body and ground work, on which the pattern in glass appears as the wet or cross work. The requisite flexibility of glass thread for manufacturing purposes is to be ascribed to its extreme fineness, as not less than fifty or sixty of the original threads (produced by steam engine power,) are required to form one thread for the loom. The process is slow, as not more than one yard can be manufactured in twelve hours. The work, however, is extremely beautiful, and comparatively cheap, inasmuch as no similar stuff, where bullion is really introduced, can be purchased for any thing like the price at which this is sold; added to this, it is so far as the glass is concerned, imperishable. Some admirable specimens of the manufactured article were exhibited at the Polytechnic Institution, Regent Street, especially two patterns of silver on a blue and red ground, and another of gold on crimson. The jacquard loom by which it is woven was also exhibited at the same establishment.

SMOKE PROTECTOR.

Mr. Wallace has exhibited and explained to the British Association his apparatus for enabling persons to enter places on fire without danger from smoke, by means of breathing through water. A box of tin, containing the water, is placed on the man's back with tubes connected, forming a ring round the body and straps for the shoulders. A hood of Mackintosh cloth, glazed in front, is put on the head, and being attached to the side tubes, four gallons of water will enable a person to bear the densest smoke for twenty minutes. The protector resembles the diving apparatus in appearance.

NOVEL APPLICATION OF CAOUTCHOUC.

Mr. Brokeden has recently detailed to the Royal Institution his "New Application of Caoutchouc." This was, the stopping of bottles, decanters, and other bottles, by means of a mould or form of felted wool covered with India Rubber. Humbolt mentions in his researches, that the natives of South America use the material for stopping vessels. In that low latitude, the softness and elasticity of Caoutchouc always remains; but in the winter of our climate it sets so hard, that, once placed in the bottle, and hardened there, it could not be withdrawn. This appeared to present an insuperable difficulty to the adoption of Caoutchouc in England for the same purpose; but a plug has been formed of felted wood, then covered with a thin sheet or film of rubber, the hardening of the rubber never equalling the elasticity of the wool: and thus a light, elastic, and impenetrable stopper, perfectly air-tight and durable, has been obtained. Mr. Brockendon thus described the preparation of the wool:—Threads are bundled together in the form of a long rope, and then fulled until the fibres felt and consolidate to the degree of hardness required. This, for stoppers as a substitute for common corks, is left soft enough to remain cylindrical, and be pressed into the vessel. The stopper is shorter than a cork, and is placed in the bottle with much greater facility than by the present bottling process; for the stopper fitting, with slight pressure, perfectly air tight, condenses the air in the neck of the bottle, and would spring out again, but that a small wire with a groove in it is first placed in the mouth of the bottle; the stopper is then pressed with the finger down in its place, and the air escapes through the groove in the wire. The wire is then withdrawn, and the stopper kept in its place by the pressure of the atmosphere as well as its adhesion to the neck of the bottle. So perfectly may the air be thus withdrawn, that not a particle may remain in the bottle, and the mass will appear like crystal If the liquid be effervescent, a flat disk of metal is to be wired over the top of the stopper and the bottle. For stopping decanters, the wool rope is felted hard enough to be turned in a lathe into the conical form required; this is covered with the sheet rubber; and this stopper is, upon slight moisture, so air tight, that the most delicate wines may be kept in perfect condition from day to day whilst a glass remains in the bottle. Some claret drinkers, who do not drink a bottle a day, will feel this to be a valuable discovery. The stoppers are manufactured by Morden and Co. Another form of stopper is, the overlaying of flat felt with a shell of rubber, and then cutting out circular pieces, which are placed in the metal disks. These are placed upon the mouths of the bottles, (not in them,) and then wired down. Those in use have been found to answer perfectly for quiet liquors. This form does not require a corkscrew: the stoppers placed in the bottles are withdrawn with a corkscrew, which enters the wood with more ease, and holds more firmly, than in a common cork. Many modes of forming the sheet rubber were described by cutting leaves or veneers from blocks of solid rubber, which had been formed by mastication in an engine, and then pressed into the form of a block. Of these veneers, 18 inches long and 9 wide, eight or nine weigh a pound, and cost five or six shillings; and Mr. Brockendon particularly recommended these for the purpose of covering pickle and preserve jars, as a substitute for the bladder usually employed—a foul and offensive matter, liable to decay, and destroy the things it was intended to preserve; the sheet of rubber, on the contrary, is pure and clean, and may, after washing in warm water, be again and again used. Other modes of obtaining sheet rubber for covering the stoppers were described, viz, by making solutions with naptha and other insolvents thin enough to cast on metal plates or on glass; and with a thicker solution, by rolling out the dissolved rubber into sheets upon cloth previously wetted; when the rubber thus rolled out had sufficiently hardened by the evaporation of the solvent, it could not be stripped from the cloth, and when free from any smell left by the solvent, it could be applied to covering the stoppers. The stoppers can be sold at a price per gross less than that of the common corks. They are not in the least degree affected by or affect spirits, wine, beer, cider, and common drinks, since neither alcohol nor the vegetable acids have the slightest action upon Indian rubber: they, with slight pressure, close perfectly air tight; and they do fix as glass stoppers do in the decanters.

CHEMICAL CHANGE IN A FAIR LADY'S COMPLEXION.

It is well known that white oxide of bismuth, under the name of pearl white, is used as a cosmetic, by those of the fair sex who wish to become fairer. A lady thus painted was sitting in a lecture room, where chemistry being the subject, water impregnated with sulphurreted hydrogen gas (Harrogate water) was handed round for inspection. On smelling this liquid, the lady in question became suddenly black in the face. Every one was of course alarmed at this sudden chemical change; but the lecturer explaining the cause of the phenomenon, the lady received no further injury, than a sulutary practical lesson to rely more on mental than personal and artificial beauty in future.

INVISIBLE INK.

Dissolve green vitriol and a little nitrous acid in common water. Write your characters with a new pen. Next infuse small Aleppo galls, slightly bruised, in water. In two or three days, pour the liquor off. By drawing a pencil dipped in this second solution over the characters written with the first, they will appear a beautiful black.

TO PREPARE A CANDLE THAT WILL NOT BLOW OUT.

Put some salt upon a linen rag, and roll it round the candle: you may then light the candle, and it will burn all away, even if you have it out all the while in a strong wind.

TO PUT ALE AND WATER IN A GLASS WITHOUT MIXING THEM.

