The young man's book of amusement

Halifax, 1848

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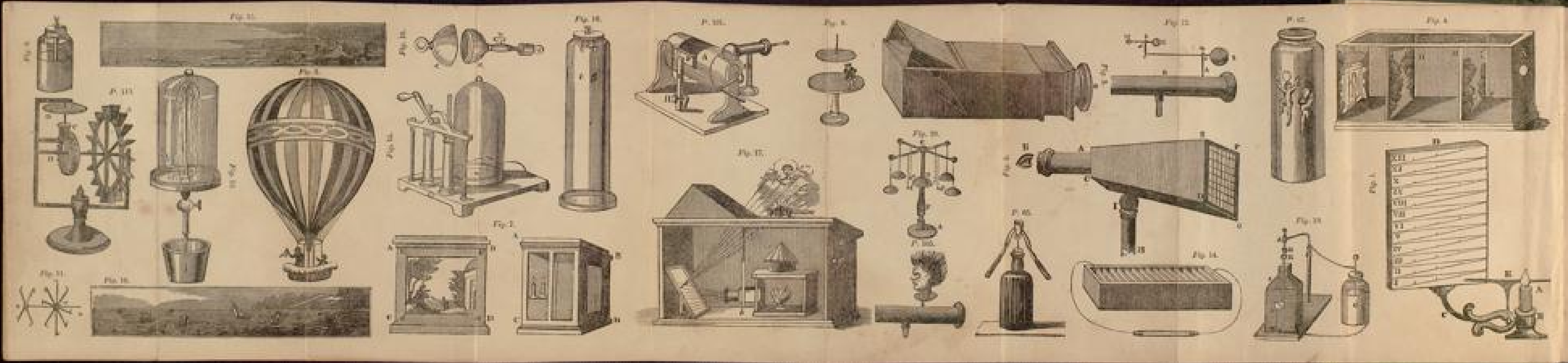
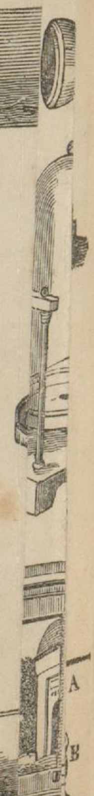
R. Dove.
from Auntie Glad.





THE

YOUNG MAN'S BOOK OF AMUSEMENT.

CONTAINING

THE MOST INTERESTING

AND

INSTRUCTIVE EXPERIMENTS

IN VARIOUS BRANCHES OF SCIENCE.

TO WHICH IS ADDED ALL THE

Popular Tricks and Changes in Cards;

AND THE

ART OF MAKING FIRE WORKS.

HALIFAX:
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CHEAPSIDE.

MDCCCXLVIII.

THE

YOUNG MAN'S
BOOK OF AMUSEMENT.

Eatable Candle Ends.

PEEL some large apples that are rather of a yellow tint; cut several pieces out of them in the shape of candle ends, round of course at the bottom and square at the top; in fact as much as possible like a candle that has been burnt down within an inch or so. Then cut some slips out of the insides of sweet almonds, fashion them as much in the shape of spermaceti wicks as you can, stick them into your mock candles, light them for an instant, so as to make their tops black, blow them out again, and they are ready for use. When you produce them, light them, (the almond will readily take fire, and flame for a few moments) put them into your mouth, chew and swallow them one after another. This may well be called the juggler's dessert.

Fulminating Powder.

Mix together one drachm of sulphur, three drachms of nitre of potass, and two drachms of carbonate of potass (all previously powdered) in a sheet of writing-paper. When properly mixed, put them into a small stoppered phial. An eighth or a sixteenth part of this, put into a fire-shovel of tin-plate, held over the fire for a few minutes will explode; immediately before the explosion, a violet-coloured flame will be seen to hover over it.

Another way.

Rub together in a hot marble mortar, with a wooden pestle, three parts, by weight, of nitre, two of mild vegetable alkali, and one of flowers of sulphur, till the whole is accurately mixed. If a drachm of this powder be exposed to a gentle heat, in an iron ladle, till it melts, it will explode with a noise as loud as the report of a cannon.

A more powerful Fulminating Powder.

The most wonderful instance of chemical detonation is formed by the combination of volatile alkali with silver. Gunpowder, or fulminating gold, are not to be compared with this invention, and the great danger attending its manufacture prevents us from giving a methodical account of its preparation to our readers, particularly as it can be purchased, properly prepared, of the chemists.

The slightest agitation or friction is sufficient to cause its explosion. When it is once obtained, it can no longer be touched with safety. The falling of a few atoms of it, from a small height produces an explosion, a drop of water falling on it has the same effect. No attempt can be made to inclose it in a bottle, but it must be let alone in the capsule, wherein by evaporation it obtains this terrible property. To make this experiment with safety, no greater quantity than a grain of silver should be used; the last process of drying should be made in a metallic vessel, and the face of the operator defended by a mask with strong glass eyes.

To prepare Fulminating Silver.

Dissolve pure silver in nitric asid, and precipitate the silver by lime-water; put the precipitate upon filtering paper, and when dry, put it into a shallow vessel, then pour liquid ammonia upon it, and when it has stood about twelve hours, pour off the liquid, and a black powder will remain, which must be carefully set by to dry.

The detonating Candle

Take about a third part of a grain of fulminating silver, and put it into the wick of a candle, which is to be burned by the person you wish to surprise. When the flame reaches the powder, it will immediately explode with a stunning report. Similar tricks may be played by placing the silver in a pair of snuffers, boots, shoes, walking-stick, &c.

To make an artificial Spider, containing Fulminating Silver.

Take about one third of a grain of fulminating silver, and inclose it in a piece of paper or cloth made up in the form of a spider, then place it in a situation where it is likely to be trod upon. The noise will both surprise and amuse.

Fulminating Bombs.

Procure a few glass balls, of about a sixth part of an inch in diameter, and put a third part of a grain of fulminating silver upon a piece of soft paper, then paste the paper round one of the glass balls, and upon treading upon it, or throwing it with force against a stone, it will break and give a report like a musket.

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 sulphuretted 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 salutary practical lesson to rely more on mental than personal and artificial beauty in future.

To Illuminate the Surface of the Water.

Wet a piece of fine loaf sugar with phosphorized ether, and throw it into a basin of water; the surface of the water will become luminous in the dark, and, by gently blowing upon it, phosphorescent undulations will be formed, which illuminate the air above the fluid to a considerable distance. In winter, the water must be rendered blood-warm. If the phosphorized ether be applied to the hand, or other warm objects (which may be done with safety) it renders them luminous in the dark.

The Well of Fire.

Add gradually one ounce, by measure, of sulphuric acid, to five or six ounces of water in an earthenware basin; and add to it also, gradually, about three quarters of an ounce of granulated zinc. A rapid production of hydrogen gas will instantly take place. Then add, from time to time, a few pieces of phosphorus of the size of a pea. A multitude of gas bubbles will be produced, which will fire, on the surface of the effervescing liquid; the whole surface of the liquid will become luminous, and fire balls, with jets of fire, will dart from the bottom through the fluid with great rapidity, and a hissing noise.

To produce fire by the mixture of two cold Liquids.

Take half a pound of pure dry nitre, in powder, put it into a retort that is quite dry; add an equal quantity of highly rectified oil of vitriol, and distilling the mixture in a moderate sand heat, it will produce a liquor like a yellowish fume; this, when caught in a dry receiver, is *Glauber's Spirits of Nitre;* probably the preparation under that name, may be obtained at the chemist's, which will of course save much time and trouble.

You then put a drachm of distilled oil of cloves, turpentine, or carraways, in a glass vessel; and if you add an equal quantity, or rather more, of the above spirit, though both are in themselves perfectly cold, yet on mixing them together, a great flame will arise and destroy them both, leaving only a little resinous matter at the bottom.

The exploding Bubble.

If you take up a small quantity of melted glass with a tube, (the bowl of a common tobacco pipe will do,) and let a drop fall into a vessel of water, it will chill and condense with a fine spiral tail, which being broken, the whole substance will burst with a loud explosion, without injury either to the party that holds it, or him that breaks it; but if the *thick* end be struck, even with a hammer, it will not break.

To give a Person a Supernatural Appearance.

Put one part of phosphorus into six of olive oil, and digest them in a sand heat. Rub this on the face (taking care to shut the eyes) and the appearance in the dark will be supernaturally frightful; all the parts which have been rubbed appearing to be covered by a luminous lambent flame of a bluish colour, whilst the eyes and mouth appear like black spots. No danger whatever attends this experiment.

The Magic Picture.

Take two level pieces of glass (plate glass is the best) about three inches long and four wide, exactly of the same size; lay one on the other, and leave a space between them by pasting a piece of card, or two or three small pieces of thick paper, at each corner.

Join these glasses together at the edges by a composition of lime slaked by exposure to the air, and white of an egg. Cover all the edges of these glasses with parchment or bladder, except at one end, which is to be left open to admit the following composition:

Dissolve by a slow fire, six ounces of hog's lard, with half an ounce of white wax; to which you may add half an ounce of clear linseed oil.

This must be poured, in its liquid state, and before a fire, between the glasses, by the space left in the sides, and which you are then to close up. Wipe the glasses clean, and hold hem before the fire, to see that the composition will not run out at any part.

Then fasten with gum a picture or print, painted on very thin paper, with its face to one of the glasses, and if you like, you may fix the whole in a frame.

While the mixture between the glasses is cold, the picture will be quite concealed, but become transparent when held to the fire; and as the composition cools, it will gradually disappear.

Beautiful Phenomena.

Dip a long slip of wood in melted sulphur, so that one-half, upwards, may be covered. Light it, and whilst burning with a weak bluish flame, introduce it into a jar of nitrous oxide gas; the flame will be instantly extinguished. Withdraw the match, inflame it again, and let it burn for two or three seconds until the flame be vivid, then immerse it once more. Instead of extinction, the flame will be now kept up with great splendour. It will be of a delicate red colour.

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.

To split a Piece of Money into two Parts.

Fix three pins in the table, and lay the piece of money upon them; then place a heap of the flowers of sulphur below the piece of money, and another above it, and set fire to them. When the flame is extinct, you will find on the upper part of the piece a thin plate of metal, which has been detached from it.

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 moments 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 inflammation 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.

Another way.

Mix three ounces of saltpetre, two ounces of salt of tartar, and two ounces of sulphur; roll the mixture up into a ball, of which take a quantity, about the size of a hazel nut, and placing it in a ladle or shovel over the fire, the explosion will resemble a loud clap of thunder.

You will produce a much more violent commotion if you double or treble the quantity of the last experiment; suppose you put two or three ounces of the mixture into the shovel. For fear of accidents, it should not be done in the house, but by placing the shovel over a chafing-dish of very hot coals, in the open air, standing a great distance off.

Common prudence will dictate the necessity of using great care in the above experiments, as an accident will soon happen, if a person does not get out of the way before the composition explodes.

The Tumbling Egg.

Fill a quill with quicksilver, seal it at both ends with good hard wax; then have an egg boiled, take a small piece of the shell off the small end, and thrust in the quill with the quicksilver; lay it on the ground and it will not cease tumbling about so long as any heat remains in it: or if you put quicksilver into a small bladder, and blow it up, then warm the bladder, it will skip about so long as heat remains in it.

Money augmented by an Optical Illusion.

In a large drinking glass of a conical shape, (small at the bottom and wide at the top) put a shilling, and let the glass be half full of water; then place a plate on the top of it, and turn it quickly over, that the water may not escape. You will see on the plate a piece of coin the size of half-a-crown; and a little higher up, another, the size of a shilling.

It will add to the amusement this experiment affords, by giving the glass to one of the company, (but who of course has not witnessed your operations) and desiring him to throw away the water, but save the pieces; he will not be a little surprised at finding only one.

To set a combustible Body on Fire, by the Contact of Water.

Fill a saucer with water, and let fall into it a piece of potassium the size of a pepper corn, which is about two grains. The potassium will instantly burst into flame, with a slight explosion, and burn vividly on the surface of the water, darting at the same time from one side of the vessel to the other, with great violence in the form of a beautiful red-hot fire-ball.

To construct the Camera Obscura.

Make a circular hole in the shutter of a window, from whence there is a prospect of some distance; in this hole place a magnifying glass, either double or single, whose focus is at the distance of five or six feet; no light must enter the room but through this glass. At a distance from it, equal to its focus, place a very white pasteboard, (what is called a Bristol board, if you can procure one large enough, will answer extremely well;) this board must be two feet and a half long, and eighteen or twenty inches high, with a black border round it: bend the length of it inward to the form of part of a circle, whose diameter is equal to double the focal distance of the glass. Fix it on a frame of the same figure, and put it on a moveable foot, that it may be easily placed at that distance from the glass, where the objects appear to the greatest perfection. When it is thus placed, all the objects in 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 you place a swing looking glass outside the window, by turning it more or less, you will have on the paper all the objects on each side the window.

If, instead of placing the looking-glass outside the window, you place it in the room above the hole, (which must then be made near the top of the shutter) you may have the representation on a paper placed horizontally on a table, and draw at your leisure all the objects reflected.

Observe, the best situation is directly north; and the best time of day is noon.

The Magnifying Reflector.

Let the rays of light that pass through the magnifying glass in the shutter be thrown on a large concave mirror, properly fixed in a frame. Then take a thin strip of glass, and stick any small object on it; hold it in the intervening rays at a little more than the focal distance from the mirror, and you will see on the opposite wall, amidst the reflecting rays, the image of that object, very large, and beautifully clear and bright.

To separate two Liquors which have been mixed together.

If you wish to separate, for example, water from oil with which it has been mixed, take a bit of cloth or sponge, well moistened in water, and place it, immersing it by one end, in the vessel containing the liquors to be separated; the other end must be made to pass over the edge of the vessel, and to hang down much lower than the liquor: this end will soon begin to drop, and in this manner will attract and separate all the water mixed with oil. If it be required to draw off the oil, the rag or sponge must be first immersed in that liquid.

To tell by a Watch Dial, the Hour when a Person intends to rise.

The person is told to set the hand of his watch at any hour he pleases, which hour he tells you; and you add in your mind 12 to it. You then desire him to count privately the number of that addition on the dial, commencing at the next hour to that which he intends to rise, and including the hour at which he has placed the hand; which will give the answer: for example:

A intends to rise at 6 (this he conceals to himself;) he places the hand at 8, which he tells B, who, in his own mind, adds 12 to 8, which makes 20. B then tells A to count 20 on the dial, beginning at the next hour to that at which he proposes to rise; which will be 7, and counting backwards, reckoning each hour as 1, and including in his addition the number of the hour the hand is placed at, the addition will end at 6, which is the hour proposed; thus,

The hour the hand is placed at is 8

The next hour to that which A intends to rise at is 7, which counts for 1

Count back the hours from 6, and reckon them at 1 each, there will be 11 hours, viz. 4, 3, 2, 1, 12, 11, 10, 9, 8, 7, 6, ... 11

Making......20

Sympathetic Ink.

The most curious of all kinds of sympathetic ink, is that from cobalt. It is a very singular phenomenon, that the characters or figures traced out with this ink, may be made to disappear and re-appear at pleasure; this property is peculiar to ink obtained from cobalt; for all the other kinds are at first invisible, until some substance has been applied to make them appear: but when once they have appeared they remain. To prepare this ink, take zaffre, and dissolve it in nitro-muriatic-acid, till the acid extracts from it the metallic part of the cobalt which communicates to the zaffre its blue colour; then dilute the solution, which is very acrid, with common water. If you write with this liquor on paper, the characters will be invisible; but when exposed to a sufficient degree of heat, they will become green. When the paper has cooled they will disappear. Observe, if the paper be too much heated, they will not disappear at all.

The Magic Oracle.

By the last mentioned kind of ink the following amusing trick may be performed:—write on several leaves of paper, with common ink, a certain number of questions, and between each question write the answer with the above kind of ink. The same question must be written on several pieces of paper, but with different answers, that the artifice may be better concealed. Then provide a box to which you may give the name of the Sybil's cave, containing in the lid a plate of iron made very hot, in order that the inside of it may be heated to a certain degree. Having selected some of the questions, take the bits of paper containing them, and tell the company you are going to send them to the Sybil, or oracle, to obtain an answer; introduce them into the heated box, and when they have remained in it some minutes take them out, and shew the answers which have been written. Take care, soon to lay aside the bits of paper; for if they remain long in the hands of those to whom the trick is exhibited, they would see the answers gradually disappear, as the paper became cold.

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, slightlv 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.

The Magical Tea-Spoon.

Put into a crucible four ounces of bismuth, and when in a state of fusion, throw in two ounces and a half of lead, and one ounce and a half of tin: these metals will combine, forming an alloy, fusible in boiling water. Mould the alloy into bars, and take them to a silver-smith's to be made into tea-spoons. Give one to a stranger to stir his tea, as soon as it is poured from the tea-pot; he will not be a little surprised to find it melt in his tea-cup.

Invisible Correspondence.

Mix up some hog's lard very intimately with a little Venice turpentine, and rub a small portion of it gently and in an equal manner, over very thin paper by means of a piece of fine sponge. When you are desirous to employ this preparation for writing secretly to a friend, lay the above paper on that you intend to dispatch, and trace out whatever you think proper with a blunted style, by which means the fat substance will adhere to the second paper in all those places the style has passed. The person who receives the letter may easily render it legible by sprinkling over it a little coloured dust, or some pounded charcoal well sifted.

Beautiful Ornament for a Room.

Dissolve in seven different tumblers, containing warm water, half ounces of sulphates of iron, copper, zinc, soda, alumine, magnesia, and potass. Pour them all, when completely dissolved, into a large evaporating dish of Wedgwood's ware, and stir the whole with a glass rod; place the dish in a warm place, where it cannot be affected by dust, or where it may not be agitated. When due evaporation has taken place, the whole will begin to shoot out into crystals. These will be interspersed in small groups and single crystals amongst each other. Their colour and peculiar form of crystallization, will distinguish each crystal separately, and the whole together, remaining in the respective places where they were deposited, will display a very curious and pleasing appearance. Preserve it carefully from dust.

To make Fire Bottles.

The phosphoric fire bottles may be prepared in the following manner :—Take a small phial of very thin glass, heat it gradually in a ladle-full of sand, and introduce into it a few grains of phosphorus ; let the phial be then left undisturbed for a few minutes, and proceed in this manner till the phial is full. Another method of preparing this phosphoric bottle, consists in heating two parts of phosphorus and one of lime, placed in layers, in a loosely stopped phial for about half an hour ; or put a little phosphorus into a small phial, heat the phial in a ladle-full of sand ; and when the phosphorus is melted, turn it round, so that the phosphorus may adhere to the sides of the phial; and then cork it closely. To use this bottle, take a common brimstone match, introduce its point into the bottle, so as to cause a minute quantity of its contents to adhere to it: if the match be rubbed on a common bottle cork, it will instantly take fire. Care should be taken not to use the same match a second time immediately, or while it is hot, as it would infallibly set fire to the phosphorus in the bottle.

A person having an even Number of Shillings in one Hand, and an odd Number in the other, to tell in which Hand the odd or even Number is.

You desire the person to multiply the number in his right hand by an odd figure, and the number in his left by an even one; and tell you if the products, added together, be odd or even. If even, the even number is in the right hand; if odd, the even number is in the left. For instance,

I. Number in the right hand is *even*.... 18
Multiply by...... 3

Product...... 54
Add the Product of the left hand..... 14

Which produces a total of 68

In the left hand *odd* 7
Multiply by 2

Product 14

II. Number in the right hand is *odd* 7
Multiply by...... 3

Product 21
Add the product of the left hand.... 36

Which produces a total of........ 57

In the left hand *even* 18
Multiply by 2

Product 36

Two cold Liquids when mixed become boiling hot.

Put into a thin phial two parts (by measure) of sulphuric acid, and add to it one part of water: on agitating or stirring them together, the mixture instantly becomes hot, and acquires a temperature above that of boiling water.

The Silver Tree.

Dissolve an ounce of fine silver in three ounces of strong aqua fortis, in a glass bottle. When the silver is dissolved, pour the aqua fortis into another glass vessel (a decanter will be best), with seven or eight ounces of mercury, to which add a quart of common water; to the whole add your dissolved silver, and let it remain untouched.

In a few days the mercury will appear covered with a number of little branches of a silver colour This appearance will increase for a month or two, and will remain after the mercury is entirely dissolved.

The Lead Tree.

A more modern invention, and an easier method by far than the above is the following:

To a piece of zinc fasten a wire, crooked in the form of the worm of a still; let the other end of the worm be thrust through a cork. You then pour spring water into a phial or decanter, to which you add a small quantity of sugar of lead; thrust the zinc into the bottle, and with the cork at the end of the wire fasten it up. In a few days the tree will begin to grow, and produce a most beautiful effect.

To produce beautiful Fire Works 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 several minutes. What remains in the flask will serve for the same experiment several times, and without adding any more water. Care should be taken, after the operation is over, to lay the flask and water in a cool secure place.

To procure Nitrous Oxide, or Laughing Gas.

Take two or three ounces of nitrate of ammonia in crystals, and put it into a retort, then apply the heat of a lamp to the retort, taking care that the heat does not exceed 500 degrees. When the crystals begin to melt, the gas will be produced in considerable quantities. The gas may also be produced, though not so pure, by pouring nitric acid, diluted with fire, or six times its weight of water, on copper filings or small pieces of tin. The gas is given out till the acid begins to turn brown; the process must then be stopped.