Fill your glass half full of ale, and set it upon a table, then put a silk handkerchief over the glass, and press it down to the surface of the ale; you may then gently fill the glass with water, and draw up the handkerchief, and you will see the water upon the ale without mixing in the least.

TO DIVERSIFY THE COLOURS OF FLOWERS.

Fill a vessel of what size or shape you please, with good rich earth, which has been dried and sifted in the sun then plant in the same a slip or branch of a plant bearing a white flower (for such only can be tinged), and use no other water to water it with, but such as is tinged with red, if you desire red flowers; with blue, if blue flowers, &c. With this coloured water, water the plants twice a day, morning and evening, and remove it into the house at night, so that it drink not of the morning dew for three weeks. You will then experience that it will produce flowers, not altogether tinctured with that colour wherewith you watered it, but partly with the natural.

ILLUSTRATION OF THE ART OF CALICO-PRINTING.

Boil a piece of white muslin for a few minutes in a solution of sulphate of iron, composed of one part of green sulphate of iron, and eight of water, squeeze it out and dry it. Then imprint upon it spots of any pattern you choose, with lemon juice; render it dry again, and rinse it well in water. If the stuff now be boiled with logwood chips and water, it will exhibit white spots on a black ground.

THE KALEIDOSCOPE.

The principal parts of the Kaleidoscope are two reflecting planes made of glass or metal, or any other reflecting substance, ground perfectly flat, and highly polished. These reflectors may have any magnitude, but in general they should be from four or five to ten or twelve inches long, their greatest breadth about an inch when the length is six inches, and increasing in proportion as the length increases When these two parts are put together at an angle of 60, or the sixth part of a circle, and the eye placed at the narrow end, it will observe the opening multiplied six times, and arranged round the centre.

WINDOW GLASS.

Window glass is usually composed of only two materials, kelp and fine white sand. Pearl ashes and other alkalis are, however, sometimes used instead of the former. Kelp, it is well known, is produced by the burning of sea weed. It is cut from the rocks for this purpose in the months of May, June, and July; and after being spread out for some time to dry, it is gathered together and thrown into a pit, where it is reduced to a state of fusion by fire. When cool, it becomes a hard solid substance, and is then broken up into small portable masses for the convenience of transportation. The kelp which is intended to use in glass making is broken first into very small pieces by a machine called a stamper. It is then put through a mill, ground to a fine powder, and afterwards passed through a brass-wire sieve. The sand, again, with which it is to be mixed, is usually washed in a large vat with either boiling or cold water, until the latter runs quite clear off. It is sometimes, also, put into an annealing or calcining arch, where it is subjected to a strong heat for twenty four hours, and then plunged into water. When this operation is completed, the sand, of which the best for the purpose of the glass maker is procured from Lynn Regis, in Norfolk, is mingled with the kelp powder in proportions adjusted by the experience of the mixer, but generally in the degree of the former to two parts of the latter. When thoroughly mixed, the compost is put into a calcining arch or reverberatory furnace; where it is reduced to a semi fluid state. This substance, which is technically called frit, is then taken from the furnace, spread on a plate of iron, and, before becoming quite cool, is broken into large cakes. It is then thrown into the melting pot, together with a proportion of what is called cullet, which is simply broken crown glass, and in about thirty to thirty six hours the whole is reduced by a powerful heat to fine liquid glass, and is then ready for the operation of the workman, having been previously skimmed to remove all extraneous substances from the surface.

The melting pot is made of the finest clay, and is subjected to a tedious and extremely troublesome process of annealing or tempering before it can be used for its ultimate purpose. The best clay for making these pots is got from Stourbridge, in England. When the glass is in a perfect liquid state, an iron tube of about six or seven feet in length is dipped into it, and a portion of the metal gathered on the end of it. This is afterwards blown into the shape of a large globe. By a subsequent operation, a small aperture is made in the centre of this sphere on the side opposite to that on which it is attached to the iron rod held by the workman; the latter, now holding the globe before the mouth of the furnace until it has become sufficiently ductile to yield readily to any impression, twirls it round with great velocity, when the aperture already spoken of gradually widens till it reaches a certain point, when the globe which is also gradually losing its spherical form, suddenly fles open with a loud ruffiing noise, and becomes a plane or circular sheet of glass of about fifty inches in diameter. This is an exceedingly beautiful operation, and well worth seeing. After undergoing a process of tempering or annealing, the sheet is divided in two with a diamond, and in this shape it comes into the handle of the glazier.

Although there are several substances that will cut glass, there is none that answers so well for this purpose, or that will last so long when thus employed, as the diamond. Dr. Wollaston, after much labour, succeeded in giving a sapphire, ruby, spinel ruby, rock-crystal, and several other substances, the peculiar curvilinear edge which forms the cutting point of the diamond, and was thus enabled to cut glass with them, but these substances soon lost their edge, whereas that of the diamond will endure for many years, though in constant daily use. The cutting point even of the diamond, however, must be a natural one; no artificial point will do this; neither will any point produced by simply fracturing the mineral. The diamond of a ring, for instance, will not cut glass, but merely mark it with rough, obvious, superficial lines. The smooth, deep effective cut necessary to divide glass, can only be produced, as already said, by a natural point. The diamond used by the glazier is called a spark, being extremely minute. It is set into a metal socket, which again is attached to a wooden handle four or five inches long. The glazier's diamond is of the description known by the name of bort, which includes all such pieces as are too small to be cut, or are of bad colour, and consequently unfit for ornamental purposes, These are selected from the better sort, and sold at an inferior price.

SEAMEN'S LIFE PRESERVER.

The invention of Mr. A. Symington, of Kettle, consists of a peculiarly constructed jacket or belt, which can be bound at pleasure round the waist; it is light and flexible, and when immersed in water, its buoyancy is so powerful, that it will not only keep the head above water, but also part of the shoulders, and preserve the body afloat for a great length of time.

GEARY'S PATENT WOOD PAVING.

This patent embraces about twenty differently formed blocks for paving streets, tram roads, and railways. The form designated "the bevil shoulder block" is stated to be superior to all others, and to possess all the advantages of the Whitehall and Oxford street paving (considered to be the most successful specimens in the metropolis), without the objection of pinning These blocks are on a self supporting principle, each acting on a shoulder, and cross jointed; thereby preventing the rising or sinking of any block, but allowing each to be easily taken out for repairing or laying gas or water pipes. Another great advantage of Mr. Geary's plan is the introduction of a pyramid bearing block every ten or twelve feet, so as to divide the pressure and form the pavement into a succession of arches across the street, instead of one continual bearing line from curb to curb.

NEW ALLOYS.—CAST STEEL.

A manufacturer, of Paris, has invented a composition much less oxidizable than silver, and which will not melt at less than a heat treble that which silver will bear; the cost being less than 4d. per ounce.

NEW PROCESS OF PRINTING IN COLOURS.

Mr. Charles Hancock, the eminent animal painter, has patented a new method of painting, engraving, and printing in colours, so as to present a perfect fac simile of the original. The means are briefly as follow. An outline is first etched and transferred to as many plates as there are positive colours in the picture; and any required gradations of light and shade in each colour are produced upon the plate assigned to that colour, by any of the ordinary modes of engraving. The different plates are then printed from in succession, with the colours appropriate to each; the chief care required being that of adjustment, so that one impression shall not, in the slightest degree, overlay another. Two or three engravers can, by this process, work simultaneously from the same picture, and a greater number of copies can be produced in a given time than has hitherto been done by any other method. The cost of each series of plates is not more than that of one plate engraved in the usual way, the metal only excepted; while against the extra expense of working must be placed the saving of the print colourers charge. This process, it is stated, will be found equally valuable to some of our manufactures—the ornamenting of china, for example, paper hangings, cottons, silks, &c.; particularly as the process can be applied to surfaces engraved in relief and printed at a type press, as well as to the ordinary modes of copper plate engraving and printing.

NEW METHOD OF CASTING IRON.

An Englishman at Brussels has discovered a mode of casting iron, so that it flows from the furnace pure steel, better than the best cast steel in England, and almost equal to what has undergone the process of beating. The cost of the steel is only a farthing per lb. greater than that of cast iron.

NEW METHOD OF CUTTING WOOD.

Messrs. Taylor and Wilmot have patented an invention of cutting wood into staves for all kinds of cooperage, shingles, park pales, &c. The blocks of wood to be cut is first submitted to steam for half or three quarters of an hour, and softened; which not only does not injure the fibre, but by destroying animal life and vegetable fungi, greatly improves the substance, and renders it more durable. It is then presented to the knives, either acting in a perpendicular direction and chopping right down, or set in circular iron plates, and working with immense velocity as they go round cutting the block into the required forms in length, breadth, and thickness, with perfect accuracy stroke, or the circular cut (as either machine is employed), is as easy as if it were slicing butter, and there is not a particle of saw dust, chipping, or waste of any kind.

ADULTERATION OF BONE DUST.

It appears that saw-dust, slacked lime, and numerous other ingredients, are now mixed with bone manure; so that in some cases the admixture not only destroys the nutritive qualities of the bone dust, but is most injurious to turnip seed. The great increase in the use of this fertiliser renders these facts important. Large quantities are now imported from abroad, in addition to the enormous mass annually collected in this country;—thus it appears that in 1823, the declared value of bone imported was £14,397; in 1837, it was £254,600, and since that period that amount has probably doubled.

PRINTING FOR THE BLIND.

The first copy of the Bible ever printed for the use of the blind has been completed by Mr. Alston, at the blind Asylum, Glasgow. It is in 15 volumes, super royal quarto, double pica: nine volumes of 200 copies each, and six volumes of 250 copies each; in all 3,300 volumes There are 2,470 pages, each page containing 37 lines

1,160 reams of paper, weighing $8\frac{1}{2}$ lbs. each ream: 9,800 lbs. The paper was made on purpose, strongly sized, to retain the impression. In order to account for the size of the work, it must be borne in mind that it can only be printed on one side, in order to suit the touch. The printing is effected by a copper-plate printing press. The types being strongly relieved, and liable to give way under the heavy pressure required, it has been necessary to have them recast no less than four times during the progress of the work. There are in the opposite department, one man and one boy as compositors, who were taught in the Institution; and one pressman, the ordinary teacher acting as corrector of the press. The New Testament is completed in four volumes, super-royal quarto, in great primer. There are 633 pages, forty two lines in each pages; 450 reams of paper, the same as made for the Bible, weighing 3,125lbs.; 250 copies. There have been published altogether by the Glasgow Asylum, 10,850 volumes printed for the blind.

THE IRISCOPE.

Dr. Reade has published to the British Association the following experiment, with an instrument which he called an Iriscope. A piece of black polished glass was rubbed over in part with a solution of Castile soap; as soon as it was dry, the soap was polished off with a glove, until as far as appearances were concerned, that one part of the glass was as clean as the other. He then blew his breath on the plate through a tube about half an inch in bore, and instantly the most vivid rings of colours (resembling Nobili's) were exhibited where the breath condensed on the part of the glass which had been previously soaped; while, on the other part, the condensed breath exhibited simply the usual dead grey colour.

GAS-LIGHTING, LONDON.

For lighting London and its suburbs with gas, there are eighteen public gas-works: twelve public gas-work companies: £2,800,000 capital employed in works, pipes tanks, gas-holders, apparatus; £450,000 yearly revenue derived. 180,000 tons of coals used in the year for making gas; 1,460,000,000 cubic feet of gas made in the year; 834,200 burners supplied to about 400,000 customers; 30,400 public, or street consumers; about 2,560 of these are in the city of London; 380 lamplighters employed; 176 gas-holders, several of them are double ones, capable of storing 5,500,000 cubic feet of gas used in the longest night, say 24th of December; about 2,500 persons employed in the metropolis alone in this branch of manufacture: between 1822 and 1827, the consumption was nearly doubled; and, between 1827 and 1837, it was again nearly doubled.

SPONTANEOUS HEATING OF CAST-IRON.

Cast iron, when brought into the air, after it had been for many years under salt and water, has become red hot. Thus, in June, 1836, some cannon balls were raised from the ship, Mary Rose, which sunk in the naval engagement near the Isle of Wight, in July, 1545, nearly 300 years before These balls all became hot on exposure to the air, and fell to pieces. The cast-iron gratings, after being long immersed in the porter-vats in the large breweries of London, grow hot, when the porter is drawn off, from a similar cause.

JETS OF FIRE.

Jets of fire are a kind of fixed rockets, the effect of which is to throw up into the air jets of fire, similar to jets of water. They serve also to represent cascades; for if a series of such rockets be placed horizontally on the same line, it may be easily seen that the fire they emit, will resemble a sheet of water. When arranged in a circular form, like the radii of a circle, they form what is called a fixed sun.

To form jets of this kind, the cartridge for brilliant fires must, in thickness, be equal to a fourth part of the diameter, and for Chinese fires only to a sixth part.