To inhale the Laughing Gas.

Procure an oiled or varnished silk bag, or a bladder, furnished with a stop-cock; fill it with nitrous oxide, and after emptying the lungs of common air, take the stop-cock into the mouth, and at the same time hold the nostrils, and the sensation produced will be of a highly pleasing nature. A great propensity to laughter, a rapid flow of vivid ideas, and an unusual fitness for muscular exertion, are the ordinary feelings which it produces. The sensations produced by breathing this gas, are not the same in all persons, but they are always of an agreeable nature, and not followed by any depression of spirits, like those occasioned by fermented liquors.

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 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 five 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 larger shot, it will produce the sound of hail.

Metallic Vegetations.

Place a few filings of copper and iron on a glass plate, at a certain distance one from the other; drop a little nitrate of silver on each parcel—the silver will soon begin to precipitate, while the iron and copper will oxidise and become coloured; then, by a small wooden point, the ramifications may be arranged at will, whilst the flame of a taper, being placed under the plate, will increase the evaporation, facilitate the re-action of the substances, blacken the lower side of the plate, and thus form a design.

To make a Ring suspend 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 yet sustain the ring.

Light produced by Sugar.

If two pieces of loaf-sugar (about a pound each) are struck against each other in the dark, a light-blue flame, like lightning, will be elicited. The same effect takes place when a loaf of sugar is struck with an iron instrument.

To give a ghastly Appearance to Persons in a Room

Dissolve salt in an infusion of saffron and spirits of wine. Dip some tow in this solution, and having set fire to it, extinguish all the other lights in the room.

To change Blue to White.

Dissolve copper filings in a phial of volatile alkali: when the phial is unstopped, the liquor will be blue; when stopped, it will be white.

To break a Stick, placed on two Glasses, without breaking the Glasses.

The stick, intended to be broken, must neither be thick, nor rest with any great hold on the two glasses. Both its extremities must taper to a point, and should be of as uniform a size as possible, in order that the centre of gravity may be more easily known. The stick must be placed resting on the edges of the glasses which ought to be perfectly level, that the stick may remain horizontal, and not inclined to one side more than another. Care also must be taken that the points only shall rest lightly on the edge of each glass. If a speedy and smart blow, but proportioned, as far as can be judged, to the size of the stick, and the distance of the glasses, be then given to it in the middle, it will break in two, without either of the glasses being injured.

Magical Transmutations.

Infuse a few shavings of logwood in common water, and when the liquor is sufficiently red, pour it into a bottle. Then take three drinking glasses, and rince one of them with strong vinegar; throw into the second a small quantity of pounded alum, which will not be observed, if the glass has been washed, and leave the third without any preparation. If the red liquor in the bottle be poured into the first glass, it will appear of a straw colour; if into the second, it will pass gradually from bluish grey to black, when stirred with a key or any piece of iron, which has been previously dipped in strong vinegar. In the third glass, the red liquor will assume a violet tint.

To make artificial Coral for Grottoes.

To two drachms of fine vermilion add one ounce of clear resin, and melt them together. Having the branches of twigs peeled and dried, paint them over with this mixture while hot. The black thorn is the best branch for it. Hold them over a gentle fire, turning them round till they are perfectly covered and smooth. White coral may be made with white lead, and black with lamp black.

Chemical Illuminations.

Put into a middling 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.

To melt Lead in a piece of Paper.

Wrap up a very smooth ball of lead in a piece of paper, taking care that there be no wrinkles in it, and that it be every where in contact with the ball; if it be held in this state, over the flame of a taper, the lead will be melted without the paper being burnt. The lead, indeed, when once fused, will not fail in a short time to pierce the paper, and run through.

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 on pasteboard; prick small 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 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 were placed in the sight-hole, it would tend greatly to increase the effect. The box must be covered in, leaving an aperture for the smoke of the lights to pass through.

The above exhibition can only be shown at candle-light; but there is another way, by fixing small pieces of gold on the building instead of drilling the holes, which gives something like 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 the aperture in the buildings, as they would then resemble lamps of different colours.

To set fire to Spirits of Wine by the Rays of the Sun.

Put a small quantity of spirits of wine into a glass, and put a halfpenny or shilling in with it, then direct the rays of the sun, by means of a burning-glass, upon the coin, and in a short time it will become so hot as to inflame the spirits.

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 experiment, p. 28. Having suffered the atmospheric air to be expelled from the bottle, by the elastic vapour produced by the solution, apply the orifice 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 inflammable air, which when forced out against the flame of a candle, by pressing the sides of the bladder, will form a beautiful green flame.

To make the Appearance of a Flash of Lightning, when any one enters a Room with a lighted Candle.

Dissolve camphor in spirit of wine, and deposit the vessel containing the solution in a very close room, where the spirit of wine must be made to evaporate by strong and speedy boiling. If any one then enters the room with a lighted candle, the air will inflame, while the combustion will be so sudden, and of so short a duration, as to occasion no danger.

Two liquids when mixed form almost a solid Mass.

Put into a wine glass a few tea-spoonsful of a concentrated solution of silicited potash, and add to it gradually drop by drop, sulphuric acid. If these two liquids be stirred together with a glass rod, they become converted into an opaque white and almost solid mass.

To melt Iron in a moment, and make it run into Drops.

Bring a bar of iron to a white heat, and then apply to it a roll of sulphur. The iron will immediately melt, and run into drops.

The experiment should be performed over a basin of water, in which the drops that fall down will be quenched. These drops will be found reduced into a sort of cast-iron.

To make a Bird seem as Dead.

Take any bird out of a cage, and lay it on a table; then wave a small feather over its eyes, and it will appear as dead; but directly you take the feather away it will revive again. Let it lay hold of the stem part of the feather with its feet, and it will twist and turn about just like a parrot; you may also roll it about on the table any way you like.

To so fill a Glass with Water that it cannot be removed without spilling the whole.

This is a mere trick: but may afford some amusement. You offer to bet any person that you will so fill a glass with water that he shall not move it off the table without spilling the whole contents. You then fill the glass, and laying a piece of paper or thin card over the top, you dexterously turn the glass upside down on the table, and then drawing away the paper, you leave the water in the glass, with its foot upwards. It will therefore be impossible to remove the glass from the table without spilling every drop.

To make an object which is too near the Eye to be distinctly perceived, to be seen in a distinct manner, without the interposition of any Glass.

Make a hole in a card with a needle, and without changing the place of the eye or of the object, look at the latter through the hole; the object will then be seen distinctly, and even considerably magnified.

New Camera Lucida.

Take a piece of looking-glass; rest it on a table in any angle in front of the object to be copied; then, having a piece of paper placed behind the mirror by looking into it from the upper part of the glass, with one eye, and with the other making the axis of vision meet in the focus point of both, any object may be seen and sketched with singular beauty and accuracy.

Two Figures, one of which blows out and the other re-lights a Candle.

Make two figures, of any shape or materials you please; insert in the mouth of one a small tube, at the end of which is a piece of phosphorus, and in the mouth of the other a tube containing at the end a few grains of gunpowder; taking care that each be retained in the tube by a piece of paper. If the second figure be applied to the flame of a taper, it will extinguish it; and the first will light it again.

An Optical Game.

Present to any one a ring, or place at some distance, and in such a manner that the plane of it shall be turned towards the persons's face; then bid him shut one of his eyes, and try to push through it a crooked stick, of sufficient length to reach it: he will very seldom succeed. A person with one eye would not experience the same difficulty; being accustomed to make use of only one eye, he acquires the habit of judging of distances with great correctness.

A Vessel that will let Water out at the bottom, as soon as the mouth is uncorked.

Provide a tin vessel, two or three inches in diameter, and five or six inches in height, having a mouth about three inches in width; and in the bottom several small holes, just large enough to admit a small needle. Plunge it in water with its mouth open, and full, while it remains in the water, stop it very closely. You can play a trick with a person, by desiring him to uncork it; if he places it on his knee for that purpose, the moment it is uncorked the water will run through the bottom, and make him completely wet.

To produce great Heat by presenting two Solids to each other.

Take a crystal or two of the nitrate of copper, and bruise them, then moisten them with water, and roll them up quickly in a piece of tin-foil, and in half a minute, or little more, the tin-foil will begin to smoke, and soon after take fire and explode with a slight noise. Except the crystals of the nitrate of copper are moistened, no heat will be produced.

A Powder which catches Fire when exposed to the Air.

Put three ounces of rock alum, and one ounce of honey or sugar, into a new earthen dish, glazed, and which is capable of standing a strong heat; keep the mixture over the fire, stirring it continually till it becomes very dry and hard: then remove it from the fire, and pound it to a coarse powder. Put this powder into a long-necked bottle, leaving a part of the vessel empty: and having placed it in a crucible, fill up the crucible with fine sand, and surround it with burning coals. When the bottle has been kept at a red heat for about seven or eight minutes, and no more vapour issues from it, remove it from the fire, then stop it with a piece of cork; and having suffered it to cool, preserve the mixture in small bottles well closed.

If you unclose one of these bottles, and let fall a few grains of this powder on a bit of paper, or any other very dry substance, it will first become blue, then brown, and will at last burn the paper or other substance on which it has fallen.

To construct and inflate a small Balloon.

It is an interesting and amusing experiment to inflate a small balloon made of gold-beater's skin, (using a little gum-arabic to close any holes or fissures) filling it from a bladder or jar, and tying a thread round the mouth of it to prevent the escape of the gas.—When fully blown, attach a fanciful car of coloured paper, or very thin pasteboard to it, and let it float in a large room; it will soon gain the ceiling, where it will remain for any length of time: if it be let off in the open air, it will ascend out of sight. This experiment may be varied, by putting small grains of shot into the car, in order to ascertain the difference between the weight of hydrogen gas and atmospheric air.

To melt a piece of Money in a Walnut-shell, without injuring the Shell.

Bend any thin coin, and put it into half a walnut-shell; place the shell on a little sand, to keep it steady. Then fill the shell with a mixture made of three parts of very dry pounded nitre, one part of flowers of sulphur, and a little saw-dust well sifted. If you then set a light to the mixture, you will find, when it is melted, that the metal will also be melted at the bottom of the shell, in form of a button, which will become hard when the burning matter round it is consumed; the shell will have sustained very little injury.

A Method of obtaining Natural Flowers in Winter.

Choose some of the most perfect buds of the flowers you wish to preserve, such as are the latest in blooming, ready to open; cut them off with a pair of scissors, leaving to each, if possible, a piece of the stem about three inches long; cover the end of the stem immediately with Spanish wax, and when the buds are a little shrunk, wrap each of them up separately in a piece of paper, perfectly clean and dry, and lock them up in a dry box or drawer, and they will keep without corrupting. In winter, or any other time, when you would have the flowers blow, take the buds over night, cut the end of the stem, and put the buds into water, wherein a little nitre or salt has been infused, and the next day you will see the buds open and expand themselves, and the flowers display their most lively colours, and breath their agreeable odours.

To find whether any given Year is Leap Year or not.

Divide the given year by 4, if nothing remain, it is leap year; but if 1, 2, or 3 remain, it shews the number of years after leap year. This rule may be committed to memory in the following lines:—

Divide by 4: what's left shall be,
For leap year, 0: past, 1, 2, 3.

Example.

Was the year 1819, leap year?—Rejecting the centuries, 19 divided by 4, and 3 remain; therefore, the year 1819 was the third year after leap year.

A Liquor that shines in the dark.

Take a bit of phosphorus, about the size of a pea; break it into small parts, which you are to put into a glass half full of very pure water, and boil it in a small earthen vessel, over a very moderate fire. Have in readiness a long narrow bottle, with a well-fitted glass stopper, and immerse it, with its mouth open, into boiling water. On taking it out, empty the water, and immediately pour in the mixture in a boiling state; then put in the stopper, and cover it with mastich, to prevent the entrance of the external air.

This water will shine in the dark for several months, even without being touched; and if it be shaken in dry warm weather, brilliant flashes will be seen to rise through the middle of the water.

Three jealous Husbands with their Wives, being ready to pass by night over a river, do find at the river side a boat which can carry but two persons at once, and for want of a boatman they are necessitated to row themselves over the river at several times; the question is, how six persons shall pass two by two, so that none of the three Wives may be found in the company of one or of two men, unless her Husband be present?

They must pass in this manner, viz.—First two women pass, then one of them bringeth back the boat and repasseth with the third woman; that done, one of the three women bringeth back the boat, and sitting down upon the ground with her husband, permitteth the other two men to pass over to find their wives; then one of the said men with his wife bringeth back the boat, and placing her upon the ground, he taketh the other man, and repasseth with him; lastly, the woman which is found with the three men entereth into the boat, and at twice goeth so fetch over the other two women.

The Hydraulic Dancer.

Procure a little figure of cork, which you may dress as your fancy dictates. In this figure place a small hollow cone, made of thin leaf brass.

When the figure is placed on a jet d'eau, that plays in a perpendicular direction it will be suspended on the top of the water, and perform a great variety of amusing motions.

If a hollow ball, of very thin copper, of an inch in diameter, be placed on a similar jet, it will remain suspended, turning round, and spreading the water all about it.

The accompanying device of Atlas carrying the world on his shoulders, is an extremely appropriate figure for this pleasing experiment.

The Fiery Fountain.

If twenty grains of phosphorus, cut very small, and mixed with forty grains of powder of zinc, be put into four drachms of water, and two drachms of concentrated sulphuric acid be added thereto, bubbles of inflamed phosphorated hydrogen gas will quickly cover the whole surface of the fluid in succession, forming a real fountain of fire.

A person having put a Ring on one of his Fingers, to name the Person, the Hand, the Finger, and the Joint on which it is placed.

Let a third person double the number of the order in which he stands who has the ring, and add 5 to that number; then multiply that sum by 5, and to the product add 10. Let him next add 1 to the last number, and if the ring be on the right hand, and 2 on the left, and multiply the whole by 10: to the product of this he must add the number of the finger, (counting the thumb as the first finger) and multiply the whole again by 10. Let him then add the number of the joint, and, lastly, to the whole join 35.

He is then to tell you the amount of the whole, from which you are to subtract 3535, and the remainder will consist of four figures; the first of which will express the rank in which the person stands, the second the hand, (number 1 signifying the right, and 2 the left) the third number the finger, and the fourth the joint.—For example:

Suppose the person who stands the third in order has put the ring upon the second joint of the thumb of his left hand; then,

The double of the rank of the third person is	6
To which add..............................	5
	11
Multiply the sum by	5
	55
To which add	10
And the number of the left hand...........	2
	67
Which being multiplied by	10
	670
To which add the number of the thumb	1
	671
And multiply again by	10
	6710
Then add the number of the joint..........	2
And lastly, the number	35
	6747
From which deducting	3535
The remainder is	3212

Of which, as we have said, the 3 denotes the third person, the 2 the left hand, the 1 the thumb, and the last 2 the second joint.

To construct Paper Balloons.

Take several sheets of silk paper; cut them in the shape of a spindle; or, to speak more familiarly, like the coverings of the sections of an orange; join these pieces together, into one spherical or globular body, and border the aperture with a ribbon, leaving the ends, that you may suspend from them the following lamp:

Construct a small basket of very fine wire, if the balloon is small, and suspend it from the aperture, so that the smoke from the flame of a few leaves of paper, wrapped together, and dipped in oil, may heat the inside of it. Before you light this paper, suspend the balloon in such a manner, that it may, in a great measure, be exhausted of air, and as soon as it has been dilated, let it go, together with the wire basket, which will serve as ballast.

Two merry Companions are to have equal shares of Eight Gallons of Wine, which are in a vessel containing exactly Eight Gallons, now to make this equal partition they have only two other empty vessels, whereof one containeth Five Gallons, and *the other three; the question is, how they shall exactly divide the Wine by the help of these three vessels?*

First, from the vessel which containeth eight gallons, and is full of Wine, let five gallons be poured into the empty vessel of five, and from this vessel so filled let three be poured into the empty vessel of three, so there will remain two gallons within the vessel of five. Then let three gallons which are within the vessel of three be poured into the vessel of eight, which will now have six gallons within it: that done let the two gallons which are in the vessel of five, be put into the empty vessel of three, then of the six gallons of Wine which are within the vessel of eight, fill again the five, and from those five pour one gallon into the vessel of three, which wanted only one gallon to fill it, so there will remain exactly four gallons within the vessel of five, and four gallons within the other two vesssels. This question may be resolved in another way, but I leave that as an exercise to the wit of ingenious readers.

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 water is specifically heavier than 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.

Two numbers, the one even and the other odd, being propounded unto two persons, to the end they may (out of your sight), severally chuse one of those numbers; to discover which of those numbers each person shall have chosen.

Suppose you have propounded unto *Peter*, and *John* two numbers, the one even and the other odd, as ten and nine, and that each of those persons is to chuse one of the said numbers unknown to you. Now to discover which number each person shall have chosen, you must take two numbers, the one even and the other odd, as two and three? then bid *Peter* multiply that number which he shall have chosen by two, and cause *John* to multiply that number which he shall have chosen by three; that done, bid them add the two products together, and let them make known the sum to you, or else demand of them whether the said sum be even or odd, or by any other way more secret, endeavour to discover it, by bidding them to take the half of the said sum, for by knowing whether the said sum be even or odd, you do obtain the principal end to be aimed at, because if the said sum be an even number, then infallibly he that multiplied his number by your odd number, (to wit, by three) did chuse the even number, (to wit, ten); but if the said sum happen to be an odd number, then he whom you caused to multiply his number by your odd number, (to wit, by three,) did infallibly chuse the odd number, (to wit, nine).

The Globular Fountain.

Make a hollow globe, of copper or lead, and of a size adapted to the quantity of water that comes from a 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 towards 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 Water Sun.

Provide two portions of a hollow sphere, that are very shallow; join them together in such a manner that the hollow between them be very narrow. Fix them vertically to a pipe from whence a jet proceeds. Bore a number of small holes all round that part where the two pieces are joined together. The water rushing through the holes will form a very pleasing water sun or star.

To cause a brilliant Explosion under Water.

Drop a piece of phosphorus, the size of a pea, into a tumbler of hot water; and, from a bladder, furnished with a stop cock, force a stream of oxygen directly upon it. This will afford a most brilliant combustion under water.

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 each 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 pasteboard 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.

Tree of Crystals.

Put a small quantity of bruised gum benzoin on a piece of thin metal or a saucer; invert over it a tumbler-glass in which place a sprig of heath, or any small-leaved plant; and apply the flame of a candle underneath, so as to melt the gum: dense fumes will soon begin to arise, and deposit themselves in most beautiful crystals of a silky texture, on the sprig of heath, in delicate soft flakes, resembling foliage.

Beautiful Experiment.

Mix a grain or two of potassium with a like quantity of sodium, by rubbing them together with the point of a knife. The mixture will take place quietly; but if the alloy of these two bodies be brought into contact with a globule of quicksilver, the compound when agitated instantly bursts into a most beautiful flame, and burns vividly.

Simple Barometer.

Take a common phial bottle, and cut off the rim and part of the neck. This may be done by a piece of string, or rather whipcord, twisted round it, and pulled strongly in a sawing position by two persons; one of whom holds the bottle firmly in his left hand. Heated in a few minutes by the friction of the string, and then dipped suddenly into cold water, the 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 so much greater than that of the small quantity within. Now let a bit of tape be tied round the middle of the bottle, 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 fair, 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.

Vegetable Chimney Ornaments.

In winter an elegant chimney ornament may be formed by cutting the head or thick end of a carrot, containing the bulb, and placing it in a shallow vessel with water. Young and delicate leaves unfold themselves, forming a radiated tuft of a very handsome appearance, and heightened by contrast with the season of the year.

To stain Wood Black.

Boil some chips of log-wood in water for about a quarter of an hour, then wash the piece of wood with it three or four times, allowing it to dry after each washing. Lastly, wash the wood by means of a common painting brush with vinegar, prepared as follows:—put one ounce of steel, or iron filings, into two ounces of vinegar, keep the phial near the fire, so as to be gently heated for about two hours, then decant the vinegar and keep it for use.

To find the number of Changes that may be rung on Twelve Bells.

Multiply the numbers from 1, to 12, continually into each other, as follow: and the last product will give the number required.

$$\begin{array}{r} 1\\ 2\\ \hline 2\\ 3\\ \hline 6\\ 4\\ \hline 24\\ 5\\ \hline 120\\ 6\\ \hline 720\\ 7\\ \hline 5{,}040\\ 8\\ \hline 40{,}320\\ 9\\ \hline 362{,}880\\ 10\\ \hline 3{,}628{,}800\\ 11\\ \hline 39{,}916{,}800\\ 12\\ \hline 479{,}001{,}600 \end{array}$$

The Enchanted Bottle.

Fill a glass bottle with water to the 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.

Cheap Hydrometer.

A very ingenius apparatus of this kind, may be made to consist of a short piece of cord, or cat-gut, from four to ten inches, suspended by a hook over a horizontal board; to the lower end of the cord is fixed a horizontal index, having a circular graduated scale on the board. As the cord attracts moisture, or the contrary, it twists or untwists, and thereby turns the index. On this principle, the Dutch toys, called weather houses, are made; one end of the index supports a small image of a man, and the other that of a woman; the former appears, or is brought out in wet weather, and the latter in fair weather.