The cartridge is loaded on a nipple, having a point equal in length to the same diameter, and in thickness to a fourth part of it; but as it generally happens that the mouth of the jet becomes larger than is necessary for the effect of the fire, you must begin to charge the cartridge, as the Chinese do, by filling it to a height equal to a fourth part of the diameter with clay, which must be rammed as if it were gunpowder. By these means the jet will ascend much higher. When the charge is completed with the composition you have made choice of, the cartridge must be closed with a tompion of wood, above which it must be choaked.

The train or match must be of the same composition at that employed for loading; otherwise the dilation of the air contained in the hole made by the piercer, would cause the jet to burst.

Clayed rockets must be pierced with two holes near the neck, in order to have three jets in the same place.

If a kind of top, pierced with a number of holes be added to them, they will imitate a bubbling fountain.

Jets intended for representing sheets of fire ought not to be choaked. They must be placed in an horizontal position, or inclined a little downwards.

It appears to us that they might be choaked so as to form a kind of slit, and be pierced in the same manner; which would contribute to extend the sheet of fire still farther. A kind of long narrow mouth might even be provided for this particular purpose.

TO MAKE FIRES OF DIFFERENT COLOURS.

It is much to be wished that, for the sake of variety, different colours could be given to the fire works at pleasure; but though we are acquainted with several materials which communicate to flame various colours, it has hitherto been possible to introduce only a very few colours into that of inflamed gunpowder.

To make white fire, the gunpowder must be mixed with iron or rather steel filings.

To make red fire, iron sand of the first order must be employed in the same manner.

As copper filings, when thrown into a flame, render it green, it might be concluded, that if mixed with gunpowder, it would produce a green flame; but this experiment does not succeed. It is supposed that the flame is too ardent, and consumes the inflammable part of the copper too soon. But it is probable that a sufficient number of trials have not yet been made; for it is not impossible to lessen the force of gunpowder in a considerable degree, by increasing the dose of charcoal.

However, the following are a few of those materials which, in books on pyrotechny, are said to possess the property of communicating various colours to fire works.

Camphor mixed with the composition, makes the flame to appear of a pale white colour.

Raspings of ivory, give a clear flame of a silver colour inclining a little to that of lead: or rather a white dazzling flame.

Greek pitch produces a reddish flame, of a bronze colour.

Black pitch, a dusky flame, like a thick smoke, which obscures the atmosphere.

Sulphur, mixed with a moderate quantity, makes the flame appear bluish.

Sal ammoniac and verdigris give a greenish flame.

Raspings of yellow amber communicate to the flame a lemon colour.

Crude antimony gives a russet colour.

Borax ought to produce a blue flame; for spirit of wine, in which sedative salt, one of the component parts of borax, is dissolved by means of heat, burns with a beautiful green flame.

Much, however, still remains to be done in regard to this subject; but it would add to the beauty of artificial fire-works, if they could be varied by giving them different colours; this would be creating for the eyes a new pleasure.

TO MAKE GLOBES ON THE WATER.

These globes, or fire balls, are made in three different forms; spherical, spheroidal, and cylindrical; but we shall here confine ourselves to the spherical.

To make a spherical fire ball, construct a hollow wooden globe of any size at pleasure, and very round both within and without, so that in thickness it may be equal to about the ninth part of the diameter. Insert in the upper part of it a right concave cylinder, the breadth of which may be equal to the fifth part of the diameter; and having an aperture equal to the thickness, that is, to the ninth part of the diameter. Insert in the upper part of it a right concave cylinder, the breadth of which may be equal to the fifth part of the diameter; and having an aperture equal to the thickness, that is, to the ninth part of the diameter. It is through this aperture that the fire is communicated to the globe, when it has been filled with the proper composition, through the lower aperture. A petard of metal, loaded with good grained powder, is to be introduced also through the lower aperture, and to be placed horizontally.

To ascertain whether the lead, which has been added to the globe, renders its weight equal to that of an equal volume of water, rub the globe over with pitch and grease, and make a trial, by placing it in water.

The composition by which the globe must be loaded, is as follows; to a pound of grained powder, add thirty two pounds of saltpetre reduced to fine flour, eight pounds of sulphur, one ounce of scrapings of ivory, and eight pounds of saw dust previously boiled in a solution of saltpetre, and dried in the shade, or in the sun.

Or, to two pounds of bruised gunpowder, add twelve pounds of saltpetre, six pounds of iron filings, and one pound of Greek pitch.

It is not necessary that this composition should be beaten so fine as that intended for rockets; it requires neither to be pulverised nor sifted; it is sufficient to be well mixed and incorporated. But to prevent it from becoming too dry, it will be proper to besprinkle it with a little oil, or any other liquid susceptible of inflammation.

TO MAKE GLOBES WHICH LEAP OR ROLL ON THE GROUND.

Having constructed a wooden globe with a cylinder, similar to that above described, and having loaded it with the same composition, introduce into it four petards, or even more, loaded with good grained gunpowder to their orifices, which must be well stopped with paper or tow. If a globe be prepared in this manner, and fired by means of a match, it will leap about as it burns, on a smooth horizontal plane, according as the petards are set on fire.

Instead of placing these petards in the inside, they may be affixed to the exterior surface of the globe; which they will make to roll and leap as they catch fire. They may be applied in any manner to the surface of the globe.

A similar globe may be made to roll upon an horizontal plane with a very rapid motion. Construct two equal hemispheres of pasteboard, and adjust in one of them three common rockets filled and pierced like flying rockets that have no petard; these rockets must not exceed the interior breadth of the hemisphere, and ought to be arranged in such a manner that the head of the one shall correspond to the tail of the other.

The rockets being thus arranged, join the two hemispheres, by cementing them together with strong paper, in such a manner that they shall not separate, while the globe is moving and turning, at the same time the rockets produce their effect. To set fire to the first, make a hole in the globe opposite to the tail of it, and introduce into it a match. This match will communicate fire to the first rocket; which, when consumed, will set fire to the second by means of another match, and so on the rest; so that the globe, if placed on a smooth horizontal plane, will be kept in continual motion.

It is here to be observed, that a few more holes must be made in the globe, otherwise it will burst.

The two hemispheres of pasteboard may be prepared in the following manner: construct a very round globe of solid wood, and cover it with melted wax: then cement over it several bands of coarse paper, about two inches in breadth, giving it several coats of this kind, to the thickness of about two lines. Or, what will be still easier and better, having dissolved, in glue water, some of the pulp employed by the paper makers, cover with it the surface of the globe; then dry it gradually over a slow fire, and cut it through in the middle; by which means you will have two strong hemispheres. The wooden globe may be easily separated from the pasteboard by means of heat: for if the whole be applied to a strong fire the wax will dissolve, so that the globe may be drawn out. Instead of melted wax, soap may be employed.

TO MAKE AERIAL GLOBES, CALLED BOMBS.

These globes are called aerial, because they are thrown into the air for a mortar, which is a short thick piece of artillery of a large calibre.

Though these globes are of wood, and have a suitable thickness, namely, equal to the twelfth part of their diameters, if too much power be put into the mortar, they will not be able to resist this force ; the charge of powder there, fore must be proportioned to the globe to be ejected. The usual quantity is an ounce of powder for a globe of four pounds weight; two ounces for one of eight, and so on.

As the chamber of the mortar may be too large to contain the exact quantity of powder sufficient for the fire ball, which ought to be placed immediately above the powder in order that it may be expelled and set on fire at the same time, another mortar may be constructed of wood, or of pasteboard with a wooden bottom : it ought to be put into a large iron mortar, and to be loaded with a quantity of powder proportioned to the weight of the globe.

This small mortar must be of light wood, or of paper pasted together, and rolled up in the form of a cylinder, or truncated cone, the bottom excepted ; which, as already said, must be of wood. The chamber for the powder must be pierced obliquely, with a small gimlet; so that the aperture corresponding to the aperture of the metal mortar, the fire applied to the latter may be communicated to the powder which is at the bottom of the chamber, immediately below the globe. By this means the globe will catch fire, and make an agreeable noise as it rises into the air; but it would not succeed so well, if any vacuity were left between the powder and the globe.

A prolific or perpendicular section of such a globe is represented by the right angled parallelogram, the breadth of which is nearly equal to the height. The thickness of the wood towards the two sides, is equal, as above said, to the twelfth part of the diameter of the globe; and the thickness of the cover is double the preceding, or equal to a sixth part of the diameter. The height of the chamber, where the match is applied, and which is terminated by a semicircle, is equal to the fourth part of the breadth; and its breadth is equal to the sixth part.

We must observe that it is dangerous to put wooden covers on aerial balloons or globes; for these covers may be so heavy, as to wound those on whom they happen to fall. It will be sufficient to place turf or hay above the globe, in order that the powder may experience some re sistance.

The globe must be filled with several pieces of cane or common reed, equal in length to the interior height of the globe, and charged with a slow composition, made of three ounces of pounded gunpowder, an ounce of sulphur, moistened with a small quantity of petroleum oil, and two ounces of charcoal, and in order that these reeds or canes may catch fire sooner, and with more facility, they must be charged at the lower ends, which rest on the bottom of the globe, with pulverised gunpowder moistened in the same manner with petroleum oil, or well besprinkled with brandy and then dried.

The bottom of the globe ought to be covered with a little gunpowder half pulverised and half grained; which, when set on fire, by means of a match applied to the end of the chamber, will set fire to the lower part of the reed. But care must have been taken to fill the chamber with a slow composition, made of eight ounces of sulphur, and once ounce of charcoal; the whole must be well pounded and mixed.

Instead of reeds, the globe may be charged with running rockets, or paper petards, and a quantity of fiery stars or sparks mixed with pulverised gunpowder, placed without any order above these petards, which must be choaked at unequal heights that they may perform their effects at different times.

These globes may be constructed in various ways, which it would be tedious here to enumerate. We shall only observe, that when loaded, they must be well covered at the top; they must be wrapped up in a piece of cloth dipped in glue, and a piece of woollen cloth must be tied round them, so as to cover the hole which contains the match.

INDELIBLE INK FOR MARKING LINEN.

Dissolve two drachms of fused sub nitrate of silver in six drachms of distilled water, and add to it two drachms of thick mucilage of gum arabic (by measure): this forms the marking ink. Then dissolve half an ounce of sub-carbonate of soda in four ounces of water; add to the solution half an ounce (by measure) of thick mucilage of gum arabic.

To use the ink, wet thoroughly the part intended to be written on with the last mixture, and, when quite dry, write thereon with a clean pen dipped in the first preparation, and let it dry; the letters will be pale at first, but soon become black by exposure to the air.

TO RESTORE FADED WRITING.

Sometimes the ink of very old writing is so much faded by time as to be illegible, in consequence of the decay of the tanning matter and gallic acid contained in the ink and a yellow or brown oxide of iron, therefore alone remains on the paper. The original colour of the written characters may be restored, or, rather a new body of colour may be given to the writing by pencilling it over carefully, first with a solution of prussiate of potass, and then with diluted muriatic acid.

If the pencilling be done neatly, and blotting paper be laid over the letters as fast as they become visible, their form will be retained distinctly. Pencilling over the letters with an infusion of gall nuts, or tincture of galls, also restores the blackness to a certain degree, but not so completely or so speedy as potass.

CHEMICAL SOAP TO REMOVE GREASE SPOTS.

Take about an ounce of fuller's earth crumbled to powder, moisten it with a little spirits of turpentine; then take about half an ounce of salt of tartar and an ounce of the best potass, and work the whole into a paste with a little soft soap; form it into squares, and it will be fit for use. Moisten the grease, and, with a little water rub the soap well on till it lathers: persevere in this for a short time till the spot disappears, then rinse the cloth with clear water.

TEST TO DISTINGUISH IRON FROM STEEL.

To distinguish iron from steel by a chemical process, take nitric acid, dilute it with so much water that it will only act feebly on the blade of a common table knife. If a drop of the acid thus diluted be dropped upon steel, and allowed to remain on it a few minutes, and then washed off with water, it bears a black spot; but if a drop of the same acid be put upon iron, the spot will not be black, but of a whitish grey.

TEST TO DETECT ARSENIC.

The presence of arsenic may be detected by sub-nitrate of silver. We are indebted to Mr. Hume for this test:—pour a few table spoonfuls of the suspected liquid into a wine glass, and present to the mere surface of the liquid a stick of dry subnitrate of silver, or lunar caustic; a yellow precipitate will instantly appear if it contains the least particle of arsenic, which will proceed from the point of contact of the subnitrate of the fluid and settle at the bottom of the glass.