Powerful Musical Instrument.

Take a common poker, and tie a tape on it at top, so that both ends of the tape are left at liberty; these ends must be rolled round the first finger of each hand, and then with these fingers stopping the ears close, strike the poker thus suspended against any body. The depth of the tone which this odd musical instrument returns will be amazing. The deepest and largest bell will not equal it.

Another Cheap Hydrometer

The following is the most lasting and convenient mode of constructing an instrument of this kind.

Take a very nice balance, and place in it a sponge or other body, which easily imbibes moisture, and let it be equalibrio, with a weight hung at the other end of the beam. Now, if the air become moist, the sponge becoming heavier will preponderate; if dry, the sponge will be raised up. The balance may be contrived two ways; by either having the pin in the middle of the beam, with a slender tongue, a foot and a half long, pointing to the division on the arched plate fitted to it; or the other extremity of the beam may be made so long, as to describe a larger arch on a board placed for the purpose.

To prepare the sponge, it may be necessary to wash it in water, and when dry, in water or vinegar in which sal-amoniac or salt of tartar has been dissolved, and let it dry again: then it is fit to be used.

Very beautiful Artificial Petrifactions.

Put into a retort a quantity of pounded fluor spar, with a few bits of broken glass, and pour upon them some sulphuric acid; fluoric acid gas will be disengaged, holding silex in solution. The subjects that you wish to resemble petrifactions must now be moistened with water, and placed in a vessel connected with the neck of the retort. The fluoric acid gas will be absolved by the moisture adhering to the substances, and the silex will be precipitated upon them like a sort of hoar frost, which will have a very beautiful appearance, and is very durable.

Singular Illusion with the Fingers.

A very singular illusion may be produced, that has its origin in the touch.

If we pass the middle finger over the fore finger, so as to make this last turn towards the thumb, and we then place a small globular body under the tips of these fingers, and press it, that it may move exactly in contact with them, we shall imagine we feel two globes. In this case, the finger that is placed out of its natural position exerts an action, which no longer in accord with the other finger, gives rise to a sensation that seems to refer to a new object.

To lay Prints on the inside of Glass Globes.

First, cut away all the white part of the impression, so that nothing appears but the print: then brush over the face side of it with strong gum water, or size; then put it into the globe, and with a long small stick, on which a camel's-hair pencil is fixed, stick it even on, and arrange what number of prints you please in the globe; let them dry about twelve hours, then pour some prepared plaster of Paris, either white or tinged with any colour you please, and turn the globe easily about, so that every part may be covered; pour out the superfluous plaster, and it is finished.

To take a Shilling out of a Handkerchief.

You must have a curtain-ring, the size of a shilling. At first, you put the shilling into the handkerchief;

but when you take it out to shew there is no deception, you slip the ring into its stead, and while the person is eagerly holding the handkerchief, and the company's eyes are fixed upon the form of the shilling, you sieze the opportunity of conveying it secretly away. When you have possession of the handkerchief again, you slip away the curtain ring.

To cause a Five Pound Note to be all in a flame, without hurting it.

Dip your Note in Brandy, or pretty strong Aqua-Vitæ, then hold it over a lighted candle, or piece of paper, whilst it takes fire, and it will spread all over it as a sheet of flame, but the spirituous matter consuming the moist part that remains will put it out, to the amazement of those who are ignorant of what is done to it. The same may be done with a Handkerchief.

How to hear the Beating of a Watch at twenty or thirty yards distance.

Place a Watch at the end of a balk, or tree, no matter how long, and put your ear against the other *end*, and you will hear the Watch beat as distinctly as if you had it against your ear. If a person strike the balk, *even with a Pin*, while your ear is placed against it, you may hear the stroke very plain.

How to prepare a Candle that the strongest Wind 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 break an Iron Bar as big as your arm.

Take melted soap, with which you will rub your Iron Bar, at the same place where you would have it break; then with any thing take off and clear away part of that unction in the middle part of it about the width of half-a-crown. Then take a sponge dipped into ardent water of three distillations, bring it round the bar, and in six hours it will break.

Curious effects of Oil upon Water.

Fasten a piece of packthread round a tumbler, with strings of the same from each side, meeting above it in a knot at about a foot distance from the top of the tumbler. Then putting in as much water as will fill about one-third part of the tumbler, lift it up by the knot, and swing it to and fro in the air; the water will keep its place as steadily in the glass as if it were ice. But pour gently in upon the water about as much oil, and then again swing it in the air as before; the tranquillity before possessed by the water will be transferred to the surface of the oil, and the water under it will be violently agitated.

Drop a small quantity of oil on the windward side of a pond or river agitated by the wind; it will immediately spread itself with surprising swiftness upon the surface, and the oil, though scarcely more than a tea-spoon-full, will produce an instant calm over a space several yards square. One remarkable circumstance in this experiment is, the sudden, wide, and forcible spreading of a drop of oil on the surface of the water; for if a drop of oil be put upon a highly polished marble table, or a looking-glass, laid horizontally, the drop remains in its place, spreading very little, but when dropped on the water it spreads instantly many feet round, becoming so thin as to produce the prismatic colours for a considerable space, and beyond them so much thinner as to be invisible, except in its effect in smoothing the waves at a much greater distance. It seems as if a repulsion of its particles took place as soon as it touched the water, and so strong as to act on other bodies swimming on the surface, as straw, leaves, chips, &c. forcing them to recede every way from the drop as from a centre, leaving a large clear space

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To cut and tear into Pieces a Handkerchief, and to make it whole again.

This feat, strange as it appears, is very simple: the performer must have a confederate, who has two handkerchiefs of the same quality, and with the same mark, one of which he throws upon the stage to perform the feat with. The performer takes care to put this handkerchief uppermost in making the bundle, though he affects to mix them together promiscuously. The person whom he desires to draw one of the handkerchiefs, naturally takes that which comes first to his hand. He desires to shake them again, to embellish the operation, but, in so doing, takes care to bring the right handkerchief uppermost, and carefully fixes upon some simpleton to draw; and if he finds that he is not likely to take the first that comes to his hand, he prevents him from drawing, by fixing upon another, under pretence of his having a more sagacious look. When the handkerchief is torn and carefully folded up, it is put under a glass upon a table placed near a partition. On that part of the table on which it is deposited is a little trap, which opens and lets it fall into a drawer. The confederate, concealed behind the curtain, passes his hand within the table, opens the trap, and substitutes the second handkerchief instead of the first; then shuts the trap, which fits so exactly the hole it closes, as to deceive the eyes of the most incredulous. If the performer be not possessed of such a table, (which is absolutely necessary for other feats as well as this) he must have the second handkerchief in his pocket, and by sleight of hand change it for the pieces, which must be instantaneously concealed.

To keep a Snow-ball all Summer in a perfect state.

Get a Snow-ball, and squeeze it very hard together, then put it in a pot and surround it well with flour, which must be pressed very hard about it, and you shall have as perfect a snow-ball in the height of summer, as you had when you first put it in the pot.

Easy Method of Purloining without Discovery.

A lady had occasion to send a diamond cross to a jeweller, to be repaired. To provide against any imposition, she had the precaution to count the number of diamonds, which she did in the following manner. She found the cross contained in length, from A to B, nine diamonds. Reckoning from B to C, or from B to D she also counted nine. When the cross was returned, counting them in the same way, she found the number precisely the same; notwithstanding which, two diamonds had been purloined. How was this managed?

```
      A
      0
      0
C     0     D
0 0 0 0 0 0 0
      0
      0
      0
      0
      0
      B
```

SOLUTION.

A bare inspection of the cross in its original, and its altered form, will explain this familiar puzzle to those who have not met with it before.

```
      A
      0                       0
      0                       0
C     0     D             0 0 0 0 0
0 0 0 0 0 0 0                 0
      0                       0
      0                       0
      0                       0
      0                       0
      0                       0
      B
```

Another way.

A gentleman sent his servant with a present of nine ducks in a box, upon which was the following direction:—

"TO ALDERMAN GOBBLE, WITH IX DUCKS."

The servant, who had more ingenuity than honesty, purloined three of the ducks, and contrived it so that the number contained in the box corresponded with that upon the direction. As he neither erased any word or letter, nor substituted a new direction, how did he so alter it as to correspond with the contents of the box?

SOLUTION.

The servant merely placed the letter S before the two Roman numerals IX. The direction then read thus:—

"TO ALDERMAN GOBBLE, WITH SIX DUCKS."

The Transposable Pieces.

Take two guineas and two shillings, and grind part of them away, on one side only, so that they may be but half the common thickness; and observe, that they must be quite thin at the edge; then rivet a guinea and a shilling together. Lay one of these double pieces, with the shilling upwards, on the palm of your hand, at the bottom of your three first fingers, and lay the other piece with the guinea upwards in the like manner, in the other hand. Let the company take notice in which hand is the guinea, and in which is the shilling. Then, as you shut your hands, you naturally turn the pieces over, and when you open them again, the shilling and the guinea will appear to have changed their places.

The Lamp Chronometer.

Refer to Fig. 1. It represents a chamber lamp, A, consisting of a cylindrical vessel made of tin, in the shape of a candle, and is to be filled with oil. This vessel should be about three inches high and one inch diameter, placed in a stand, B. The whole apparatus of lamp and stand, can be purchased, ready made, at any tin-shop in London. To the stand B, is fixed the handle C, which supports the frame D, about 12 inches high, and four inches wide. This frame is tc be covered with oiled paper, and divided into 12 equal parts by horizontal lines, at the end of which are written the numbers for the hours, from 1 to 12, and between the horizontal lines and diagonals, divided into halves, quarters, &c. On the handle C, and close to the glass, is fixed the style or hand, E.

Now, as the distance of the style from the flame of the lamp is only an inch, then, if the distance of the frame from the style be six inches, while the float that contains the light descends by the decrease of the oil, one inch, the shadow of the style on the frame will ascend 12 inches, being its whole length, and show, by its progression, the regular increase of the hours, with their several divisions.

You must be careful always to burn the same oil, which must be the best; and the wick must never vary in size; if these precautions are not attended to the dial never can be accurate.

To diversify the Colours of Flowers.

Fill a vessel of what size or snape 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 plant twice a day, morning, and evening, and remove it into the house at night, so that it drink not of the morning or evening dew for those weeks. You will then experience, that it will produce flowers, not altogether tinctured with that colour wherewith you watered it, but partly with that, and partly with the natural.

To make a shilling turn upon its edge on the point of a needle.

Take a wine or porter bottle, and insert in the mouth a cork, with a needle in a perpendicular position. Then cut a nick in the face of another cork, in which fix a shilling; and into the same cork stick two common table-forks, opposite to each other, with the handles inclining downwards, as will be perfectly understood by consulting the annexed engraving.

If the rim of the shilling be then placed upon the point of the needle, it may be turned round, without any risk of falling off, as the centre of gravity is below the centre of suspension.

Easy method of making a Rain Gauge.

A very simple rain gauge, and one which will answer all practical purposes, consists of a copper funnel, the area of whose opening is exactly ten square inches:

this funnel is fixed in a bottle, and the quantity of rain caught is ascertained by multiplying the weight in ounces by 173, which gives the depth in inches and parts of an inch. In fixing these gauges, care must be taken that the rain may have free access to them: hence the tops of buildings are usually the best places. When the quantities of rain collected in them at different places, are compared, the instruments ought to be fixed at the same heights above the ground at both places, because at different heights the quantities are always different, even at the same place.

To recover a Fly after being drowned several hours.

A fly drowned in water, wine, ale, or beer, and so thoroughly dead, being laid overhead in chalk crushed very fine, or warm ashes, (but they must not be burning, or very hot,) will recover and live again.

To put a Ring through your Cheek, and then to bring it on a Stick.

You must have two rings exactly alike, one of which has a notch which admits your cheek. When you have exhibited the perfect ring, you change it for the other, and privately slip the notch over one side of your mouth; in the meantime, you slip the whole ring on your stick, hiding it with your hand; then desire some one to hold the end of the stick, whip the ring out of your cheek, and smite with it instantly upon the stick, concealing it, and whirling the other ring, which you hold your hand over, round about the stick.

The Aquatic Dancers.

Construct two small hollow figures of enamel; but in the lower part, representing the feet, leave a small hole, through which a drop of water can be introduced, or apply to the back part of each a sort of appendage in the form of a tail, pierced at the end, so that a portion of water may be made to enter this tube. Then bring the figure into equilibrium in such a manner, that with this small drop of water, it shall keep itself upright, and remain suspended in the fluid. Fill the bottle with water to the orifice, and cover it with parchment, which must be closely tied round the neck: see accompanying figure. To put the figures in motion, press the parchment over the orifice with your finger, and the figures will descend, remove your finger, they will rise; apply and remove your fingers alternately, the figures will be agitated in the middle of the fluid, in such a manner as to excite the astonishment of those unacquainted with the cause.

To lock a Padlock upon your Cheek.

The padlock for this purpose has a bow with a division which admits the cheek, so contrived that when locked in, it may neither pinch too hard, nor yet hold it so slightly as to be drawn off. There should be a variety of notches in it, that the place of the division may not be noticed. This invention, which is very curious, can never be detected; it is an improvement of the old feat of cutting one's nose off, which was done by a knife made to fit half way upon the nose.

EXPERIMENTS IN MAGNETISM.

THE smallest natural magnets generally possess the greatest proportion of attractive power. The magnet worn by Sir Isaac Newton, in his ring, weighed only three grains, yet was able to take up 756 grains, or nearly 250 times its own weight: whereas, magnets weighing above two pounds, seldom lift more than five or six times their own weight.

For the more clearly explaining the following experiments, it is to be observed, that the two ends of a magnet are called its poles. When placed on a pivot, in just equilibrium, that end which turns to the north is called the north pole, and the other end the south pole.

To Find the Poles of a Magnet.

Immerse a magnet in iron filings, and when drawn out, it will be found covered all over with them; but it will be observed that there are 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.

To shew the effect of the Magnet Poles on each other.

Fix two touched needles horizontally on two separate pieces of cork floating in water; then place the pieces of cork beside each other, the needle being in a parallel position, with the poles of the same name together, (north or south) and they will mutually repel each other; but if the poles of contrary name be placed together, they will draw each other nearer

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The Magnetic Wand.

Bore a hole, three-tenths of an inch 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 very strongly 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 Learned Swan.

Have a large marble or china bowl, painted inside the rim with the letters of the alphabet; a small swan in which is concealed a steel or iron pin, is set to swim in the bowl, and on being desired, will select any letters, say those which compose your name—to effect this, the performer of the trick must have a magnet in his pocket, by means of which, as he moves round the table, the swan will be attracted to every letter at which it is required to stop.

The Mysterious Watch.

You desire any person to lend you his watch, and ask him if it will go when laid on the table. He will, no doubt, say it will; in which case, you place it over the end of the magnet, and it will presently stop. You then mark the precise spot where you placed the watch, and moving the point of the magnet, you give the watch to another person, and desire him to make the experiment; in which he not succeeding, you give it to a third (at the same time replacing the magnet) and he will immediately perform it.

This experiment cannot be effected, unless you use a very strongly impregnated magnetic bar, (which may be purchased at an optician's) and the balance of the watch must be of steel, which may be easily ascertained by previously opening it, and looking at the works.

Concealed Money,

May be discovered by means of the magnetic compass, if it be previously loaded with a touched needle. This may be effected by boring a hole in the edge of the money, and having driven in the needle, let the hole be filled with a bit of pewter, or silver, to hide the head of it. Next take a needle that is balanced on a pivot, in the same manner as the mariner's compass, and this will turn towards the needle inclosed in the money. Desire any person to lend you a crown, or other piece of money, and having dexterously changed it, let him at his option, secretly place the piece in a snuff-box, or not, as he thinks fit, and it then becomes your task to say whether he has or has not done so, without touching the box. Your own compass, or needle upon a pivot, enables you to do this, by placing it near the box: if the needle maintains its northerly direction, unalterably, be assured the money is not contained in the box, unless the north-pole of the needle, (which lies hid within the money) happens to be placed in a northerly direction—a thing not very likely to happen. However, to be quite sure, find fault with the position of the snuff-box—contrive to move it—and if the needle does not vibrate one way or the other, the loaded money is not in the box. Two points remain, upon which you may deceive yourself, viz. first, your needle must be very sensible, or the influence will be too inconsiderable to effect any change in it; second, take good care that your adversary (or person acted on) does not change your piece for another, and thus defeat the accomplishment of your purpose.

To suspend a Needle in the Air by means of the Magnetic Fluid.

Place a magnet on a stand to raise it a little above the table, then bring a small sewing needle, containing a thread, within a little of the magnet, keeping hold of the thread to prevent the needle from attaching itself to the magnet. The needle, in endeavouring to fly to the magnet, and being prevented by the thread, will remain curiously suspended in the air.

The Magnetical Table.

Under the top of a common table, place a magnet that turns on a pivot, fix a board to cover it, so that it may not be discovered. At one end of the table, secretly place a tin, that communicates with the magnet, and by which it may be placed in several different positions. Strew some steel filings, or very small nails, over that part of the table where the magnet is, and requesting the loan of a knife or key, apply it to the filings, and it will have the same effect on the larger ends of these as a magnet would. Then placing your hand as if carelessly on the pin at the bottom of the table, alter the position of the magnet, and giving the key or knife to any one you will disappoint, he will be unable to perform the experiment as you have done; changing the pin's influence again, you may shew that you have these things at command.

CHEMISTRY.

For many of the experiments mentioned in this book, useful apparatus may be made with a common Florence oil-flask, divided into two parts by means of a thread, previously dipped in oil of turpentine, tied round the middle and ignited; the upper part will make a good funnel, the other will contain chemical ingredients, which may require to be held over a flame.

To Procure Hydrogen Gas.

Provide a phial with a cork stopper, through which is thrust a piece of tobacco-pipe. Into the phial put a few pieces of zinc, or small iron nails; on this pour a mixture, of equal parts of sulphuric acid, (oil of vitriol), and water, previously mixed in a tea-cup, to prevent accidents. Replace the cork stopper, with the piece of tobacco-pipe in it; the hydrogen gas will then be liberated through the pipe into a small stream. Apply the flame of a candle or taper to this stream, and it will immediately take fire, and burn with a clear flame until the hydrogen in the phial be exhausted. In the experiment, the zinc or iron, by the action of the acid becomes oxygenised, and is dissolved, thus taking the oxygen from the sulphuric acid and water; the hydrogen (the other constituent part of the water) is therefore liberated and ascends.

To Fill a Bladder with Hydrogen Gas.

Apply a bladder, previously wetted and compressed, in order to squeeze out all the common air, to the piece of tobacco-pipe inserted in the cork stopper of the phial, (as described in the experiment above). The bladder will thus be filled with hydrogen gas.

Pure Flame.

Hydrogen gas furnishes the purest flame that can be exhibited; for the flame of bodies that emit much light derive that power from solid bodies intensely ignited, and diffused through them, and which, in ordinary flames, as of gas, tallow, wax, oil, &c. consists of finely divided charcoal.

Inflamed Soap Bubbles.

With a pair of bellows, half fill a bladder, having a stop-cock, with common air, and fill the other half with hydrogen gas: screw a brass tobacco-pipe to the stop-cock, and dip it into a basin of soap-lather. When the bladder is pressed, bubbles will rush out, to which apply the flame of a candle; and they will explode with great violence. Let the bubbles be detached from the bowl of the pipe, before they are inflamed, or else the flame may rush into the pipe, and burst the bladder.

Exploding Gas Bubbles.

Put a small quantity of phosphorus and some potash, dissolved in water, into a retort; apply the flame of a candle or lamp to the bottom of the retort, until the contents boil. The phosphuretted hydrogen gas will then rise, and may be collected in receivers. But if instead of receiving the gas into a jar, you let it simply ascend into water, the bubbles of gas will then explode in succession, as they reach the surface of the water, and a beautiful white smoke will be formed, which rises slowly and majestically to the ceiling. If bits of phosphorus are kept some hours in hydrogen gas, phosphorized hydrogen gas is produced; and if bubbles of this gas are thrown up into the receiver of an air pump, previously filled with oxygen gas, a brilliant blueish flame will immediately fill the jar.

To Procure Oxygen Gas.

Put a small quantity of the black oxide of manganese into a tubulated retort, and pour upon it as much strong sulphuric acid as will convert it into a thin paste. Support the retort upon a wire stand, and let the open end of it dip under the edge of the glass vessel which is placed on the shelf of the pneumatic-trough full of water to receive the gas; then apply the heat of a lamp to the retort, and the gas will continue to form as long as the manganese contains any of it.

To Exhibit the Combustion of Charcoal in Oxygen Gas.

Take a small piece of red-hot charcoal, and fasten it to the end of a copper wire, then let it down in a jar of oxygen gas, and the appearance will be very beautiful; for the charcoal burns with great splendour and throws out sparks in all directions.

To Exhibit the Combustion of Phosphorus in Oxygen Gas.

Place a piece of phosphorus about the size of a small pea in a copper cup, about the size of a button, fastened to a thick iron wire, the other end of which is fastened to a cork. Take a bottle capable of containing a quart, and after having filled it with oxygen gas, set fire to the phosphorus, and immediately plunge it into the jar, suspending it by the cork; the light will be so excessively brilliant, that it will be impossible to look at it. This is one of the most beautiful experiments it is possible to exhibit, and the light is the most brilliant that can be produced by art.

Interesting Experiment on Glow-Worms.

Place a glow-worm within a jar of oxygen gas in a dark room. The insect will shine with much greater brilliancy than it does in atmospheric air. As the luminous appearance depends on the will of the animal, this experiment probably affords an instance of the stimulus which this gas gives to the animal system.

To Shew the Combustion of Zinc in Oxygen Gas.

Take some turnings of zinc, form a ball of it, and affix it to a wire; insert a small bit of phosphorus into the ball, set fire to it, and introduce it quickly into the bottle filled with oxygen gas. The zinc will take fire, and burn with a beautiful green flame surrounded by a white one.

Another way.

If a current of oxygen gas be conveyed to filings of the metals, they will burn with great rapidity. For this purpose, fill a large bladder with oxygen gas, and adapt it to a tube; by pressing the bladder, and throwing the gas on a piece of ignited charcoal, on which filings of metal have been put, they will burn rapidly. The filings of metal which exhibit the most brilliant appearances, are those of zinc, copper, antimony, iron, and steel.

Astonishing Heat of the Flame of Oxy-hydrous Gas.

On projecting the flame issuing from the compound blow-pipe, against the outside of a small tinned iron cup, full of cold water, the outside of the cup will become red hot, and at length assume a white heat, not only on its outside, but within, in contact with the water: and in an instant afterwards the flame will break through the side of the cup, and enter the water without being extinguished. The jet-pipe and flame are plunged under water; with due precautions, the flame will continue to burn with undiminished energy, in actual contact with the water, which latter, in a tumbler holding about half-a-pint, will quickly become heated from about 56 degrees to 170 degrees of Farenheit.

Instantaneous Light Apparatus.

The extremity of a fine platina wire is to be rolled into a spiral form, and then dipped in ammonia-murate, or muriate of platina, until about two grains are taken up; after which it is to be heated red-hot in a spirit lamp. In this way a quantity of spongy platina is formed on the wire so minute, that if put in contact with a mixture of oxygen and hydrogen, it becomes heated, and inflames the glass as rapidly almost as if an electrical spark had passed. Such a wire as this, fixed on the jet pipe, so that the spongy metal shall be exposed to the current of hydrogen, immediately inflames it. It happens that if an instrument of this kind has been exposed for some hours to a humid atmosphere, the inflammation does not take place readily, but in this case, if the top of the platina be touched by the finger or palm of the hand, either before or during the time that the current of hydrogen is passing out, the inflammation immediately takes place. Contact, indeed, is not necessary, for the mere approach of the hand is sufficient to elevate the temperature so much as to cause instant inflammation.

An Apparent Impossibility.

A glass shall be quite filled with rain-water, yet substances shall be added and it shall not run over. Dissolve a portion of salt in the water; after which it will receive a certain quantity of sugar, and after that a certain quantity of alum, and perhaps other dissoluble bodies, and not increase its first dimensions; which proves that fluids have vacuities, or are not perfectly dense.

To Produce a Scarlet Pattern on a Black Ground.

Boil a piece of white muslin, or calico, for a few minutes, in a solution of acetate of iron, and dry it strongly near a fire. Having done this, rinse it in water, and dye it black, by boiling it for a short time with a few chips of logwood and water; and lastly, clear it of the superfluous dye, by rinsing it in water. Then suffer the dyed cloth to dry again, and sprinkle it over with lemon-juice, or dilute muriatic acid. It will then be seen, that, wherever the lemon juice is applied, it will turn the dyed stuff of a scarlet colour; and in this manner any pattern may be produced upon a black ground, upon calico or linen cloth.

Illustration of the Art of Calico Printing.—To Produce White 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 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 upon a black ground.

Method of making a Cheap Aromatic Vinegar, for Purifying large Buildings, or Manufactories, &c.

Take of common vinegar any quantity, mix a sufficient quantity of powdered chalk, or common whiting with it, to destroy the acidity; then let the white matter subside, and pour off the insipid supernatant liquor; afterwards let the white powder be dried, either in the open air, or by the fire. When it is dry, pour upon it sulphuric acid, as long as white acid fumes continue to ascend. Stone vessels are most proper to be used on this occasion, as the acid will not act upon them. This product is the acetic acid known in the shops by the name of aromatic vinegar. The simplicity and cheapness of this process, point it out as a very useful and commodious one, for purifying prisons, hospitals, ships, and houses, where contagion is presumed or suspected; the white acid fumes diffusing themselves quickly round.

The Mode of Constructing and Filling Balloons.

The best forms for balloons, are those of a globe, and an egg-like figure. Fire-balloons, or those raised by heated air, if very large, may be made of linen, or silk, and must be open at the bottom, having a hoop round the opening, from which is suspended the grate for the fuel, which is best of straw, or other light combustibles. Small balloons of this kind may be made of tissue paper, having a wire round the bottom. Two cross wires may support in the centre of the opening a little cup, with some cotton and spirits of wine, the flame of which will rarefy the air, and raise the machine. Large balloons for inflammable air, must be made of silk, and varnished over, so as to be air-tight. To the upper part of the balloon there should be fitted a valve, opening inwards, to which a string should be fastened, passing through a hole made in a small piece of wood, fixed in the lower part of the balloon; so that the aeronaut may open the valve when he wishes to descend. The action of the valve is effected by a round brass plate, having a hole about two or three inches diameter: on the inside there is a shutter of brass, covered also with leather, which serves to close the hole; it is fastened to the leather of the plate, and kept against the hole by a spring. To the lower part of the balloon a pipe is fixed, made of the same materials with the balloon, which serves it to fill it by. The car or boat, is made of wickerwork, covered with leather, and well varnished, or painted, and is suspended by ropes proceeding from the net, which goes over the balloon. This netting should cover the upper part, and come down to the middle, with various cords proceeding from it to the circumference of a circle, about two feet below the balloon. From that circle other ropes go to the edge of the boat. This circle may be made of wood, or of several pieces of slender cane, bound together. The meshes of the net should be small at top (against which part of the balloon the inflammable air exerts the greatest force) and increase in size as they recede from the top. The inflammable air for filling the balloon, is procured by putting a quantity of iron-filings, or turnings, with some oil of vitriol diluted with water, into casks lined with lead. From the top of these casks, tin tubes proceed, which unite into one that is connected with the silk tube of the balloon. Balloons cannot be made smaller than six feet in diameter, of oiled silk, as the weight of the material is too great for the air to buoy it up. They may be made smaller, of thin strips of bladder, or other membrane, glued together. The best for this purpose is the allantois of a calf, which is the membrane enclosing the fœtus in the womb. With this they may be made eighteen inches in diameter. Fig. 2, represents the present improved form of the hydrogen gas balloon.

Artificial Volcano.

Mix 28 pounds of sulphur and 28 pounds of iron-filings together, and add as much water as will form the whole into a paste: bury the mass about two feet below the surface of the earth, and in twelve or fourteen hours so much heat will be generated, as to swell the earth, and cause an artificial volcano, throwing up whatever impedes its progress, and scattering round ashes of a yellowish and black colour. To succeed in this experiment, advantage should be taken of warm weather, and after the tenth hour of burying the mass, care should be taken not to approach too near its situation.

To make Beautiful Transparent Coloured Water.

The following liquors, which are coloured, being mixed, produce colours very different from their own. The yellow tincture of saffron, and the red tincture of roses, when mixed, produce a green. Blue tincture of violets, and brown spirit of sulphur, produce a crimson. Red tincture of roses, and brown spirits of hartshorn, make a blue. Blue tincture of violets, and blue solution of copper, give a violet colour. Blue tincture of cyanus, and blue spirit of sal-ammoniac coloured, make green. Blue solution of Hungarian vitriol, and brown ley of potash, make yellow. Blue solution of Hungarian vitriol, and red tincture of roses, make black; and blue tincture of cyanus, and green solution of copper, produce red.

OPTICS.

Singular Experiment.

FIX, at the height of the eye, on a dark ground, a small round piece of white paper, and a little lower, at the distance of two feet to the right, fix up another, of about three inches in diameter; then place yourself opposite to the first piece of paper, and, having shut the left eye, retire backwards, keeping your eye still fixed on the first object; when you are at the distance of nine or ten feet, the second will entirely disappear from your sight.

Singular Effect on the Visual Organs.

Affix to a dark wall a round piece of paper, an inch or two in diameter; and a little lower, at the distance of two feet on each side, make two marks; then place yourself directly opposite to the paper, and hold the end of your finger before your face in such a manner, that when the right eye is open, it shall conceal the mark on the left; and when the left eye is open, the mark on the right: if you then look with both eyes to the end of your finger, the paper, which is not at all concealed by it from either of your eyes, will nevertheless disappear.

Portable Camera Obscura.

The camera obscura is a most amusing optical toy. Fig. 3, is a box constructed for this purpose. A magnifying-glass is placed in the wooden tube *a*, and the object is thrown upon the angular mirror *b*, A complete picture of the most extensive view may thus be obtained in the space of a few inches, and the box may be carried in the pocket of the observer.

The Thaumatrope—an amusing Toy.

The optical principle on which this machine is constructed, is the duration of an impression on the eye, after the object producing it has been withdrawn, and which is said to last about a second.

The cards are each suspended by a bobbin at either side. There is a *part* of a figure or object represented on one side of the card, and the remainder on the other. For example: we have the head of a watchman on the obverse of one, and the empty watch-box on the reverse; by twirling the bobbins, and consequently spinning the card, the head and box fit together and we see a complete guardian of the night.

Then there are some choice *jeux d'esprit*. There is on the obverse of one card a thing like a well worn bundle of birch, but by twirling the bobbins we produce a shower of fresh leaves, and these leaves falling upon that bundle produce the striking likeness of a *tree*.

Optical Experiment.

If a box be formed with a small aperture at one of its sides, and three candles be made to revolve on a piece of wood in the centre, the light opposite the axis will be visible on a semi-transparent screen, placed to receive its image. The other two candles will also have their flames depicted on the screen, at similar distances on each side. This experiment serves to shew the exceeding minuteness of the rays which emanate from the candles; for, if they were not exceedingly small, they would not pass each other without destroying the perfection of the image.

This experiment may be made very amusing by placing a piece of glass, with a ship or any other object painted on it, in the aperture; and when the candles are parallel to the screen, three images may be seen; but, on making them revolve through a quarter of a circle, only one image will be visible on the screen. By increasing the number of candles, the ships will be increased in an equal ratio, and a single ship, by turning the row of candles, will be converted into an entire fleet.

The Artificial Landscape.

Procure a box (See Fig. 4.) of about a foot long, eight inches wide, and six inches high; or any other dimensions you please; so they do not greatly vary from these proportions. At each of its opposite ends on the inside of this box, place a piece of looking-glass that shall exactly fit: but at that end where the sight hole A is, scrape the quicksilver off the glass, through which the eye can view the objects.

Cover the box with gauze, over which place a piece of transparent glass, which is to be well fastened in. Let there be two grooves at each of the places C, D, E, F, to receive two printed scenes as follows: on two pieces of pasteboard, let there be skilfully painted, on both sides, any subject you think proper, as woods, bowers, gardens, houses, &c. and on two other boards, the same subjects on one side only, and cut out all the white parts: observe also, that there ought to be in one of them some object relative to the subject placed at A, that the mirror placed at B may not reflect the hole on the opposite side.

The boards painted on both sides are to slide in the grooves C, D, E, F, and those painted on one side are to be placed against the opposite mirrors A and B; then cover the box with its transparent top. This box should be placed in a strong light, to have a good effect.

When it is viewed through the sight hole, it wil present an unlimited prospect of rural scenery, gradually loosing itself in obscurity; and be found well worth the pains bestowed on its construction.

Pleasing Optical Appearance.

If a soap-bubble be blown up, and set under a glass, so that the motion of the air may not affect it, as the water glides down the sides, and the top grows thinner, several colours will successively appear at the top, and spread themselves from thence in rings down the sides of the bubble, till they vanish in the same order in which they appeared. At length a black spot appears at the top, and spreads till the bubble bursts.

The thinnest substance ever observed is the aqueous film of the soap bubble previous to bursting; yet it is capable of reflecting a faint image of a candle, or the sun. Hence its thickness must correspond with what Sir Isaac Newton calls the *beginning of black*, which appears in water at the thickness of the seven hundred and fifty thousandth part of an inch.

Another.

A convex and concave lens, of nearly the same curvature, being pressed closely together, exhibit rings of colours about the points where they touch. Between the colours there are dark rings, and, when the glasses are very much compressed, the central spot is dark.

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 being about an inch when the length is six inches, and increasing in proportion as the length increases. When these two plates 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.

Changes of the Kaleidoscope.

The following curious calculation has been made of the number of changes this instrument will admit.

Supposing the instrument to contain twenty small pieces of glass, &c. and that you make ten changes in each minute, it will take the inconceivable space of 462,880,899,576 years, and 360 days to go through the immense variety of changes it is capable of producing. Or, if you take only twelve small pieces and make ten changes in each minute, it will then require 33,264 days, or 91 years and 49 days, to exhaust its variations.

On the selection of objects for the Kaleidoscope.

Although the Kaleidoscope is capable of creating beautiful forms from the most ugly and shapeless objects, yet the combinations which it presents, when obtained from certain forms and colours, are so superior to those which it produces from others, that no idea can be formed of the power and effects of the instrument, unless the objects are judiciously selected.

The objects which give the finest outlines by inversion, are those which have a curvilineal form, such as circles, ellipses, looped curves like the figure 8, curves like the figure 3, and the letter S; spirals and other forms, such as squares, rectangles, and triangles, may be applied with advantage. Glass, both spun and twisted, and of all colours and shades of colours, should be formed into the preceding shapes; and when these are mixed with pieces of flat-coloured glass, blue vitriol, native sulphur, yellow orpiment, differently coloured fluids enclosed and moving in small vessels of glass, &c., they will make the finest transparent objects for the Kaleidoscope. When the objects are to be laid upon a mirror plate, fragments of opaquely-coloured glass should be added to the transparent fragments, along with pieces of brass wire, of coloured foils, and grains of spelter. In selecting transparent objects, the greatest care must be taken to reject fragments of opaque glass, and dark colours that do not transmit much light, and all pieces of spun glass or coloured plates should be as thin as possible.

Solar Microscope.

Make a round hole in the window-shutter, about three inches in diameter, and place it in a glass lens of about twelve inches focal distance. To the inside of the hole adapt a tube, having at a small distance from the lens, a slit, capable of receiving one or two very thin plates of glass, to which the object to be viewed must be affixed by means of a little gum water, exceedingly transparent. Into this tube fit another, furnished at its anterior extremity with a lens half an inch focal distance. Place a mirror before the hole of the window shutter on the outside, in such a manner as to throw the light of the sun into the tube, and you will have a solar magic lantern. The method of employing it is as follows: having darkened the room, and by means of the mirror reflected the sun's rays on the glasses in a direction parallel to the axis, place some small object between the two moveable plates of glass, or affix it to one of them with very transparent gum water, and bring it exactly into the axis of the tube; if the moveable tube be then pushed in or drawn out till the object be a little beyond the focus, it will be seen painted very distinctly on a card or piece of white paper, held at a proper distance; and will appear to be greatly magnified. A small insect will appear a large animal, or a hair as big as a walking-stick; the eels in vinegar, or flour paste will look like small serpents.

The Portable Diorama,

Is a most instructive and delightful production of art, capable of affording endless and refined amusement to all ranks and ages. A neat box contains a series of transparent views, abbey ruins, sea-pieces, various landscapes, &c., which fit into a slight wooden frame. There is also a number of atmospheric, and other effects produced by having similar transparencies painted in clouds, with a rainbow, with a moon, or merely plain pieces of silk, of crimson, yellow, &c.; any of which being placed behind the first-mentioned views, (and occasionally combined with a moveable gauze curtain,) impart to them all the changes of morning, evening, dawn, sunset, moonlight, &c., &c., and gratify the spectator with the most charming and picturesque changes. Objects seem to take novel positions, and the entire scenes, have all their relations varied from tempest to profound repose. It is really difficult to imagine seeing them, how materials so unimposing in their forms should be made to convey such gratification to the mind.

To draw, easily and correctly, a Landscape, or any other object without being obliged to observe the Rules of Perspective, and without the Aid of the Camera Obscura.

Procure a box of pasteboard, A, B, C, D, (Fig, 5) of about a foot and a half long, and made in the shape of a truncated pyramid, whose base B, D, F, G, is eight inches wide, and six inches high. Fix to the other end of it a tube of four or five inches long, and which you can draw out from the box more or less. Line the inside of the box with black paper, and place it on a leg or stand of wood, H, and on which it may be elevated or depressed by the hinge I.

Take a small frame of wood, and divide it at every inch by lines of black silk drawn across it, forming forty-eight equal parts; divide these into still smaller equal parts, by lines of finer silk; the different thicknesses of silk serving to distinguish more readily the corresponding divisions: fix this frame at the end of B D, as the base of the pyramid.

Provide a drawing paper, divided into the same number of parts as in the frame, by lines, lightly drawn in pencil. It is not material of what size these divisions are; that will depend entirely on the size you propose to draw the objects by this instrument.

Place this instrument opposite a landscape, or any other object that you want to draw, and fix the leg firmly on, or in the ground, that it may not shake; then turning it to the side you choose, raise or incline it, and put the tube further in or out, till you have gained an advantageous view of the object you intend to draw.

Place your eye E, by the instrument which you have adjusted to the height of your eye, and looking through the tube, carefully observe all that is contained in each division of the frame, and transpose it to the corresponding division in your paper: and if you have the least knowledge in painting, or even drawing, you will make a very pleasing picture, and one in which all the objects will appear in the most exact proportion.

By the same method you may draw all sorts of objects, as architecture, views, &c. and even human figures, if they remain some time in the same attitude, and are at a proper distance from the instrument.

Illuminated Prospects.

Provide yourself with some of those prints that are commonly used in optical machines, printed on very thin white paper; taking care to make choice of such as have the greatest effect from the manner in which the objects are placed in perspective. Place one of these on the borders of a frame, and paint it carefully with the most lively colours, making use of none that are terrestrial. Observe to retouch those parts several times where the engraving is strongest, then cut off the upper part or sky, and fix that on another frame. When you colour a print, place it before you, against a piece of glass, in a position nearly erect, that it may be enlightened by the sun. You may also colour both sides of the print.

The prints being thus prepared place them in a box, A, B, C, D, (Figs. 6, 7.) the opening to which, E, F, G, H, should be a little less than the print. Cover this opening with a glass, and paint all the space between that and the prints, which should be about two or three inches, black. The frame that contains the sky should be about an inch behind the other. In the back part of this box, which is behind the prints, and which may be about four inches deep, place four or five small candlesticks to hold wax lights, and cover that part entirely with tin, that it may be the more luminous.

When the print is placed between the wax lights and the opening in the front of the box, and there is no other light in the room, the effect will be highly pleasing; especially if the lights are at a sufficient distance from each other, and not too strong, that they may not occasion any blots in the print. Those prints that represent the rising or setting of the sun will have a very picturesque appearance. Such as represent conflagrations have also a striking effect.

There should be two grooves for the print next the glass, that you may insert a second subject before you draw away the first: and that the lights in the back of the box may not be discovered.

You must not, thinking to make the print more transparent, cover it with varnish; for that will prevent the gradation of the colours from being visible. The frame should enter the side of the box by a groove, that a variety of subjects may be introduced.

Optical Illusion.

Suspend a ring freely to a string, on a level with the eye, but in such a manner that you cannot see the hole of the ring. Take a stick about a yard long, and fasten another smaller stick crosswise to one end of it. Then shut one eye and try to thread the ring with the small stick, and you will scarcely ever succeed; but use both eyes, and you will do it at the first attempt.

ELECTRICITY.

Electricity is found to be of two kinds, which are generally distinguished by the appellations of *positive* and *negative*, or their equivalents *plus* and *minus*.

Positive and negative electricity may be readily distinguished by the taste, on making the electric current pass, by means of a point, on to the tongue. The taste of the positive electricity is acid, that of the negative electricity is more caustic, and, as it were, alkaline.

The two electricities may also be distinguished in the following manner: if a pointed conductor, such as a needle, be presented to an excited glass tube in the dark, a globular speck of light will be observed upon its point, which is a proof that the tube is electrified positively: but if this pointed conductor be presented to an excited stick of sealing-wax, a stream or pencil of light will be observed, which is an equally distinctive mark of the negative electricity in the electric.

All bodies which admit electricity to pass through them, are called *conductors of electricity;* the same bodies are often called *non-electrics.*

All bodies which are impermeable to electricity, are called *non-conductors of electricity;* they are also called *electrics,* with almost equal frequency.

The following lists of these bodies will be useful to the reader: they are classed according to their excellence:

Conductors or Non-Electrics.

Gold,
Silver,
Copper,
Platina,
Brass,
Iron,
Tin,
Quicksilver,
Lead,
Semi-metals, and metallic ores,
Black lead, or carburet of iron,
Charcoal from all substances,
The fluids of an animal body,
Salt-water, fresh-water, and all non-elastic fluids, except fixed oils.
Ice and snow, till cooled down—13 of Fahren-

heit's thermometer; below this temperature, Achard of Berlin, found that they became electrics.

Most saline substances, of which the metallic salts are best.