Dr Marcet has lately pointed out the following modification of the test:—Let the fluid suspected to contain arsenic be filtered, and suffer the end of a glass rod, wetted with liquid ammonia, to be brought into contact with it; and let the end of a glass rod, also wetted with the solution of nitrate of silver, be immersed in the mixture; a yellow precipitate will gradually fall to the bottom; as this precipitate is soluble in ammonia, the greatest care is necessary not to add an excess of it.

The objection arising from the action of muriatic acid upon this test is easily obviated; for, if a little muriatic acid be dipped into the fluid suspected to contain arsenic, and the nitrate of silver very cautiously be added till the precipitate ceases, the muriatic acid will be removed, and the arsenic remain in solution, and the addition of liquid ammonia will produce the precipitate in its characteristic form.

TO CLEAN OLD GOLD.

Dissolve sal-ammoniac in wine, and boil the article in it for a short time; clean it with rag and whiting.

NANKEEN DYE.

Boil equal parts of annatto and common potass in water till the whole is dissolved.

TO STAIN LEATHER GLOVES.

Those different pleasing hues of yellow, brown, or tan colour, are readily imparted to leather gloves by the following simple process:—Steep saffron in boiling soft water for about twelve hours; then, having slightly sewed up the tops of the gloves to prevent the dye from staining the inside, wet them over with a sponge dipped in the liquid The quantity of saffron, as well as of water, will, of course. depend on how much dye may be wanted, and their relative proportions on the depth of the colour required.

TO TAKE IRON STAINS OUT OF MARBLE.

Mix equal quantities of spirit of vitriol and lemon juice; shake it well: wet the spots, and in a few minutes rub them with a soft rag till they disappear.

CHINESE MODE OF RENDERING CLOTH WATERPROOF.

By the following simple process it is said that the Chinese render, not only the strongest cloth, but even the finest muslin, water proof, without injuring the appearance or quality of the article. The composition to which these valuable articles are imputed, is merely a solution of an ounce of white wax in a pint of spirit of turpentine. In a sufficient quantity of the mixture made with these materials, immerse the goods intended to be rendered waterproof, and then hang them in the open air till they become perfectly dry. This is all the process necessary for accomplishing so desirable a purpose; against which, however, may be objected, perhaps, the expense, and the unpleasant smell of the turpentine. But this objection may be remedied by using equal parts of spirits of wine and oil of wormwood; a mixture of which is said to dissipate the smell of turpentine; but the former, it is not to be denied, must necessarily be augmented.

TO CLARIFY QUILLS.

Scrape off the outer film and cut the ends off; then put the barrels into boiling water, wherein is a small quantity of alum and salt; let them remain a quarter of an hour, and then dry them in an oven.

TO ASCERTAIN THE QUANTITY OF SPIRIT CONTAINED IN ANY LIQUOR.

For this method of ascertaining the strength of liquors, we are indebted to Mr. Brande. It destroys the commonly received opinion first entertained by Fabroni; namely, that the brandy or spirit obtained from wine, is formed during the distillatory process, by which means it is usually obtained; whilst, on the contrary, it clearly proves, that the brandy exists ready formed in all vinous liquors; and, hence, it may be separated from them without distillation, which may be done in the following manner: Add to eight parts of the liquor to be examined, one part of a concentrated solution of sub-acetate of lead; a dense insoluble precipitate will ensue; it is a combination of the lead with the colouring extractive, and acid matter of the wine; shake the mixture for a few minutes, pour the whole upon a filter, and collect the filtered fluid. This fluid contains the brandy, or spirit and water, of the wine, together with a portion of the sub acetate of lead, provided the latter has not been added in excess; in which case, a part, of course, remains undecomposed. Add, in small quantities at a time, to this fluid, warm, dry, and pure sub-carbonate potass, which has previously been freed from water by heat, till the last portion added remains undissolved. The brandy or spirit contained in the fluid will thus become separated; for the sub-carbonate of potass attracts from it the whole of the water with which it was combined; the brandy or spirit of wine forming a distinct stratum, which float upon the aqueous solution of the alkaline salt. If the experiment be made in a glass tube from half an inch to two inches in diameter, and graduated into one hundred equal parts, the per centage of spirit in a given quantity of liquor, may be seen at a time.

By operating upon artificial mixtures of alcohol and water, Mr. Brande found, that, when the alcohol is not less than ten per cent, the quantity indicated by the dry and warm sub carbonate of potass, after the colouring and acid matter had been separated by sub-acetate of lead, was always within one half part in one hundred of the proportion contained in the mixture.

PASTE FOR SHARPENING RAZORS.

Take oxide of tin livigated one ounce, saturated solution of oxalic acid a sufficient quantity to form a paste. This composition is to be rubbed over the strop, and when dry, a little water may be added; the oxalic acid having a great attachment for iron. A little friction with this power gives a fine edge to the razor.

TO PRODUCE A FAC-SIMILE OF ANY WRITING.

The pen should be made of glass enamel, the point being small and finely polished, so that the part above the point may be large enough to hold as much or more ink, than a common pen.

A mixture of equal parts of Frankfort black and fresh butter is now to be smeared over sheets of paper, and rubbed off after a short time. The paper thus smeared is to be pressed for some hours, taking care to have sheets of blotting paper between each of the sheets of black paper. and the upper sheet is to be written upon with an enamel pen. By this method, not only the copy is obtained on which the pen writes, but also as many copies as there are sheets of white paper placed between black ones.

A very ingenious trick may be performed by means of this invention; the operator may propose that one of the company shall write down his thoughts on a piece of paper, and hand the paper to a third person whom the operator will be enabled to give a ready answer to what he may have written, by privately inspecting the remaining sheets, where he will find a fac-simile of the writing.

THE ART OF VARNISHING AND JAPANNING.

To be a proficient in this art several matters are required and these you must consider as suitable, not only in property but goodness, that your cost and labour may not prove in vain.

Use two strainers made of flannel, moderately fine, or of coarse linen, in the nature of a tunnel, for to strain your black varnish, and the other for your white varnish, and the first of these may serve for lackers, when your occasion requires you to make them; besides these are required two tunnels of tin for the same purpose as before; glass bottles and vials great and small must be in readiness, as to suit with the quantities of varnish your business requires you to use, and gallipots to put it in when you design to work; as also to mix your blacks in when they come to be ordered with other things.

As for tools they are no less requisite, for without them this art would be insignificant, and therefore to furnish yourself with them, you must have pencils according to the greatness or smallness of the things intended to work on; those for the varnish must be made of camel's hair very soft, and are of various prices, as to the largeness or fineness; likewise drawing pencils placed in duck or goose quills, as the fineness or largeness of the strokes require, and the longest haired pencils are accounted the best in this business; you must have in readiness a considerable number of muscle shells to mix your colours and minerals in, as the occasion shall require it.