Earthy substances,

Smoke,

The vapour of hot water

Electrics or Non-conductors.

Glass, and vetrifications, whether of earths, or metals.

All precious stones, of which the most transparent are the best,

Amber,

Jet,

Sulphur,

All resinous substances,

Baked wood,

Wax,

Silk,

Cotton,

Hair, wool, feathers, and most animal substances, when dry,

Paper,

Air, and other elastic fluids,

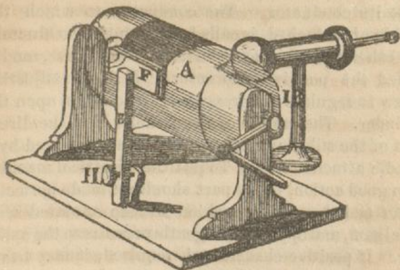
Fixed oils,

Metallic oxides,

The ashes of animal and vegetable substances,

Dry vegetable substances,

Most hard stones, of which the hardest are the best.



Electrical Machine.

The best electrical machine for experimental purposes is represented in the above Fig. It consists of a glass cylinder, A, about ten or twelve inches in diameter, and fifteen or twenty inches in length, turning between two upright pieces of wood, fixed to a stout mahogany base. Two smooth metal conductors equal in length to the cylinder, and about one-third of its diameter, are placed parallel to it upon two glass pillars B, B, which are cemented into sliding pieces of wood, by which their distance from the cylinder may be adjusted. One of the conductors has a cushion, F, attached to it by a bent metallic spring, nearly as long as the cylinder, and about one inch, or an inch and a half wide, to the upper part of which is sewed a flap of oil-silk, which should reach from the cushion over the upper surface of the glass cylinder, to within about an inch of a row of points attached to the side of the opposite conductor. The conductor to which the cushion is attached, is called the negative conductor; the other collects the electricity of the glass, and is called the positive conductor. H is an adjusting screw to regulate the pressure of the cushion upon the cylinder. The motion of the cylinder is in the direction of the silk flap, and may be commu nicated by a handle attached at I. To put this electrical machine into good action, every part should be made perfectly clean and dry. The cushion is then anointed with amalgam, and applied by a gentle pressure to the cylinder. If positive electricity is required, it may be received from the conductor bearing the points, that supporting the cushion being uninsulated by a wire passing from it to the stand; if, on the contrary, negative electricity is required, it may be obtained from the insulated cushion cylinder, the other being uninsulated.

Plate Electrical Machine.

The plate electrical machine consists of a circular plate of glass revolving on an axis which passes through its centre, the excitation is effected by two pairs of cushions placed at opposite parts of the circumference of the plate. The cushions are loosely attached to thin pieces of mahogany, and the pressure upon the plate is adjusted by screws which pass through the opposite pieces. A brass conductor, supported by a glass arm, is fixed to one pillar, or in large ones to the bottom of the frame of the machine, carrying two branches expanding beyond the periphery of the plate. The extremities of the conductors are furnished with points in order to collect the electricity from the excited surface.

The Leyden Phial.

The Leyden phial (see Fig. 8.) consists of a thin glass jar, coated internally and externally with tinfoil, to within a short distance of its mouth. When the inner surface is rendered positive by union with the conductor of the electrical machine, the exterior, being connected with the ground, becomes negative by induction. When the inner and outer surfaces are united by a conductor, all electrical accumulation is annihilated by a powerful spark, and the two opposite states are found to have been precisely equivalent. If the communication between the opposite surfaces of the Leyden phial be made by the hands, a painful jarring sensation is felt at the joints of the fingers, the elbows, shoulders, and chest, commonly called the electrical shock. Metallic wires, with balls at their ends, bent or jointed and fixed to a glass handle, are generally used to transfer the electric charge, and these instruments are called dischargers.

Electrical Automata.

If a metal plate be attached to the prime conductor of the electrical machine, and a similar plate be supported by a foot beneath, small figures, made of pith or paper, will readily leap from the one to the other continuously; and to effect this amusing dance, it will only be necessary to turn the cylinder of the electrical machine rapidly. A representation of this simple apparatus is seen at Fig. 9.

Electric Spider.

Insulate two bodies, and charge one of them plus, the other minus. Then suspend between them, by a silken string, an artificial spider, of which the body may be cork and the legs and fibres of feathers; the spider will move from one of the insulated bodies to the other, till their charge is equalized.

To Exhibit Electrical Attraction on a Number of Objects at once.

Place a cap or covering of metal upon the two extremities of a glass tube four or five inches long, and enclose in the tube some saw-dust or pith-balls; then charge one of the plates plus and the other minus, when, as glass is a non-conductor, the equilibrium can only be restored by the saw-dust or balls, which will accordingly jump up and down till the charge of each plate is the same.

To shew Electric Attraction and Repulsion.

Two distinct bodies in the same electrical state repel each other, whether they have both more or less than their natural share of electricity; but if the one has more or less than the other, attraction takes place; this is a summary of the doctrine of electrical attraction and repulsion, and explains the various experiments which bring these properties into action.

If a bundle of hairs or feathers be hung upon the prime conductor, the moment they are electrified by working the machine, they begin to fly from one another, and they will not again collapse until the electricity is taken off. A fanciful mode of shewing this experiment consists in making the form of a human head, (See the Fig.) with hair on, and placing this image upon the electrified conductor, the hair immediately stands up like "quills upon the fretful porcupine."

Curious Peal of Bells.

From a small pedestal A, (Fig. 10.) rises a stem, F, which supports a small bell, B. From this bell rises a glass tube, to the top of which is cemented a brass ball, C, with four wires of the same metal fastened in it at equal distances. From each extremity of these wires, which terminate in small knobs, hangs, by a brass chain, a small bell, like a bell B. From the middle of each wire, hangs, by a silken thread, a small brass ball. The bells are all suspended in the same plane, and the balls *a, b, c, d,* are at such a height that they will, if caused to vibrate, equally strike near the base, the bell in the centre, and their respective bells hanging from the wires. From this construction it will be understood, that the brass balls *a, b, c, d,* are insulated, because they are suspended by silk; but the bell B has a communication with the earth, because its support is a conductor, while it is separated from the brass knob C and the wires, by the non-conductor or glass pillar. Connect the knob C with the machine, by means of a chain or wire, and electrify it; the wires and bells suspended from them will be electrified at the same instant. As soon as this is done, the bells attract the insulated clappers, and having communicated to them a little electricity, immediately repels them. The clappers now fly to deposit the electricity, they have received upon the centre bell. They are then again in a condition to be attracted by the suspended bells, and again return to the centre bell on being repelled, and this alternate motion continues, accompanied of course by the ringing of the bells till the electrification of the ball C, is discontinued, or the communication of the bell B with the earth cut off.

The Electric Aurora Borealis.

Make a Torricellian vacuum* in a glass tube, about three feet long, and hermetically sealed."† Let one end of this tube be held in the hand, and the other applied to the conductor; and immediately the whole tube will be illuminated from one end; and when taken from the conductor will continue luminous, without interruption, for a considerable time, very often about a quarter of an hour. If after this, it be drawn through the hand either way, the light will be uncommonly brilliant, and without the least interrup-

* A Torricellian vacuum is made by filling a tube with pure mercury, and then inverting it, in the same manner as in making a barometer; for as all the mercury runs out, the space above will be a true vacuum.

† A glass is hermetically sealed by holding the end of it in the flame of a candle, till it begins to melt, and then twisting it together with a pair of pincers.

tion, from one hand to the other, even to its whole length. After this operation, which discharges it in a great measure, it will still flash at intervals, though it be held only at the extremity, and quite still; but if it be grasped by the other hand at the same time, in a different place, strong flashes of light will dart from one end to the other. This will continue for twenty-four hours, and often longer, without any fresh excitation. Small and long glass tubes, exhausted of air, and bent in many irregular crooks and angles, will, when properly electrified, exhibit a very beautiful representation of vivid flashes of lightning.

The Animated Feather.

Electrify a smooth glass tube with a rubber, and hold a small feather at a short distance from it. The feather will instantly fly to the tube, and adhere to it for a short time; it will then fly off, and the tube can never be brought close to the feather till it has touched the side of the room, or some other body that communicates with the ground. If, therefore, you take care to keep the tube between the feather and the side of the room, you may drive it round to all parts of the room without touching it; and what is very remarkable, the same side of the feather will be constantly opposite the tube.

While the feather is flying before the smooth tube, it will be immediately attracted by an excited rough tube or a stick of wax, and fly continually from one tube to the other, till the electricity of both is discharged.

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 larger sized jar.

Electrical Air Cannon.

Hydrogen is inflammable, and extinguishes flame. When pure, it burns quietly with a lambent blue flame at the surface, in contact with air; but, if mixed with thrice its volume of air, it burns rapidly, and with detonation. In making this experiment, a strong phial, capable of holding about six ounces of water, may be employed; or the inflammable air cannon, which admits of the mixture being fired by the electric spark. This instrument consists of a cylinder of brass about three-fourths of an inch diameter, and six inches long, in the form of a small cannon or pistol-barrel, properly mounted, and having a wire, passing through a tube of ivory, and not quite touching the interior of the cylinder, at the part usually occupied by the touch-hole, an electric spark communicated to this wire inflames the mixture of hydrogen and atmospheric air in its interior. It may be charged by previously filling it with dry sand, and emptying it out into a phial of hydrogen, which rises into the gun sufficiently mixed with air; the muzzle may be secured by a cork, which is expelled with much violence and a loud report, upon the inflammation of the gas.

Artificial Earthquake.

In the middle of a large basin of water, lay a round wet board. On the board place any kind of building made of pasteboard, of separate pieces, and not fastened together. Then fixing a wire that communicates with the two chains of the electrifying battery, so that it may pass over the board and the surface of the water, upon making the explosion, the water will become agitated as in an earthquake, and the board moving up and down, will overturn the structure, while the cause of the commotion is totally concealed.

Magical Explosion.

Make up some gunpowder, in the form of a small cartridge, in each end of which put a blunt wire, so that the ends inside of the cartridge be about half an inch of each other; then joining the chain that proceeds from one side of the electrifying battery, to the wire at the other end, the shock will instantly pass through the powder, and set it on fire.

Method of receiving the Electrical Shock from a Cat.

Place the left hand under the throat, with the middle finger and thumb slightly pressing the bones of the animal's shoulder, then gently passing the right hand along the back, sensible electrical shocks will be felt in the left hand, and very distinct discharges may be obtained by touching the tips of the ears, after applying friction to the back: the same may be obtained from the foot.

Another Electrical Experiment.

Place a thin piece of tin-foil vertically, between two horizontal and insulated rods of brass, each terminated by a knob, and distant from each other between one and two inches, then pass from one to the other a strong charge of a large electrical battery: the plate of tin will be found pierced by two holes, with their burs in opposite directions. That the experiment may succeed, the tin-foil should be thin, and the charge strong, otherwise only two impressions will be seen on the plate.

The Electrical Fountain.

Suspend a vessel of water from the middle of the brass arch, and place in the vessel a small tube. The water will be one continued stream; and if the electrification be strong, a number of streams will issue, in form of a cone, the top of which will be at the extremity of the tube. This experiment may be stopped and renewed almost instantly, as if at the word of command.

To pierce a Card, &c. by Electricity.

Take a card, a quire of paper, or any similar material, and place it against the outside coating of a charged jar: keep the card in its situation by pressing against it one knob of the discharged rod, and with the other knob of the rod touch that of the jar. The discharge which will immediately follow, to restore the equilibrium of the two sides of the jar, will be found to have made one or more holes entirely through the card; and each hole will have a bur or raised edge on both sides, unless pressed rather hard against the sides of the jar. This double bur shews that the card is not perforated in the direction of the passage of the fluid, but by the expansion of its substance in every direction.

If, instead of paper, a very thin plate of glass, sealing-wax, rosin, or the like, be interposed between the knob of the discharging rod and the outside coating of the jar, the discharge will break these substances to pieces.

A small insect interposed, in the manner of the card, though not pressed, will be instantly killed by the discharge: and a discharge of six square feet will deprive a man of sensation for a time, if the head be made part of the circuit.

Electric Chase.

The experiment called *The Electric Flies,* shews the effect of points in an amusing manner. Fig. 11, shews a combination of two of these flies, which consist of brass wires fastened, in the same plane, in a small brass centre-piece or cap; these wires are finely pointed, and bent at right angles near their extremities; and those of each fly are bent in the same direction, though the two flies with respect to each other have their points in a contrary direction. Each fly $a, b,$ is exactly balanced, and will turn on its centre by the slightest impulse. The supporting wire *c* is fixed in the prime conductor, and so soon as it is electrified, the flies begin to turn with great rapidity, each in a contrary direction to that of its point, and in the dark the course of each fly will be marked by a line of fire. With a sufficiently powerful machine, the number of flies may be considerable, and by varying their sizes, distances, and position, an interesting spectacle will be produced

The flies, in this experiment, turn the same way, whether positively or negatively electrified. This must be evident, when the cause of their motion is considered. When they are positively electrified, the electric fluid issuing from the points strikes the air, and causes their motion in a contrary direction to the points: and when they are electrified negatively, the stream of electricity which they solicit, impels them in the same direction. Under an exhausted receiver no motion is produced, because the medium which still remains is not dense enough for the electric fluid to act upon with so much force, as to overcome the friction of the flies upon their centres. Also, under an insulated receiver, containing only common air, the motion soon ceases, because the air and the glass soon become so much electrified, that the electric fluid ceases to escape from the points.

Another.

On the top of a finely-pointed wire, rising perpendicularly from the conductor, let another wire, sharpened at each end, be made to move freely, as on a centre. If it be well balanced, and the points bent horizontally, in opposite directions, it will, when electrified, turn very swiftly round, by the re-action of the air against the current which flows from off the points. These points may be nearly concealed, and the figures of men and horses, with hounds, and a hare, stag, or fox, may he placed upon the wires, so as to turn round with them, when they will appear as if in pursuit. The chase may be diversified, and a greater variety of figures put upon them, by increasing the number of wires proceeding from the same centre.

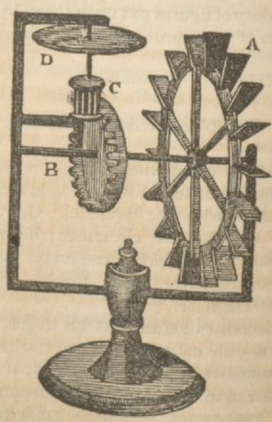
The Unconscious Incendiary.

Let a person stand upon a stool made of baked wood, or upon a cake of wax, and hold a chain which communicates with the branch. On turning the wheel he will become electrified; his whole body forming part of the prime conductor; and he will emit sparks whenever he is touched by a person standing on the floor.

If the electrified person put his finger, or a rod of iron, into a dish containing warm spirits of wine, it will be immediately in a blaze: and, if there be a wick or thread in the spirit, that communicates with a train of gunpowder, he may be made to blow up a magazine, or set a city on fire, with a piece of cold iron, and at the same time be ignorant of the mischief he is doing.

The Electrical Mill.

See the following Fig. A is the water-wheel, B the cog-wheel on its axis, C the trundle turned by that wheel, and D the running mill-stone on the top of the axis of the trundle. It may easily be turned by electricity, if instead of the round plate D for the mill-stone, there be a horizontal wheel on the axis of the trundle C, with spur-cogs, which will turn two



trundles placed on its opposite sides; and on the top of each axis of the trundles, may be a round plate, representing a mill-stone; so that this model has all the working parts of a double water-mill, turning two mill-stones.

Set the mill near the prime conductor, and place the crooked wire, so that its point may be directed towards the uppermost side of the great wheel A; then work the electrical machine, and the stream of fire that issues from the point of the wire will turn the wheel; and consequently all the other working parts of the mill.

The Inconceivable Shock.

Put in a person's hand a wire that is fixed on to the hook that comes from the chain which communicates with one side of the battery, and in his other hand put a small wire with a hook at the end of it, which you direct him to fix on a hook which comes from the other chain. On attempting to do this, he will instantly receive a shock from his body, without being able to guess the cause.

Care should be taken that the shock be not too strong; and regard should be had to the constitution and disposition of the party, as a shock that would hardly affect one person, might be productive of very serious consequences to another.

Much entertainment may be derived from concealing the chain that communicates with that which proceeds from the outside of the battery, under a carpet, and placing the wire that communicates with the chain from the inside, in such a manner, that a person may put his hand on it without suspicion, at the same time that his feet are upon the other wire.

The whole company may be made to partake of the shock, by joining hands, and forming a circle. The experiment may also be varied if they tread upon each other's toes, or lay their hands upon each other's heads. It might happen, by the latter method, that the whole company would be struck to the ground; but it will be productive of no danger, and very little inconvenience; on the contrary, it has happened that they have neither heard nor felt the shock.

Electrical Orrery.

A great diversity of other experiments have been contrived to shew the power of points, one of them is the *Electrical Orrery*, represented at Fig. 12. The sun and earth go round their common centre of gravity in a solar year, and the earth and moon go round their common centre of gravity in a lunar month. These motions are represented by an electrical experiment as follows; the ball S represents the sun, E the earth, and M the moon, connected by wires *a*, *c*, and *b*, *d*; *a* is the centre of gravity between the sun and earth, and *b* is the centre of gravity between the earth and the moon. These three balls and their connecting wires are hung and supported on the sharp point of a wire A, which is set upright in the prime conductor B of the electrical machine; the earth and moon hanging upon the sharp point of the wire *e*, in which wire is a pointed short pin, sticking out horizontally at *c*; and there is just such another pin at *d*, sticking out in the same manner, in the wire that connects the earth and moon.

When the working of the electrical machine is commenced, and consequently these balls and wires are electrified, the fluid that flies off horizontally from the point *c* and *d*, causes S and E to move round their common centre of gravity *a*; and E and M to move round their common centre of gravity *b*: and as E and M are light when compared with S and E, there is much less friction on the point *b* than upon the point *a*; so that E and M will make a much greater number of revolutions about the point *b*, than S and E made about the point *a*. The weights of the balls may be adjusted so that E and M may go twelve times round *b*, in the same time that S and E go once round *a*.

Brilliant Electrical Star.

If a plate of tin be cut into the form of a star, and be supported on its centre by a wire projecting from the prime conductor, as soon as the wheel of the machine is turned, and this apparatus electrified, a flame will appear at the extremity of every angle of the star, which will be very beautiful; and if the star be made to turn swiftly on its centre, an entire circle of fire will be seen in the dark. This experiment will appear very surprising to persons unacquainted with electricity, if the operator now and then privately touch the prime conductor, which may easily be managed as the experiment is performed in the dark; for by this means he may command the appearance or disappearance of the star or circle of fire, at pleasure.

Electrical Illumination.

To illuminate eggs by electricity, it is merely necessary to get a mahogany stand so constructed as to hold three eggs at a greater or smaller distance, according to the position of two sliding pieces of wire. A chain is then placed at the bottom in such a manner as to touch the lowest egg with one end, and with its other the outside coating of a charged jar. The sliding wire at the top is made to touch the upper egg, and the distance of the eggs asunder should not exceed the quarter or eighth part of an inch. The electricity being, by means of the discharging rod, sent down the ball and wire, will, in a darkened room, render the eggs luminous and transparent.

To Illuminate a Piece of Sugar by an Electrical Explosion.

Place a piece of sugar on the top of a Leyden Jar, and bring the discharging rod in contact with it, so that an explosion will take place; if the room be darkened, the light will be seen upon its surface; continuing some time after the explosion. If chalk be used, it will also retain the light after the explosion, which will be of a different colour.

The Electrical Kiss.

A lady may challenge any gentleman, not acquainted with the experiment, that he will not be able to kiss her, although she may incline to meet him. If he accepts the challenge, and the machine turn while they are inclining their heads to kiss each other, provided their clothes do not touch before their lips meet, a spark of fire will fly from the lady to the gentleman, which will be sure to make him draw back, without accomplishing his design.

The Miraculous Luminaries.

You must previously prepare the following phosphorus: Calcine common oyster-shells, by burning them in the fire for half an hour: then reduce them to powder; of the clearest of which take three parts, and of flowers of sulphur one part; put the mixture into a crucible, about an inch and a half deep. Let it burn in a strong fire for rather better than an hour; and when it is cool, turn it out and break it in pieces;

and taking those pieces into a dark place, scrape off the parts that shine brightest, which, if good, will be a white powder.

Then construct a circular board, of three or four feet diameter, on the centre of which draw in gum-water, or any adhesive liquid, a half-moon, of three or four inches in diameter, and a number of stars round it, at different distances, and of various magnitudes. Strew the phosphorus over the figures, to the thickness of about a quarter of an inch, laying one coat over the other. Place this board behind a curtain; and when you draw the curtain up or back, discharge one electrifying jar or phial over each figure, at the distance of about an inch, and they will become illuminated, exhibiting a very striking resemblance of the moon and stars; and will continue to shine for about half an hour, their splendour being gradually more faint.

The Fiery Shower.

On the plate put a number of any kind of seeds, grains of sand, or brass dust. The conductor being strongly electrified, those light particles will be attracted and repelled by the plate suspended from the conductor, with amazing rapidity, so as to exhibit a perfect fiery shower.

Another way is by a sponge that has been soaked in water. When this sponge is first hung to the conductor, the water will drop from it very slowly; but when it is electrified, the drops will fall very fast, and appear like small globes of fire, illuminating the basin into which they fall.