Dutch rushes are another material useful in this matter to smooth the work before it is varnished, to get off the nobs or grittiness of the ground, or when it is varnished.

Tripoly is proper to polish this work with when varnished, being reduced into fine powder, and sifted; as for linen rags, you must be provided with them both fine and coarse, to clear and polish this work, also olive oil for clearing: many of these things shall be directed hereafter, as they occur in due place, in the work.

SPIRITS OF WINE.

This is of main use in varnishing, and if it be not properly qualified it will spoil the varnish, and not be capable, for want of strength, to dissolve your gums, or make them spread, and so consequently lie uneven upon the work; and to know when this spirit is sufficiently rectified, put some of it in a spoon, and put a little gunpowder in, and is it burns out, blows up the gunpowder, and leaves the spoon dry, then it is good spirit, but failing in this, and leaving the spoon moist when the flame extinguishes, it is not fit for use.

GUM ANIMÆ, GUM LAC, AND GUM SANDARACK

To choose these well, as for the first, get the most transparent, clearest, and whitest, which is the best.

The second also, called seed lack, choose that free from dross, sticks, or dust, large grained and quite bright.

As for the third, get that which is large, and very white, casting the least yellow, free from dust and dross.

SHELL LAC, WHITE ROSIN, BOLE AMMONIAC, AND VENICE TURPENTINE.

As for the first, that is best that is most transparent and will easily melt, and draw out with your fingers as fine as a hair.

As for the second, choose that for your use which is whitest and clearest.

As for the third, that is most fit for your purpose that is free from grittiness or gravel, and is of a blackish red colour, commonly called French bole.

GUM ELEMI, GUM ARABIC, AND GUM COPAL.

As for the first, choose the hardst, and freest from dirt and dross.

Choose the second white and transparent.

As for the third, the best for your use is that which is the whitest, free from dross, and the thick dark stuff incorporated with it..

GAMBOGIUM, ISINGLASS, BENZOIN AND DRAGON'S BLOOD.

These are other things necessary in this art, and ought to be well chosen.

As for the first, the best is that of a bright yellow, free from dirty thickness and dross.

Choose as to the second that which is whitest and clearest, and free from yellowness.

As for the third, the best is that of a bright red colour, much like to clarified rosin, free from all dross and filth.

The fourth, when the best is of a bright red, free from dross, it may be had, as the others, at the druggists.

SILVER DUST, BRASS DUST, DIRTY GOLD, COPPERS, POWDER, TIN, &c.

The silver dust, the best is brought beyond seas, and is known from the counterfeit by being squeezed between the finger and thumb, giving a glorious lustre, as indeed it does in the work.

Brass dust, by artists called gold dust, the best is made in Germany, and is of a bright colour, nearest resembling gold, try it as the silver dust; as for the coarse sort, though it will work very well with gold size, yet it will not do near so well with gum water.

Green gold is a corrupt metal so called, is very good in this work, for casting a fading green colour.

Dirty gold is a corrupt metal, casting a dark, dull, though silverish colour bearing very well a resemblance to dirty drossy gold.

Coppers are three sorts, natural, adulterate, and artificial; as for the natural, being cleansed, it may be ground without any mixture.

The adulterate is most fit for a ground, and serves most commonly to lay other metals on, as in etching or heightening gold or silver on; but as the artificial is of a higher or brighter colour than either. Their is also in this art, those called spectacles of copper, gold, and silver, and divers other colours, differing in fineness, which may be worked as the artist fancies, either on the outside of boxes or drawers, or on mouldings, and may be purchased ready done.

COLOURS PROPER FOR JAPANNING.

Some of these are called transparent, on which gold and silver are to be laid, or some light colour, so that by this means they appear in their proper colours, lively and beautiful.

Of these, for a green, use distilled verdigris; for a red, fine lake; for a blue, smalt; you have to grind these on a porphiry, or marble stone.

Grind with a muller what quantity you please of smalt or verdigris; with nut oil, as much as will moisten the colours and grind them till they are aa fine as butter, then put the colours into shells, and mix them with oil of turpentine till they become thin, for use; lay them on silver, gold, or any other light colour, and they will then become transparent, altering their lightness or darkness according to that of the metal or colours that are placed under them; this for a curious red may be done with lake, but use drying oil to grind it with.

If you design figures on the back of your tables or boxes, as trees, birds, or flowers, those may be done, for white, with white lead; for blue, smalt, mixing it with gum arabic water, and mingle them as you please, to make them lighter or deeper; flake white is a very pure white, but the other will do for an ordinary use; and you must use either of these with smalt, or other colours that have not a body of their own; you may for a purple use russet, fine lake, and sea green, and it may be done with other sorts of reds and greens, and except transparent colours, all must be laid with gum water.

TO MAKE SEED LAC VARNISH.

Your ground work is good rectified spirits, of which you may take a gallon, put it into as wide a necked bottle as you can get, that the gums may better come out, then of the best seed lac, add a pound and a half, let it macerate twenty four hours, or till the gums are well dissolved, with often shaking to keep them well together; then with flannel strainers strain it into a tin funnel, placed in the mouth of the empty bottle, the strainer may be made as before directed, and squeeze the dross in the bag, and throw it away as of no use; then let the varnish settle, and pour it off into other bottles, till it rises thick, and no longer; then strain the thick part and settle that again, and keep the fine varnish for your use, and this does well, without the danger of attempting to boil it, which endangers firing the house and the parties life.

TO MAKE SHELL LAC VARNISH.

This in curious glossy pieces of work is not of value, but in varnished wood it succeeds. To make it, put to a gallon of spirit, a pound and a half of the best shell lac, order it as the former, and though it has no sediment, it is proper, however, it should be strained, to take away the sticks or straws that may be in the gum, nor will it ever be fine and clean as the former, but turns in a few days to cloudiness, yet it is fit for coarse work, and much used.

TO MAKE WHITE VARNISH.