The Illuminated Vacuum.

Take a tall receiver that is very dry, and fix through the top of it, with cement, a blunt wire: then exhaust the receiver, and present the knob of the wire to the conductor, and every spark will pass through the vacuum in a broad stream of light, visible through the whole length of the receiver, let it be as tall as it will. This generally divides into a variety of beautiful rivulets, which are continually changing their course, uniting and dividing again in the most pleasing manner.

If a jar be discharged through this vacuum, it presents the appearance of a very dense body of fire, darting directly through the centre of the vacuum, without touching the sides; whereas, when a single spark passes through, it generally goes more or less to the side, and a finger placed on the outside of the glass, will draw it wherever a person pleases. If the vessel be grasped by both hands, every spark is felt like the pulsation of a large artery; and all the fire makes towards the hands. This pulsation is even felt at some distance from the receiver, and a light is seen between the hand and the glass.

All this while the pointed wire is supposed to be electrified positively; if it be electrified negatively, the appearance is astonishingly different; instead of streams of fire, nothing is seen but one uniform luminous appearance, like a white cloud, or the *milky way* in a clear star-light night. It seldom reaches the whole length of the vessel, but generally appears only at the end of the wire, like a lucid ball.

If a small phial be inserted in the neck of a small receiver, so that the external surface of the glass be exposed to the vacuum, it will produce a very beautiful appearance. The phial must be coated on the inside, and while it is charging, at every spark taken from the conductor into the inside, a flash of light is seen to dart at the same time from every part of the external surface of the phial, so as quite to fill the receiver. Upon making the discharge, the light is seen to run in a much closer body, the whole coming out at once.

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*The Illuminated Cylinder.**

Provide a glass cylinder, three feet long, and three inches in diameter; near the bottom of it fix a brass plate, and have another brass plate, so contrived that you may let it down the cylinder, and bring it as near the first plate as you desire. Let this cylin-

* To shew this and the other electrical experiments of a like nature, the room in which they are exhibited ought to be completely darkened; the illuminated water, eggs, &c. will then appear to great advantage;—the discharge even of the Leyden Phial will appear with greater brilliancy under such circumstances.

der be exhausted and insulated, and when the upper part is electrified, the electric matter will pass from one plate to the other, when they are at the greatest distance from each other that the cylinder will admit. The brass plate at the bottom of the cylinder will also be as strongly electrified, as if it were connected by a wire to the prime conductor.

The electric matter, as it passes through this vacuum, presents a most brilliant spectacle, exhibiting sparkling flashes of fire the whole length of the tube, and of a bright silver hue, representing the most lively exhalations of the aurora borealis.

To Illuminate Water.

Connect one end of a chain with the outside of a charged jar, and let the other end lie upon the table. Place the end of another piece of chain at the distance of about one quarter of an inch from the former; then set a decanter of water upon these separated ends, and on making the discharge, the water will be illuminated.

The Electrified Cotton.

Take a small lock of cotton, extended in every direction as much as can conveniently be done, and by a linen thread about five or six inches long, or by a thread drawn out of the same cotton, tie it to the end of the prime conductor: then set the machine in motion, and the lock of cotton on being electrified, will immediately swell, by repelling its filaments from one another, and will stretch itself towards the nearest conductor. In this situation let the cylinder be kept in motion, and present the end of your finger or the knob of a wire towards the lock of cotton, which will then immediately move towards the finger, and endeavour to touch it: but take with the other hand a pointed needle, and present its point towards the cotton, a little above the end of the finger, and the cotton will be observed immediately to shrink upwards, and move towards the prime conductor. Remove the needle, and the cotton will come again towards the finger. Present the needle, and the cotton will shrink again.

The Electric Sparks.

When the prime conductor is situated in its proper place, and electrified by whirling the cylinder, if a metallic wire, with a ball at its extremity, or the knuckle of a finger, be presented to the prime conductor, a spark will be seen to issue between them, which will be more vivid, and will be attended with a greater or less explosion, according as the ball is larger. The strongest and most vivid sparks are drawn from that end or side of the prime conductor which is farthest from the cylinder. The sparks have the same appearance whether they be taken from the positive or the negative conductor; they sometimes appear like a long line of fire reaching from the prime conductor to the opposite body, and often (particularly when the spark is long, and different conducting substances in the line of its direction) it will have the appearance of being bent to sharp angles in different places, exactly resembling a flash of lightning.

The figure of a spark varies with the superficial dimensions of the part from which it is taken. If it be drawn from a ball of two or three inches in diameter, it will have the appearance of a straight line; but if the ball from which it is drawn be much smaller, as half an inch in diameter, it will assume the zig-zag appearance above mentioned.

Dancing Balls.

Take a common 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 the 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.

Resin Ignited by Electricity.

Wrap some cotton wool, containing as much powdered resin as it will hold, about one of the knobs of a discharged rod. Then having charged a Leyden jar, apply the naked knob of the rod to the external coating, and the knob enveloped by the cotton to the ball of the wire. The act of discharging the jar will set fire to the resin.

A piece of phosphorus or camphor wrapped in cotton wool, and used in the same way, will be much more easily inflamed.

Spirits Ignited by Electricity.

Hang a small ball with a stem to the prime conductor, so that the ball may project below the conductor. Then warm a little ardent spirit, by holding it a short time over a candle in a metallic spoon; hold the spoon about an inch below the ball, and set the machine in motion. A spark will soon issue from the ball, and set fire to the spirits.

This experiment may be varied different ways, and may be rendered very agreeable to a company of spectators. A person, for instance, standing upon an electric stool, and communicating with the prime conductor, may hold the spoon with the spirits in his hand, and another person, standing upon the floor, may set the spirits on fire, by bringing his finger within a small distance of it. Instead of his finger he may fire the spirits with a piece of ice, when the experiment will seem much more surprising. If the spoon be held by the person standing upon the floor, and the insulated person bring some conducting substance over the surface of the spirit, the experiment succeeds as well.

Electrified Ball.

Place an ivory ball on the prime conductor of the machine, and take a strong spark, or send the charge of a Leyden phial through its centre, and the ball will appear perfectly luminous; but if the charge be not sent through the centre, it will pass over the surface of the ball and singe it. A spark made to pass through a ball of box-wood, not only illuminates the whole, but makes it appear of a beautiful crimson, or rather fine scarlet colour.

Illuminated Phosphorus.

Put some of Canton's phosphorus into a clear glass phial, and stop it with a glass stopper, or a cork and sealing-wax. If this wire be kept in a darkened room (which for this experiment must be very dark) it will give no light; but let two or three strong sparks be drawn from the prime conductor, when the phial is kept about two inches distant from the sparks, so that it may be exposed to that light, and this phial will receive the light, and afterwards will appear illuminated for a considerable time.

This powder may be stuck upon a board by means of the white of an egg, so as to represent figures of planets, letters, or any thing else, at the pleasure of the operator, and these figures may be illuminated in the dark, in the same manner as the above described phial.

A beautiful method of expressing geometrical figures with the above powder, is to bend small glass tubes, of about the tenth part of an inch diameter, in the shape of the figure desired, and then to fill them with the phosphoric powder. These may be illuminated in the manner described; and they are not so subject to be spoiled, as the figures represented upon the board frequently are.

The Luminous Writing.

Small pieces of tin-foil may be stuck on a flat piece of glass, so as to represent various fanciful figures. Upon the same principle is the word LIGHT produced, in luminous characters.

It is formed by the small separations of the tin-foil pasted on a piece of glass fixed in a frame of baked wood. To use this, the frame must be held in the hand, and the ball presented to the conductor. The spark will then be exhibited in the intervals composing the word, from whence it passes to the hook, and then to the ground by a chain. The brilliancy of this is equal to that of the spiral tubes.

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 minu tes. 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 large jar, and insulate it; then connect two or more sharp pointed wires or needles, with the 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 soon 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.

Another Electric Orrery, (See p. 118.)

From the prime conductor of an electric machine, suspend six concentric hoops of metal at different distances from each other, in such a manner as to represent in some measure the proportional distances of the planets. Under these, and at a distance of about half an inch, place a metallic plate, and upon this plate, within each of the hoops, a glass bubble blown very thin and light. On electrifying the hoops, the bubbles will be immediately attracted by them, and will continue to move round the hoops as long as the electrification continues. If the electricity be very strong, the bubbles will frequently be driven off, run hither and thither on the plate, making a variety of pleasing and surprising motions round their axis; after which they will return to the hoop, and circulate as before; and if the room be darkened, they will all appear beautifully illuminated with electric light.

Beautiful Electrical Experiment.

Take some oxalate of lime, obtained by precipitation, well washed, and dried in a Wedgewood's basin at a temperature of 300 degrees, until so dry as not to render a cold glass plate, placed over it, dim Stir it with a platina spatula; in a few moments, by friction against the metal, it will become so strongly electrical, that it cannot be collected together, but will fly about the dish whenever it is moved, and over its sides into the sand-bath. It requires some little stirring before the particles of the powder are all of them sufficiently electrical to produce the effect.

Safest Situation during a Thunder-Storm.

[*Though not exactly an experiment, the following advice will be important to the reader.*]

The safest situation during a thunder-storm is the cellar; for when a person is below the surface of the earth, the lightning must strike it before it can reach him, and will of course, in all probability, be expended on it. Dr. Franklin advises persons apprehensive of lightning to sit in the middle of a room, not under a metal lustre, or any other conductor, and to lay their feet upon another chair. It will be safer still, he adds, to lay two or three beds or mattresses in the middle of the room, and folding them double, to place the chairs upon them. A hammock suspended by silk cords would be an improvement upon this apparatus. Persons in fields should prefer the open parts to the vicinity of trees, &c. The distance of a thunder-storm, and consequently the danger, is not difficult to be estimated. As light travels at the rate of 72,420 leagues in a second of time, its effects may be considered as instantaneous within any moderate distance. Sound on the contrary, is transmitted only at the rate 1,142 feet, or about 380 yards, in a second. By accurately observing therefore the time which intervenes between the flash and the noise of the thunder which follows it, a very near calculation may be made of its distance, and there is no better means of removing apprehensions.

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 extremities 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 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, a 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 do 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 plentifully 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 Electric 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 a 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 cradle 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.

To Spin Sealing-Wax into Threads by Electricity.

Stick 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 stuck 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 melting 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.

The Electrified Camphor.

A beautiful experiment of the same nature is made with camphor. A spoon holding a piece of lighted camphor is made to communicate with an electrified body, as the prime conductor of a machine; while the conductor continues electrified by keeping the machine in motion, the camphor will throw out ramifications, and appear to shoot like a vegetable.

GALVANISM.

A LONG time prior to the establishment of galvanism as a science, it had been observed, that if two different metals were placed in contact under water, they were subject to a rapid oxidation, though the water had no perceptible action upon them, when they were alone.

When metals have been soldered by means of other metals, they were found to tarnish about the places where they were joined; and the copper sheathing of ships when fastened by means of iron nails, soon corrodes about the place where the different metals touch each other.

It had been generally affirmed, that porter drunk out of a pewter vessel, has a taste different from that drunk out of glass or earthenware.

Galvanic Battery.

(Refer to Frontispiece, Fig. 14.)

The zinc plates are made by casting that metal in an iron or brass mould; they may be about an eighth of an inch thick. The copper need not exceed twelve or fourteen ounces to the square foot, and may be soldered to the zinc at one edge only, the other three being secured by cement in the trough. The trough must have as many grooves in its sides as the number of plates it is intended to contain, which should be fewer in proportion to their size, otherwise the apparatus will be inconvenient from its weight. When the plates are not more than three inches square, their number in one trough may be fifty, and the distance of the grooves from three-eighths to half an inch. The trough must be made of very dry wood, and put together with white lead. The plates being placed at the fire, the trough is to be well warmed, and placed horizontally on a level table, with its bottom downwards; very hot cement is then to be poured into it, until the bottom is covered to the depth of a quarter of an inch. During this process the plates will have become warm, and they are then to be quickly slided into the grooves and pushed firmly to the bottom, so as to bed themselves securely in the cement. In this way the plates are very perfectly cemented at the bottom, and when this cement is sufficiently cool, a slip of thin deal is to be slightly nailed on the top edge of one of the sides of the trough, so as to overhang the inner surface about a quarter of an inch. The trough being about three quarters of an inch deeper than the diameter of the plates, there will be an interval between their top edges and the deal slip; and when the side of the trough to which the slip is attached is laid flat on the table, this interval forms a channel into which very hot cement is to be poured, and it will flow between each pair of plates, so as to cement one side of all the cells perfectly. As soon as the channel is quite full of fluid cement, the strip of deal is to be torn off, and the trough inclined so as to admit of the superfluous cement to run out. When this is effected, and the cement cool, a slip of deal is to be nailed on the opposite side, and the same process pursued with that. The instrument will then be cemented in the most perfect manner, and it may be cleaned off and varnished.*

Voltaic Pile.

The Voltaic Pile was invented towards the close of

* The zinc end of a battery is considered to be plus or positive: the silver end, (or copper end, when copper is used with the zinc,) is considered to be minus or negative. The effect of the galvanic battery is considered much greater in oxygen than in atmospheric air, and it ceases entirely in azote or hydrogen.

the last century, and since that period, the science of Voltaic electricity has done more towards the progress of chemical research, than any other apparatus yet discovered. The Voltaic Pile consists of a series of plates composed of zinc and copper, in alternate layers; it is found that when a pile is thus raised, each alternate pair of plates being separated by a piece of moistened flannel, that smart shocks will be received by any person who may make a communication between the top and bottom of the pile. An electrical arrangement of this kind usually consists of about fifty pair of plates.

Vegetable Galvanic Pile.

A galvanic pile has been constructed by a scientific gentleman, entirely of vegetable substances. For this purpose, he cut discs of horse-radish and beet-root of two inches in diameter. He then prepared equal discs of walnut-tree wood, which were raised at their edges, to contain a little solution of acidulous tartrate of potash in vinegar, in which they had been previously boiled, to free the wood from rosin. Sixty pairs of discs were employed in the following order; viz. horse radish, beet root, discs of wood. The spinal marrow of a prepared frog was connected with the pile, by means of a leaf of *cochlearia;* the muscles of the frog were connected with the top of the pile by means of a double band of grey paper, wetted with vinegar; and, as often as this circuit was completed, contortions were excited in the animal.

*Galvanic Experiment with Frogs.**

Frogs have been found the most convenient subjects for galvanic operations. Galvani prepared these animals by skinning their legs when recently dead, (they are usually killed by decapitation,) and leaving the legs attached to a small part of the spine, but separated from the rest of the body. Any other limb may be prepared in a similar manner, viz. the limb is deprived of its integuments, and the nerve which belongs to it is partly laid bare. The strongest contractions are produced when the galvanic electricity is caused to pass through the nerve to the muscles. Frogs which have been galvanized, very quickly become putrid.

The Effect of Galvanism upon Living Animals.

The following Experiments, which are not attended with any circumstances that can wound the feelings of humanity, may be easily made to shew the action of voltaic electricity on living animals.

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* Perhaps most of those who try galvanic experiments merely for the purpose of amusement, would choose to dispense with the operations of decapitating and skinning frogs. It may therefore be observed, that an ample proof of the power of galvanism over the dead animal muscle, may be obtained by galvanizing any animal killed for domestic use. It will only be necessary to point the wires from the battery, and to penetrate the skin with them, at the two parts between which a communication is intended to be made.

Experiment on a Frog.

Place a living frog upon a plate of zinc wetted with water, and paste a slip of tin-foil, or a shilling, also wetted with water, upon the back of a frog. If now a communication be formed between the zinc and the tin-foil, by means of a wire, or other piece of metal, the frog will be violently convulsed, and jump off the plate.

Experiment with a Leech.

Those animals can only be convulsed by galvanism which possess distinct limbs and muscles; yet reptiles may be shewn to be affected by it: thus if a leech or a worm be laid upon a plate of zinc, and surrounded at a little distance by pieces of silver, for example half-crowns, every time the animal touches one of the pieces of silver, it will be observed to draw itself back.

Experiment on a Flounder.

Take a live flounder, and put it on a pewter plate, or upon a large piece of zinc, wetted with water, upon its back; or place the fish upon its back, and apply the coin to its cheek or breast, then touch the plate or zinc with a wire, and apply the other extremity of the wire to a piece of silver, violent contractions will be immediately excited in the fish, which may be renewed at pleasure by forming a connection between the two metals. The animal, therefore, is quiet, until a commnnication be made between the silver and the zinc, by means of a third metal, to the edges of the others. The galvanic agency then takes place, because a galvanic circle is formed.

Besides these effects produced by the influence on the muscles, the sensations which it excites in some of the organs of sense are equally evinced in the following manner.

Place a thin plate of zinc upon the upper surface of the tongue, and half a crown, or piece of silver or tea-spoon, on the under surface. The metals ought to be allowed to remain for a little time in contact with the tongue before they are made to touch each other, that taste of the metals themselves may not be confounded with the sensation produced by their contact. When the edges which project beyond the tongue are then made to touch, a sensation is produced which it is difficult accurately to describe. It takes place suddenly, like a slight electrical shock, and a subacid taste, somewhat resembling dilute nitric acid, is perceived confounded with an evident metallic taste.

Another.

Place a silver tea-spoon as high as possible between the gums and the upper lip, and a bar of zinc between the under lip: on bringing the extremities into contact, a very vivid sensation, resembling a flash of light, will be perceived. It is singular, that this light is equally vivid in the dark with the strongest light, and whether the eyes be shut or open.

Another.

Place a cup of silver, filled with water, on a plate of zinc, standing upon a table, and touch the water with the tip of the tongue, it will be tastless as long as the zinc plate is not touched, for the body does not form a voltaic circle with the metals. Moisten well the hands, and lay hold of the plate of zinc, whilst the tongue is brought to touch the water, a peculiar sensation, and an acid taste will be immediately experienced.

Galvanic Shock.

Several persons may receive the shock together, by joining hands, in the same manner as in receiving the shock from a Leyden phial. Their hands should be well moistened; but the strength of the shock diminishes as it proceeds, in consequence of which the last person feels it much less violently than the first. After receiving the galvanic shock, a slight numbness of the part that has been exposed to it remains for some time.

The galvanic shock may also be conveniently given by immersing the hands or the feet into vessels containing a solution of salt, and bringing wires from each end of the battery into the liquid. If any other part of the body is intended to be operated upon, a sponge, moistened with salt-water and fastened to a metal plate connected with one end of the battery, may be applied to the part, and the hand or foot put into a vessel of the same liquid, connected by a wire with the other end of the battery. Small bits of sponge, or bits of leather, may be fastened to the end of the connecting wires, and made more or less moist as the delicacy of the part may require.

The Decomposition of Water by Galvanism.

The most simple mode of performing this experiment, is to bring the wires coming from each end of the battery into a vessel of water. A profusion of bubbles of gas will appear to be given out from each wire, as far as they are immersed in the liquid. The nearer the wires are brought together, so as not to touch, the more rapidly the decomposition goes on. The gas produced from the wire coming from the zinc end of the battery, if the wire be of gold or platina, is found as before mentioned, to be oxygen; but if the wire be of any more oxidable metal, no gas will appear, but the wire will be oxidated. The gas furnished by the wire from the copper end of the battery, of whatever kind of metal the wire may be, is pure hydrogen. If the immersed part of this, however, be previously oxidated, no gas will be observed for some time, the hydrogen being employed in reducing the oxide upon the surface. Both the gases are furnished by the decomposition of the water.

Powerful Batteries.

Sir H. Davy's great voltaic battery consisted of two thousand double plates of copper and zinc of four inches square.

Each plate of Mr. Children's large galvanic battery consists of thirty-two square inches, and produced intense heat. Iron was instantaneously converted by it to blister steel, and diamond powder disappeared.

Galvanic Experiments on the Dead Body of a Criminal.

The following interesting experiments, illustrative of the amazing powers of Galvanic operations, will be highly acceptable to the reader. The subject of these experiments was a middle sized, athletic, and extremely muscular man, about thirty years of age. He was a murderer, and after hanging nearly an hour, underwent the experiments about to be detailed.

Experiment 1. A large incision was made into the nape of the neck, close below the occiput. The posterior half of the atlas vertebra was then removed by bone forceps, when the spinal marrow was brought into view. A profuse flow of liquid blood gushed from the wound, inundating the floor. A considerable incision was at the same time made in the left hip, through the great gutteal muscle, so as to bring the sciatic nerve into sight, and a small cut was made in the heel; the pointed rod connected with one end of the battery was now placed in contact with the spinal marrow, while the other rod was applied to the sciatic nerve. Every muscle of the body was immediately agitated with convulsive movements resembling a violent shuddering from the cold; the left side was most powerfully convulsed at each renewal of the electric contact. On moving the second rod from the hip to the heel, the knee being previously bent, the leg was thrown out with such violence as nearly to overturn one of the assistants, who in vain attempted to prevent its extension.

Experiment 2. The left phrenic nerve was now made bare at the outer edge of the *sternothyroidhus* muscle, from three to four inches above the clavicle, the cutaneous incision having been made by the side of the sternocleido mastoideus. Since this nerve is distributed to the diaphragm, and since it communicates with the heart through the eighth pair, it was expected, by transmitting the galvanic power along it, that the respiratory process would be renewed. Accordingly a small incision having been made under the cartilage of the seventh rib, the point of the one insulating rod was brought into contact with the great head of the diaphragm, while the other point was applied to the phrenic nerve in the neck. This muscle, the main agent of respiration, was instantly contracted, but with less force than was expected. Satisfied from ample experience on the living body, that more powerful effects can be produced in galvanic excitation, by leaving the extreme communicating rods in close contact with the parts to be operated on, while the electric chain or circuit is completed by running the end of the wires along the top of the plates, in the last trough of either pole, the other wire being steadily immersed in the last cell of the opposite pole, I had immediate recourse to this method. The success of it was truly wonderful. Full, nay, laborious breathing, instantly commenced. The chest heaved, and fell; the belly was protruded, and again collapsed, with the relaxing, and retiring diaphragm. This process was continued without interruption, so long as I continued the electric discharges.

In the judgment of many scientific gentlemen who witnessed the scene, this respiratory experiment was perhaps the most striking ever made with a philosophical apparatus. Let it also be remembered, that for full half an hour before this period, the body had been well nigh drained of its blood, and the spinal marrow severely lacerated. No pulsation could be perceived meanwhile at the heart or wrist; but it may be supposed, that but for the evacuation of blood, the essential stimulus of that organ, this phenomenon might also have occurred.

Experiment 3. The supra-orbital nerve was laid bare in the forehead, as it issues through the supraciliary *foramen* in the eye-brow: the one conducting rod being applied to it, and the other to the heel, most extraordinary grimaces were exhibited every time that the electric discharges were made, by running the wire in my hand along the edges of the last trough, from the 220th, to the 270th pair of plates: thus fifty shocks, each greater than the preceding one, were given in two seconds. Every muscle in his countenance was simultaneously thrown into fearful action: rage, horror, despair, anguish, and ghastly smiles united their hideous expression in the murderer's face; surpassing far the wildest representation of a Fuseli or a Kean. At this period several of the spectators were forced to leave the apartment from terror or sickness, and one gentleman fainted.

Experiment 4. The last galvanic experiment consisted in transmitting the electric power from the spinal marrow to the ulnarnerve, as it passes by the internal condyle to the elbow: the fingers now moved nimbly, like those of a violin performer: an assistant, who tried to close the fist, found the hand to open forcibly, in spite of his efforts. When the one rod was applied to a slight incision in the tip of the forefinger, the fist being previously clenched, that finger extended instantly; and from the convulsive agitation of the arm, he seemed to point to the different spectators, some of whom thought he had come to life. About an hour was spent in these operations.

PNEUMATICS.

The Air Pump.

It will be advisable in the first place to describe the way in which the Air Pump is usually constructed. In the frontispiece, Fig. 15, represents the cheapest form, and in its action it exactly resembles the common sucking pump. Within each of the two strong brass barrels in front is fixed (at the bottom) a valve, opening upwards; these valves communicate with a concealed pipe leading to the hole under the glass receiver. The barrels also include moveable pistons, with valves opening upwards. To the upper parts of the pistons are attached rack-work, (part of which is elevated in the cut,) these racks are moved up and down by means of a little cog wheel turned round by a handle affixed. A little beneath the pistons is a small screw which serves to re-admit air into the receiver when it is in a state of exhaustion. When the Air-Pump is to be used, *a slip of wet leather should be placed under the edge af the receiver,* because the plate is liable to be scratched, and the smallest unevenness between the receiver and the plate would prevent the success of any experiment.

The Shower of Fire.

Place on the top of the air-pump a small circular plate, pierced with holes, and supporting a small cylindric receiver, terminating in a hemisphere, and cover the whole with a larger receiver, having a hole in its summit, to admit a glass funnel filled with mercury. The funnel must shut with a stopper, so as to open when necessary. Then exhaust the air from the receiver, and open the funnel which contains the mercury, which will run down, and falling on the convex summit of the interior receiver, will be thrown up in small luminous drops, so as to resemble a shower of fire.

Bottles broken by Air.

Take a square bottle of thin glass, 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 off, will act so powerfully as to break the bottle into pieces.

Water boiled by Air.

Take water made so warm that you can just bear your hand in it, but that has not been boiled; put it under the receiver, and exhaust the air. Bubbles of air will soon be seen to rise, at first very small, but presently become larger, and will be at last so great, and rise with so much rapidity, as to give the water the appearance of boiling. This will continue till the air is let into the receiver, when it will instantly cease.

Glass broken by Air.

Lay a square of glass on the top of an open receiver, and exhaust the air. The weight of the external air will press on the glass, and smash it to atoms.

The Hand fixed by Air.

If a person hold his hand on an open receiver, and the air be exhausted, it will be fixed as if pressed by a weight of sixty pounds.

The Floating Stone.

To a piece of cork tie a small stone that will just sink it; and putting it in a vessel of water, place it under the receiver. Then exhausting the receiver, the bubbles of air will expand from its pores, and adhering to its surface, will render it, together with the stone, lighter than water, and consequently they will rise to the surface, and float.

Feather and Guinea.

It is sometimes imagined that mass for mass, a pound of gold would be heavier than a pound of feathers; and hence the paradoxical experiment of "which is heaviest?" And yet we may place a guinea and feather under such circumstances that they will both arrive at the ground at the same instant of time when discharged from a proper apparatus. Fig. 16 shews the glass receiver and plate of the Air-Pump by which the air must be withdrawn, and it will then be seen that it is the air alone that makes the difference in their descent.

Withered Fruit Restored.

Take a shrivelled apple, and placing it under the receiver, exhaust the air. The apple will immediately be plumped up, and look as fresh as when first gathered; for this reason, that the pressure of the external air being taken off, the air in the apple extends it so much so that it will sometimes burst. If the air be let into the receiver, the apple will be restored to its original shrivelled state.

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 faint, till at last not the least noise can be heard. As you let the air in again, the sound returns.

The Mercurial Wand.

Take a piece of stick, cut it even at each end with a penknife, and immerse it in a vessel of mercury. When the air is pumped out of the receiver, it will at the same time come out of the pores of the wood through the mercury, as will be visible at each end of the stick. When the air is again let into the receiver, it falls on the surface of the mercury, and forces it into the pores of the wood to possess the place of air.

When the rod is taken out, it will be found considerably heavier than before, and that it has changed its colour, being now all over of a blueish hue. If cut transversely, the quicksilver will be seen to glitter in every part of it.

Feathers heavier than Lead.

At one end of a fine balance, hang a piece of lead, and at the other as many feathers as will poise it; then place the balance in the receiver. As the air is exhausted, the feathers will appear to overweigh the lead, and when all the air is drawn off, the feathers will proponderate, and the lead ascend.

The Self-moving Wheel.

Take a circle of tin, about ten inches in diameter, or of any other size that will go into the receiver, and to its circumference fix a number of tin vanes, each about an inch square. Let this wheel be placed between two upright pieces on an axis, whose extremities are quite small, so that the wheel may turn in a vertical position with the least possible force. Place the wheel and axis in the receiver, and exhaust the air. Let there be a small pipe with a cock; one end of the pipe to be outside the top of the receiver, and the other to come directly over the vanes of the wheel.

When the air is exhausted, turn the cock, and a current will rush against the vanes of the wheel, and set it in motion, which will increase, till the receiver is filled with air.

The Artificial Halo.

Place a candle on one side of a receiver, and let the spectator place himself at a distance from the other side. Directly the air begins to be exhausted, the light of the candle will be refracted in circles of various colours.

Vegetable Air Bubbles.

Put a small branch of a tree with its leaves, or part of a small plant, in a vessel of water, and placing the vessel in the receiver exhaust the air. When the pressure of the external air is taken off, the spring of that contained in the air vessels of the plant, by expanding the particles, will make them rise from the orifices of all the vessels for a long time together, and produce a most beautiful appearance.

A Fountain to play by the pressure of Air.

To produce a fountain in vacuo, it is merely necessary to exhaust a glass receiver by means of the air-pump, and when that is effected, to place the lower end of the stop cock in a basin of water, which will be driven up in a continuous jet by the pressure of the air. The apparatus is represented at Fig. 18.

Effect of the Air respired from the Lungs.

Half fill a wine glass with fresh prepared lime water or barytic water, and breathe into the fluid for a few minutes, by means of a tobacco pipe or glass tube, air from the lungs. The lime water will speedily become turbid, and a white precipitate fall to the bottom of the glass.

The Exploded Bladder.

Take a glass pipe open at both ends, to one of which tie fast a wet bladder, and let it dry. Then place it on the plate of the pump. While the air presses the bladder equally on both sides, it will lie even and straight; but as soon as the air is exhausted, the bladder will become more stretched; it will soon yield to the incumbent pressure, and burst with a loud explosion. To make this experiment more easy, one part of the bladder should be scraped with a knife, and some of its external fibres taken off.

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 it into a basin of mercury or water. Then the cock being again turned, the fluid, by the pressure of the air, will play upon the tube, in the form of a beautiful fountain.

The Cemented Bladder.

Tie the neck of the bladder to a stop-cock which is to be screwed to the plate of the pump, and the air exhausted from the bladder; then turn the stop-cock to prevent the re-entrance of the air, and unscrew the whole from the pump. The bladder will be transformed into two flat skins, so closely applied together, that the strongest man cannot raise them half an inch from each other; for an ordinary sized bladder, of six inches across the widest part, will have one side pressed upon the other with a force equal to 396 pounds' weight.

The Animated Bacchus.

Construct a figure of Bacchus, seated on a cask; let his belly be formed by a bladder, and let a tube proceed from his mouth to the cask. Fill this tube with coloured water or wine, then place the whole under the receiver. Exhaust the air, and the liquor will be thrown up into his mouth. While he is drinking, his belly will expand.

The Artificial Balloon.

Take a bladder containing only a small quantity of air, and a piece of lead to it, sufficient to sink it, if immersed in water. Put this apparatus into a jar of water, and place the whole under a receiver. Then exhaust the air, and the bladder will expand, become a balloon lighter than the fluid in which it floats, and ascend, carrying the weight with it.

Curious Experiment with a Viper.

Many natural philosophers, in their eagerness to display the powers of science, have overlooked one of the first duties of life, humanity; and, with this view, have tortured and killed many harmless animals, to exemplify the amazing effects of the air-pump. We, however, will not stain the pages of this little work, by recommending any such species of cruelty, which in many instances can merely gratify curiosity: but as our readers might like to read the effect on animals, we extract from the learned Boyle, an account of his experiment with a viper.

He took a newly-caught viper, and shutting it up in a small receiver, extracted the air. At first, upon the air being drawn away, the viper began to swell: a short time after, it gaped and opened its jaws; it then resumed its former lankness, and began to move up and down within the receiver, as if to seek for air. After a while, it foamed a little, leaving the foam sticking to the inside of the glass: soon after, the body and neck became prodigiously swelled, and blistered on its back. Within an hour and a half from the time the receiver was exhausted, the distended viper moved, being yet alive, though its jaws remained quite stretched: its black tongue reached beyond the mouth, which had also become black in the inside; in this situation it continued for three hours; but on the air being re-admitted, the viper's mouth was presently closed, and soon after opened again; and these motions continued some time, as if there were still some remains of life.

New Method of Congealing Water.

A celebrated gentleman gives the following account of his interesting experiment on this subject:

—into a metal vase half filled with water, I poured very gently an equal quantity of ether, so that no mixture might take place in the two liquids. The vase was placed under the receiver of an air-pump, which was so fixed upon its support, as to remain quite steady when the air was pumped out. At the first stroke of the piston the ether became in a state of ebullition, it was evaporated in less than a minute, and the water remained converted into ice. The experiment was made in an apartment, the temperature of which was 16 deg. R.

Experiments with Sparrows.

Count Morozzo placed successively several full-grown sparrows under a glass receiver, inverted over water. It was filled with atmospheric air, and afterwards with vital air. He found

First.—That in *atmospheric* air

	HOURS.	MIN.
The first sparrow lived.............	3 ..	0
The second sparrow lived	0 ..	3
The third sparrow lived............	0 ..	1

The water rose in the vessels eight lines during the life of the first; four during the life of the second; and the third produced no absorption.

Second.—In *vital* air or *oxygen*.

	HOURS.	MIN
The first sparrow lived............	5 ..	23
The second	2 ..	10
The third.........................	1 ..	30
The fourth........................	1 ..	10

	HOURS.	MIN.
The fifth	0	30
The sixth	0	47
The seventh	0	27
The eighth	0	30
The ninth	0	22
The tenth	0	21

The above experiments elicit the following conclusions :—

1. That an animal will live longer in vital than in atmospheric air.—2. That, one animal can live in air, in which another has died.—3. That, independently of air, some respect must be had to the constitution of the animal ; for the sixth lived 47 minutes, the fifth only thirty.—4. That there is either an absorption of air, or the production of a new kind of air which is absorbed by the water as it rises.

HYDROSTATICS AND HYDRAULICS.

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 time the vessel is filling. From this also is understood, how a hole or leak, 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.

The power of Water.

Let a strong small iron tube of twenty feet in height be inserted into the bung-hole of a cask, and the aperture round so closed, that it shall be water-tight; pour water into the cask till it is full through the pipe: also continue filling the pipe till the cask bursts, which will be when the water is within a foot of the top of the tube. In this experiment the water on bursting the vessel, will fly about with considerable violence.

Expansive Force of Freezing Water.

Colonel E. Williams, of the Royal Artillery, when at Quebec, made many experiments on the expansive force of freezing water. He filled all sizes of iron bomb-shells with water, then plugged the fuze-hole close up, and exposed them to the strong freezing air of the winter in that climate, sometimes driving in the iron plugs as hard as possible with a sledge hammer; and yet, though they weighed near three pounds, they were always forced out by a sudden expansion of the water in the act of freezing, like a ball impelled by gunpowder, sometimes to the distance of between 400 and 500 feet; and when the plugs were screwed in, or furnished with hooks or barbs, by which to lay hold of the inside of the shell, so that they could not possibly be forced out, in that case the shell always split in two, though its thickness of metal was about an inch and three quarters. It is further remarkable, that through the circular rack, round about the shells where they burst, there stood out a thin film, or sheet of ice like a fin; and in the cases where the plugs were projected by freezing water, there suddenly issued from the fuze-hole a bolt of ice of the same diameter, and stood over it sometimes to the height of eight inches and a half. Hence, we need not be surprised that excessive frost should cause the ice to split rocks and other solid substances.

To make Water ascend between two Pieces of Glass, and form a regular Figure.

Procure two pieces of glass, about six inches square, join any two of their sides, and separate the opposite sides with a piece of wax, so that their surfaces may form an angle of about two or three degrees; immerse this apparatus about an inch in a basin of water, and the water will rise between the plates, and form a beautiful geometrical figure, called an hyperbola.

How to raise Water several Feet above its ordinary Level.

The syphon is employed by distillers and others, for the purpose of emptying casks, and it may be advantageously used to decant wine, as the wine may be raised from the most turbid ground without mixing with the sediment beneath. To make this instrument, it is merely necessary to bend a glass tube by the application of heat; and if a second tube be attached, and the air sucked out, the fluid will continue to flow as long as any water remains in the upper vessel.

How to Work a Pump without Manual Labour.

Captain Leslie, of the American vessel the George and Susan, invented, in his voyage from North America to Stockholm, the following simple method of keeping the ship's pumps at work, when the sea runs high, and when the crew are not sufficient, or are already fatigued:—About ten or twelve feet above the pump, he fixed a spar, or small mast, one end of which projected overboard, while the other was fastened as a lever to the machinery of the pump. To the end which projected overboard, was suspended a water butt, half full. By this simple contrivance, every coming wave, as it raised the water butt sunk with it, and raised the piston again; thus, without the aid of the crew, the ship was cleared of water in four hours' time.

Exposition of a Paradox.

It is a vulgar paradox, "that when water is boiling in a vessel the bottom is cool, but the moment it ceases to boil the bottom becomes hotter." The whole of the paradox appears to be founded on an error of sense. When a person applies his finger to the vessel, though he applies it for a considerable time, it is not heated more than he can endure, for the blood in the course of its circulation loses some of its heat before it arrives at the extremities: and till the blood in the extremities is heated to the same degree with that of the heart, we feel no pain from burning; but as soon us this is effected, the least degree of heat becomes painful. When the finger is first applied to the bottom of the vessel, after it is taken off the fire, the heat is endured for these reasons. When the boiling ceases, it is natural to take the same finger (for, having dirtied one, people seldom choose to take another), and that finger being already heated almost as much as it could bear, now finds the heat at the bottom of the vessel exquisitely painful.

To shew that Water is contained in the Atmosphere in the driest Weather.

Take a tea-spoonful of dry muriate of lime, or acetate of potash, or sub-carbonate of potash, spread it in a saucer, and suffer it to be exposed to the open air for a few days, the dry salt will thus be rendered completely liquid, by the watery vapour which always exists in the atmosphere.

Imitative Water Spout.

The phenomenon of the water spout may be illustrated by a very easy experiment.

In a stiff paper card make a hole just large enough to insert a goose quill; after cutting the quill off square at both ends, lay the card upon the mouth of a wine-glass filled with water to within the fifth or sixth part of an inch from the lower orifice of the quill; then applying the mouth to the upper part, draw the air out of the quill, and in one draught of the breath draw in about a spoonful of water; and this you may repeat, the water remaining as before. The water will not ascend to the mouth in a stream, which it would do if the quill reached to it, but broken, and confusedly mixed with the air which ascends with it. The usual phenomena of water-spouts are exactly agreeable to this theory.

To render visible the opposite Currents in which Fluids are thrown, while they change their Temperature.

Fill a common eight-ounce phial, or cylindrical glass jar, about two inches or more in diameter, and five or six inches long, with cold water, and diffuse through it a small portion of pulverised amber: let the phial of water be immersed into a tumbler, containing hot water: this being done, two currents, going in different directions, will be observed in the inner vessel, the one ascending, the other descending; that is to say, the minute particles of amber, which were diffused through the fluid, and were at rest before the heat was applied to the water in the inner vessel, will be seen in motion; those particles that are situated towards the sides of the glass, or which are the nearest to the source of heat, will move upwards, whilst those that are in the centre move downwards: and thus two distinct currents are formed in opposite directions. These currents gradually diminish in velocity; and when the water in the inner vessel has acquired the same temperature as that in the outer one, the particles of amber will again be brought to a state of rest.

If the position of the two glass vessels be reversed, namely, if the glass containing hot water be immersed in a vessel containing cold water, the motion of the currents will be also reversed: the particles next to the sides of the glass are thrown into currents, directed downwards, whilst the particles in the centre form a current upwards. The equilibrium of these two currents will also be restored, when the equalization of temperature of the water within, and that without, has been effected.

To render the experiment more decisive, the lower part of the water may be coloured by tincture of cabbage, or red ink, leaving the upper part uncoloured. If heat be then applied to the bottom part of the glass, the coloured part of the water gradually ascends, and uniformly tinges the whole fluid.

Mode of Attracting Water.

Hang a quantity of wool, tied loosely together, down into a deep well, about five or six yards from the water; leave it in that position through the night, and its weight will, in the morning, be greater by one-fifth than it was the evening before. The additional weight will have been caused by the accession of particles of water from the humid atmosphere.

To find the Specific Gravity of Solids.

Hang the substance by a hair to one end of the beam, weigh it first accurately in air, setting down with a pen the weight in grains and decimal parts; then place under it a glass vessel, pouring water in till it be filled to within three quarters of an inch from the brim. And immerge the body in the water, suspended by the horse hair to the hook at the bottom of the water scale. In this proceeding, we must take care that the same weights that balanced the body in air be in the opposite scale, and likewise the proper *balance water weights*, and that no air-bubble adhere to any part of the substance in the water, which will render it apparently lighter. The *opposite* scale to that which contains the substance will now greatly preponderate; weights should therefore be put into the scale till the equilibrium be restored.

The pen will now finish the operation. Divide the weight in air by the loss in water; that is, divide the number of grains in the large scale by those in the small one, and the quotient will shew the specific gravity, or how many times heavier the substance that was weighed is than water. If the weight in the small scale be *subtracted* from that in the other, it will shew the *respective gravity* of the weighed substance, or the weight with which it will be evenly balanced in water.

Table of Specific Gravities.

Refined gold	19.640
English guinea	18.888
Mercury	14.019

Lead..............................	11.344
Refined silver	11.019
Copper from Sweden...............	8.843
Hammered brass..................	8.349
Cast brass.........................	8.100
Elastic steel........................	7.820
Soft steel...........................	7.738
Iron.................................	7.645
Pure tin............................	7.471
A diamond.........................	3.400
Island crystal......................	2.720
Rock crystal.......................	2.650
Common glass	2.620
Fine Marble........................	2.704
Stone of mean gravity,.............	2.500
Brick	2.000
Nitre...............................	1.000
Alabaster	1.875
Dry ivory..........................	1.825
Brimstone	1.800
Alum...............................	1.714
Oil of vitriol	1.700
Honey	1.450
Gum arabic........................	1.375
Aquafortis.........................	1 300
Pitch...............................	1.150
Human blood......................	1.126
Amber.............................	1.040
Milk...............................	1.030
Urine	1.030
Dry box-wood	1.030
Sea-water.........................	1.030

Common water	1.000
Bees-wax	0.955
Linseed oil	0.932
Oil, olive	0.913
Spirit of turpentine	0.874
Rect. spirit of wine	0.856
Cork	0.240
Air	0.00¼

Experiment with the Syphon.