Take an ounce of common gum mastic, and an ounce of white gum sandarach, three ounces of the best and clearest Venice turpentine, gum elemi half an ounce, gum copal an ounce and a half, gum Benvoin of the clearest, half an ounce, and half an ounce of white rosin, and the gums being separated in their quantities provided, put the rosin and copal in a glass vial, with half a pint of spirits, that they may be dissolved; and to the same end, in a glass bottle of three quarts of spirits put the Venice turpentine, anima, and Benzoin, and in another bottle of gum mastic and sandarach, in a pint and a half of spirits, then dissolve the gum elemi in a quarter of a pint of spirits, powder very finely the anima and Benzoin, the better to dissolve in the spirit, and then pour them into one large bottle, let them stand to fine at the former, then strain them through a linen cloth gently, not hardly pressing the sediment, lest you carry the grittiness of the gum along with you, to injure the varnish.

GENERAL RULES FOR VARNISHING.

This is a point nicely to be observed, or your labour and cost will be in vain.

1.—If you choose wood that requires to be varnished, let it be exempted from knots, very close grained, smooth, clean, well rushed, and freed from greasiness.

2.—As for your colours and blacks, lay them even, and exquisitely smooth, sweep all roughness off with your brush.

3.—Keep your work ever warm, but not hot, to raise blisters, or crack it, which nothing but scraping off all the varnish can amend.

4.—After every distinct wash, let your work be thoroughly dry, for neglect in this point introduces the fault of roughness.

5.—After it is varnished, let it lie by and rest as long as your convenience will admit, and it will be the better.

6.—Ever take care to begin your varnish strokes in the middle of the table, or what you do it on, and not from end to another, and your brush being planted in the middle strike it to one end, then take it off and fix it to the place you begun at, so draw or extend it to the other end, and so continue it till the whole plain be varnished over, and beware you overlay not the edges, which is when the varnish hangs in splashes or drops on them, and therefore to prevent it, draw your brush gently once or twice against your gally pot side.

7.—When you have proceeded so far as to come to polish, let your tripoli be very fine, and the finer the work, let it be still finer, and use fine rags, keeping your hand moderately hard upon it, and brighten or polish one place as much as you intend e'er you leave it and pass to another, and always have regard, that you polish your work as much as you intend at one time, but if your conveniency will admit, let it rest two or three days before you give the finishing strokes after you have polished it, but come not too near the wood, or make it thin or hungry, for then it will require another varnish, or remain to your discredit.

8.—Take a sufficient quantity of tripoli at the first polishing, till it begins to come smooth, and so lessen by degrees, and carefully observe there be no scratches or gratings in it.

9.—When you have a mind to clear up the work wash off the tripoly with a sponge, and soak up the wet with a fair linen cloth, and with lamp black mixed with oil, gently smear the whole face of it, let no corner nor moulding of escape, that the whole face may be freed, then with other linen, and a hard hand cleanse it of that, and these things done, there will be an admirable gloss.

BLACK VARNISHING OR JAPAN.

Provide first for this imitation of Japan, a close grained wood, well wrought off, rub it smooth and keep it warm by a fire, but never so near as to burn, scorch, or blister your work, then add to seed lac varnish, as much lamp black as will at the first stroke colour the wood; do it three times, permitting it to dry well between every time doing, and rush it well, then with a quarter of a pint of the thickest seed lac, mixed with an ounce of Venice turpentine, put in more lamp black, so much as may well colour it, and with this wash it six times, letting it stand twelve hours between the first and three last washings; then with the finest seed lac just tinctured with the black, do it over twelve times, letting it dry between every time of doing, after which let it remain five or six days before you polish it. For white let your polishing be gentle and easy, do it nimbly, and clear it with oil and fine flour, and in observing these rules you will prove an artist.

At the end of that time, take water and tripoly and polish it, having first dipped your cloth in water and rub it till it gains a very fine smoothness and gloss, but do not rub so as it may any ways wear off the varnish, which cannot be easily repaired, then use a rag wetted without tripoly, and clear it up with oil and lamp black, yet polish it not all at once, but let it have some days respite between the first and last polishing, at least three or four days.

WHITE VARNISHING OR JAPAN.

This must be curiously done without any soiling and therefore you must be cautious of letting any dirty thing come near, while you are doing it.

To begin this work scrape as much isinglass as will make it of a reasonable thickness, or when dipping your pencil in it, it will with a stroke whiten the body which has been passed over with a brush, but let it be in neither of the extremes, too thick, nor too thin, then mix it with your size, whiten your work over with it, and when dry, repeat the same, covering it from all manner of dust before it is varnished; it must be whitened three times, and dried between every one of them, smooth and lay it as close as you can to the wood with your rushes; then mix flake white with your size, only so that it may lie with a full and fair body on the piece, and whiten your work three several times with this, drying between each, then make it with your rushes very smooth, but keep your distances from the wood.

In the next place, take white starch boiled in fair water till it come to be somewhat thick, and when it is lukewarm, wash over your work with it twice or thrice, drying between whiles, and let them stand twenty four hours, then get the finest of the white varnish I have directed you to make, wash your pencil in spirits, and wash or anoint your work six or seven times, and after thirty or forty hours do the same again, and if done with a dexterous hand, a better gloss will be set on than if it had been polished; but if it miss of that gloss, it is requisite that you polish it: and in order thereto, you must accommodate it with five or six washes of varnish more than the former, and it must continue to settle well about a week before you polish it.

In polishing, your linen and tripoly must be the finest, being neat and careful in this operation, your hand light and gentle, having your cloth neither too dry nor too wet, and clear it up with fine flour and oil.

TO MAKE ISINGLASS SIZE.

Break and divide an ounce of isinglass into little pieces, put it into a glazed, clean, and well covered pipkin, and let it for twelve hours soak in a pint and a half of fair water, then place it over a gentle fire, till it boil well at leisure, and when the water is consumed to a pint, let it stand to cool leisurely, and then it will be a jelly, and may be used in the white varnish, and other works, but prepare no more at a time than you will use, for in two or three days it will prove good for nothing.

TO MAKE RED JAPAN.

The reds are properly three, viz., the common red, the deep dark red, and the light pale red.

In the first vermillion is proper, mixed with the thickest of seed lac, warm the work and mix your vermillion with your varnish in a medium, carry it over in four times, permitting it to dry as the former; and if your reds be in a good body and full, rush it smooth, then with the ordinary seed lac varnish, wash it eight times, and after twelve hours rush it again, and then for a curious outward covering, give it eight or ten washes with seed lac varnish, and after five days polish it, and clear it with lamp black and oil.

OF THE DARK RED.

The common red laid as before directed, deepen it with dragon's blood mixed with your own varnish, and when it has a pretty good colour go over it with lac varnish, which will much deepen and strengthen the colour, and in all things else, as to polishing and clearing, do as in the other red.