If one leg of a syphon be immersed in a vessel of water, and the other leg hang out of it, in such manner that the lower end be below the surface of the water; on opening both the orifices at the same instant, the water will be found to flow out at the lower orifice, till its surface has sunk down to the orifice of the leg in the water.

Tantalus's Cup.

Several entertaining deceptions have been practised by means of the Syphon. One of the most usual is that of Tantalus's Cup, but the explanation of which is not necessary here, as its operation will be evident at the first view. It is usual to conceal the syphon in the figure of a man representing Tantalus; and when the cup is filled with water as high as his mouth, that is a little above the curve of the syphon, the latter beginning to act, at length discharges the whole contents of the cup. Similar deceptions have been practised by concealing the syphon in the handle of a drinking vessel.

ACCOUSTICS.

The Talking Busts.

PROCURE two busts of plaster of Paris, place them on pedestals on the opposite sides of a room. Let a thin tube, of an inch diameter, pass from the ear of one head through the pedestal, under the floor, and go up to the mouth of the other; taking care that the end of the tube that is next the ear of the one head, be considerably larger than that end which comes to the mouth of the other.

Now when a person speaks quite low into the ear of one bust, the sound is reverberated through the length of the tube, and will be distinctly heard by any one placing his ear to the mouth of the other. It is not necessary that the tube should come to the lips of the bust. If there be two tubes, one going to the ear, and the other to the mouth of each head, two persons may converse together by whispers, without the knowledge of any person who may stand in the middle of the room.

Sound.

The French academicians made, in 1738, some experiments for measuring the velocity of sound: the Board of Longitude renewed them in the month of June last, with all possible precision, when they found that the velocity of sound in the air at the temperature of 55 degrees, Fahrenheit, differs very little from 1044 feet per second.

Music of Light.

Dr. Buchanan, of Kentucky, conceives that he has found some affinity between the different rays of light, as presented in a rainbow, and the notes of music. Following up this theory, real or imaginary, he proposes to furnish a concert for the eye; that is, that the eye should experience the same pleasure by an harmonic rise and fall of the different rays of light, as the ear does by the accordance of sweet sounds. How far this plan is practicable, is a thing resting on experiment. Something analagous to this may have given birth to the fable of Memnon's harp, which was said to have uttered delightful strains of melody when touched by the solar rays.

Speaking Automata.

The Egyptian idols are of this class. Memnon, the head of Friar Bacon, and the statue of Albert Magnus. Darwin, in his Temple of Nature, lays down a process for forming an automatical speech. Bacon, in his Natural History, experiment 139, notes the trembling of water resembles the letter *h*; the quenching of hot things, the letter *z*; the sound of strings, the letters *n* and *o*; and the jerking of a switch the letter *g*.

Ventriloquism.

It seems that the factitious voice produced by a ventriloquist, does not (as the etymology of the word imparts) proceed from the belly, but is formed in the inner parts of the mouth and throat. The art does not depend on a particular structure or organization of these parts, but may be acquired by almost any person ardently desirous of attaining it, and determined to persevere in repeated trials. A sudden change of direction in sound, our knowledge of which does not depend on the impulse of the ear, but on other facts, will be perceived, when the original communication is interrupted, provided there be a sensible echo. This will be perceived by any person who walks along a valley intercepted with buildings, at a time that a peal of bells is ringing; for the sound of the bells, instead of arriving constantly at the ears of the person in its true direction, is frequently reflected in a short time from two or three different places, and the steeple appears, in the hearer's judgment, to perform the part of an expert ventriloquist, that which is occasioned by accident in the case of the bells, being performed by art in the case of the ventriloquist. The following curious facts, tending to illustrate a professional display of the art, may now be introduced :—The audience were arranged in two opposite lines, corresponding to the two sides of a long narrow room. The benches on which they were seated, reached from one end of the place to the middle of it, the other part remaining unoccupied. The feats exhibited by him were the three following : —First, he made his voice come from behind his audience, but it never seemed to proceed from any part of the wall near the heads of the people present ; on the contrary, it was always heard resembling the voice of a child, who seemed to be under the benches. He stood during the time of speaking in a stooping posture, having his mouth turned towards the place from which the sound issued : so that the line, joining his lips and the reflecting object, did not approach the ears of the company. Second, advancing into the vacant part of the room, and turning his back to the audience, he made a variety of noises, that seemed to proceed from an open cupboard which stood directly before him, at the distance of two or three yards. Third, he placed an inverted glass cup on the hands of his hearers, and then imitated the cries of a child confined in it. His method of doing it was this : the upper part of the hearer's arm laid close along his side; then the part below the elbow was kept in a horizontal position, with the hand turned downwards, which was done by the operator himself. After taking these preparatory steps, the man bent his body forwards in a situation which presented the profile of his face nearly to the front of his hearers, whilst his mouth pointed to the cup; in which posture he copied the voice of a confined child so completely, that three positions of the glass were easily distinguished by as many different tones, viz. when he pressed the mouth of the cup close against the palm, when one edge of it was elevated, and when the vessel was held near the hand, but did not touch it. The second and third instances of ventriloquism afford strong proofs, that this delusive talent is nothing more than the art of substituting an echo for the primary sound; for, besides the change perceivable in the direction of the voice, it was found to be blended with a variety of secondary sounds; such as we know by experience are produced, as often as a noise of any kind issues from a cavity. The responses of many of the ancient oracles were delivered by persons possessing this quality, so very capable of being applied to the purpose of priestcraft and delusion.

On Sounds excited in Hydrogen Gas.

As the intensity of sound is diminished by the rarefaction of the medium in which it is produced, it might have been expected that the sound in hydrogen gas would be feebler than when produced in atmospheric air in similar circumstances. Mr. Leslie, however, has found the difference to be actually much greater. Having placed within a receiver of an air-pump, a small piece of clock-work, by which a bell was struck every half minute, the air was rarefied, and after the re-action had been carried the length of one hundred times, hydrogen gas was introduced. The sound, however, so far from being augmented, was, at least, as feeble as in atmospheric air of that extreme rarity, and decidedly much feebler than when formed in air of its own density, or rarefied ten times. Mr. Leslie likewise observed the very curious fact, that the mixture of hydrogen gas with atmospheric air, has a predominant influence in blunting or stifling sound. When one half of the volume of atmospheric air is extracted, and hydrogen gas admitted to fill up the vacant space, the sound will now become scarcely audible: an effect which he ascribes to a want of intimate combination between the gases, which causes the pulsatory impressions to be dissipated before the sound is originally formed.

Sonorous Properties of different Gases.

By causing a small tin pipe, brought into contact with a cock in the neck of a bell glass, to be blown by gas contained in a bladder applied to the external aperture of the cock, it will be observed, that the sound is a semitone lower with azotic and oxygen gas than with atmospheric air, a third lower with carbonic acid gas, and nearly the same with nitrous gas; but with oxygen gas, from nine to eleven tones higher than the air that surrounds us. A mixture of azote and oxygen, in the same proportion as in the atmospheric air, will give the same tone as the latter; but when the mixture of these gases is not uniform, the sounds are totally discordant.

When a plate of glass is agitated by means of a bow, if some dust is strewed over the glass, the former will appear to have arranged itself symmetrically, after the plate ceases to emit sound. Under the like circumstances, the figures are always the same, their changes depending only upon the gravity or acuteness of the tone.

Musical Figures resulting from Sounds.

Cover the mouth of a wide glass, having a foot-stalk with a thin sheet of membrane, or vegetable paper, over which scatter a layer of fine sand. The vibrations excited in the air by the sound of a musical instrument, held within a few inches of the membrane, will cause the sand on its surface to form regular lines and figures with astonishing celerity, which vary with the sound produced, affecting a particular mode of division, according to the number of vibrations.

Gigantic Meterological Æolian Harp.

Captain Haas, of Basle, has designated by these an apparatus which emits of itself a variety of sounds during a change of weather. Since the year 1787, he had stretched above his garden fifteen iron wires, three hundred and twenty feet long, and at the distance of about two inches from one another: the largest wire was two lines in diameter, the smallest one line, and those of intermediate size one line and a half. They were situated towards the south, and are inclined 20 or 30 degs. to the horizon, being stretched by means of rollers, properly arranged for the purpose. Whenever the weather changes, these wires sound with such loudness that it is impossible to go on with a concert in the house. The sounds sometimes resemble the hissing noise of water rapid in ebullition, sometimes tnat of an harmonicon, and sometimes that of a distant chime, or an organ.

The inventor of this curious apparatus is Mr. Ventau, provost of Burkli, not far from Basle. He sometimes shot at a mark from his window, and in order that he might not go to the mark at each shot, he attached to it a long iron wire to draw it to him at pleasure. He remarked more than once that the wire sounded exactly an octave; and he found that every iron wire, stretched in a direction parallel to the sounds, emitted this tone at every change of the weather.

A brass wire did not produce any sound, nor did an iron wire when it was stretched from east to west.

M. Dobereiner, of Jena, conceives that the phenomenon now described, is the effect of an electro-magnetic action; and he proposes to try if the brass wire would not sound when it communicates at its extremity with an energetic electrometer.

To Make an Æolian Harp.

This instrument may be made by almost any carpenter: it consists of a long narrow box of very thin deal, about five or six inches deep, with a circle in the middle of the upper side, of an inch and a half in diameter, in which are to be drilled small holes. On this side, seven, ten, or more strings, of very fine gut, are stretched over bridges at each end, like the bridges of a fiddle, and screwed up or relaxed with screw pins. The strings must be all tuned to one and the same note, and the instrument be placed in some current of air, where the wind can pass over its strings with freedom. A window, of which the width is exactly equal to the length of the harp, with the sash just raised to give the air admission, is a proper situation. When the air blows upon these strings, with different degrees of force, it will excite different tones of sound; sometimes the blast brings out all the tones in full concert, and sometimes it sinks them to the softest murmurs.

Beautiful Figures in Sand, &c. produced by Sound.

It has long been known that the agitations produced in the air by a sounding body may be sufficient to excite a second body placed even at a great distance from the first, provided, however, that both be capable of producing exactly the same number of vibrations in the same time.

Dr. Savarb has been making experiments with stretched membranes, which at the same time that the thickness are very inconsiderable, present large surfaces to the air, which puts them in motion. He took, for example, a circular piece of thin paper, or gold-beaters' skin, about ten inches in diameter, and carefully stretched it by its circumference upon the edge of a large glass vase; on strewing the surface, placed horizontally, with fine and dry sand, and bringing a plate of glass in vibration within the distance of nine or ten inches, and parallel with the surface, the membrane entered into motion, and the sand assumed figures, which were sometimes perfectly regular, and which often formed themselves with so much rapidity, that his eye had scarcely time to perceive the circumstances which accompanied the transformation of the light layer of sand into a greater or less number of quiescent lines. Various figures were thus obtained—stars with four, six, ten, or more radiations, circles, &c. When the plate instead of being parallel, was placed perpendicularly to one of the diameters of the surface, the sand formed itself into a system of quiescent lines, which generally were parallel with one another: one of these lines passed always through the centre of the membrane, and was contained in the plane which passed through the face of the plate; the direction of the motion consequently continually changed with the direction of the vibrating plate. If instead of holding the place in the direction of perpendicular to that of the surface, it was inclined; at every degree of inclination the phenomena obtained were different, and the lines traced by the sand continually modified themselves differently, although the number of vibrations remained the same.*

Acoustical Alphabet.

By varying the order of arrangement, the whole alphabet may readily be rung on three bells; and these being formed into sentences by short pauses between each word, will fully serve for distant conversation. For musical instruments, it is merely changing keys for bells, and the same purpose may

* The tones of the flute, trumpet, musical glasses, &c. or of the voice, produced the same results as a vibrating plate. When the tones were successively varied, for example, when a very slow air was performed on the flute, at about nine or ten inches distance from the membrane, the sand was agitated, and traced lines, the combinations of which incessantly varied with the sound produced.—Stringed instruments were not so well calculated to produce these effects. These experiments were varied in a number of ways, by employing membranes, of which the dimensions, nature, and tension, as well as form, were different: they always, however, presented analogous results.

be answered without the trouble of forming changes upon so small a number of fixed tones. A table is subjoined, by the use of which a combination of three bells is made to express the whole alphabet:

A is represented by		111	O is represented by		222
B	..	112	P	..	223
C	..	113	Q	..	231
D	..	121	R	..	232
E	..	122	S	..	233
F	..	123	T	..	311
G	..	131	V	..	312
H	..	132	U	..	313
I	..	133	W	..	321
K	..	211	X	..	322
L	..	212	Y	..	323
M	..	213	Z	..	333
N	..	221			

Musical Flame.

Musical tones are produced by the combustion of hydrogen gas in tubes of different diameters.

The following Experiment is taken from the Century of Inventions of the Marquis of Worcester, and professes to be, "How to make a Brazen or Stone Head in the midst of a great Field, or Garden, so artificially and natural, that though *a Man speak ever so softly, and even whisper into the ear thereof, it will presently open its Mouth and resolve the question in French, Latin, Welsh, Irish, or English, in good terms, uttering it out of its Mouth, and then shut it until the next question is asked."*

Let a concave mirror of about two feet diameter, be placed in a perpendicular direction. The focus of this mirror may be fifteen or eighteen inches from its surface. At the distance of about five or six feet let there be a partition, in which there is an opening, equal to the size of the mirror: against this opening must be placed a picture, painted in water-colours, on a thin cloth, that the sound may easily pass through it. Behind the partition, at the distance of two or three feet, place another mirror, of the same size as the former, and let it be diametrically opposite to it. Place the figure of a man seated on a pedestal, with his ear exactly in the focus of the first mirror: his lower jaw must be made to open by a wire, and shut by a spring; and there may be another wire to move the eyes; these wires must pass through the figure, go under the floor, and come up behind the partition. A person, properly instructed, should be placed behind the partition near the mirror. Then propose to any one to speak softly to the statue, by putting his mouth to the ear of it, assuring him that it will answer instantly. You then give the signal to the person behind the partition, who, by placing his ear to the focus of the mirror, will hear distinctly what the other said; and, moving the jaw and eyes of the statue by the wires, will return an answer directly; which will, in like manner be distinctly heard by the first speaker.

Singular Experiment with a Barrel Organ.

In a large case, such as is used for dials and spring-clocks, the front of which, or at least the lower part of it, must be of glass, covered on the inside with gauze, let there be placed a barrel organ, which when wound up is prevented from playing, by a catch that takes a toothed wheel at the end of the barrel. To one end of this catch there must be joined a wire, at the end of which there is a flat circle of cork, of the same dimension with the inside of a glass tube, in which it is to rise and fall. This tube must communicate with a reservoir that goes across the front part of the bottom of the case, which is to be filled with spirits, such as is used in thermometers, but not coloured, that it may be the better concealed by the gauze. This case being placed in the sun, the spirits will be rarefied by the heat; and rising in the tube, will lift up the catch or trigger, and set the organ in play: which it will continue to do as long as it is kept in the sun; for the spirits cannot run out of the tube, that part of the catch, to which the circle is fixed, being prevented from rising beyond a certain point, by a check placed over it. When the machine is placed against the side of a room on which the sun shines strong, it may constantly remain in the same place, it inclosed in a second case, made of thick wood, and placed at a little distance from the other. When you want it to perform, it will only be necessary to throw open the door of the outer case, and expose it to the sun.—But if the machine be moveable, it will perform in all seasons by being placed before the fire; and in winter, it will more readily stop when removed into the cold.

The following interesting Account of the Echo will be, no doubt, amusing to the reader.

An echo is a reflection of sound striking against some object, as an image is reflected in a glass: but it has been disputed what are the proper qualities in a body for thus reflecting sounds. It is in general known, that caverns, grottos, mountains, and ruined buildings, return this image of sound. There is a very extraordinary echo, at a ruined fortress near Louvain, in Flanders. If a person sung, he only heard his own voice, without any repetition: on the contrary, those who stood at some distance, heard the echo but not the voice; but then they heard it with surprising variations, sometimes louder, sometimes softer, now more near, then more distant. There is an account in the Memoirs of the French Academy, of a similar echo near Rouen. As every point against which the pulses of sound strike, becomes the centre of a new series of pulses, and sound describes equal distances in equal times; therefore, when any sound is propagated from a centre, and its pulses strike against a variety of obstacles, if the sum of the right lines drawn from that point to each of the obstacles, and from each obstacle to a second point be equal, then will the latter be a point in which the echo will be heard. Hence all the points of the obstacles which produce an echo, must lie in the surface of the oblong sphæroid, generated by the revolution of the elipse round its major axis.

But though the first reduced pulses may produce no echo, both on account of their being too few in number, and too rapid in their return to the ear; yet it is evident, that the reflecting surface may be so formed, as that the pulses which come to the ear after two reflections or more, may, after having described 127 feet or more, arrive at the ear in sufficient numbers, and also so nearly at the same instant, as to produce an echo, though the distance of the reflecting surface from the ear be less than the limit of echoes. This is confirmed by a singular echo in a grotto on the banks of the little brook, called the Dinan, about two miles from Castlecomber, in the county of Kilkenny. As you enter the cave, and, continue speaking loud, no return of the voice is perceived; but, on your arriving at a certain point, which is not above fourteen or fifteen feet from the reflecting surface, a very distinct echo is heard.

EXPERIMENTS WITH THE MAGIC LANTERN.

THE construction of this amusing optical machine is so well known, that to describe it would be superfluous; particularly as it can now be purchased at a very reasonable expense, at any of the opticians': but as many persons who have a taste for drawing might not be pleased with the designs to be had at the shops, or might wish to indulge their fancy in a variety of objects, which to purchase would become expensive; we here present our readers, in the first place, with the method of drawing them, which will be succeeded by a plain description of some very diverting experiments.

Phantasmagoria.

In the optical deception called Phantasmagoria, the object increases in brightness as it diminishes in size, or as it seems to retire, till it finally verges into a luminous point; a mode of disappearance so unexpected as to destroy the illusion it is designed to produce. This defect Mr. William Ritchie proposes to avoid by the following method, by which the disappearance of the objects may be rendered more in accordance with what is supposed to take place, under the circumstances intended to be represented.

He proposes to supply the light by a portable gas lamp, with apparatus for increasing or diminishing the supply of gas to the burner at pleasure, which, by a peculiar stop cock, might very readily be accomplished. Then, by diminishing the light gradually, the brilliancy of the figure might be reduced as it retires, its lineaments would become shadowy and obscure, and at length vanish into thin air, as it is expected a phantom would do.

Of Painting the Glasses.

You first draw on a paper, the size of the glass, the subject you mean to paint: fasten this at each end of the glass with paste, or any other cement, to prevent it from slipping. Then with some very black paint mixed with varnish, draw with a fine camel's hair pencil, very lightly, the outlines sketched on the paper, which, of course, are reflected through the glass. Some persons recommend writing ink, and a common pen with a fine nib: but this, even if it succeeds in making a delicate black outline, is sure to be effected by damp or wet.

It would improve the natural resemblance, if the outlines were drawn with a strong tint of each of the natural colours of the object; but in this respect you may please your own fancy. When the outlines are dry, colour and shade your figures; but observe, to temper your colours with strong white varnish. A pleasing effect will be produced, if you leave strong lights in some parts of the drapery, &c. without any colours. The best colours for this purpose are transparent ones; opaque or mineral colours will not do. The following are in most repute.

For	Pink and crimson..	Lake or carmine.
	Blue..............	Prussian Blue.
	Green	Calcined verdigris, or distilled ditto.
	Yellow............	Gamboge.

To facilitate the Painting on Glass, by laying on Mezzotinto Prints, for Magic Lanterns, &c.

Cut off the margin of the print you intend to use, and lay it in a flat vessel of hot water; let it remain on the surface till it sinks. Take it out and press it between cloths or papers, so that no water may appear on the surface, but the print be quite damp; then lay it, face uppermost, on a flat table, and have ready a piece of crown glass free from blemishes; lay some Venice turpentine all over on one side of it with a soft brush, hold it to the fire that it may be quite equal and thin: then let it fall gently on the print. Press it down, that the turpentine may adhere to the print; also press the print with your fingers, from the middle to the edges of the glass, that no blisters may remain. Wet the print now with a soft cloth, and rub it gently with your finger, and the paper will peel off, leaving the impression on the glass. When it is dry, wet it over with oil of turpentine till it is transparent, and set it by to dry, when it will be fit for painting.

The colours used for the painting are the usual transparent oil colours.

Subjects for magic lanterns may be painted by those who cannot paint in oil, on thin paper in water colours, and afterwards varnished to make them transparent.

New Construction of Magic Lantern Sliders.

A very beautiful mode of exhibiting an optical fountain is described below.

Take a frame of brass, of the same size and thickness as a magic lantern slider, and introduce a number of pieces of twisted glass, so that they may all be made to revolve in conjunction by turning a handle provided for the purpose. If the frame be now introduced into the lantern, and a painted plate of glass representing a fountain be placed in the front, it will be found, that when the twisted glass is turned, streams of water will appear to ascend on the screen in the most perfect way possible.

To represent a Storm at Sea.

Provide two strips of glass, whose frames are thin enough to admit both strips freely into the groove of the lantern. On one of these glasses paint the appearance of sea from a smooth calm to a violent storm, (see Fig. 15.) Let these representations run gradually into each other, as in the figure; and you will of course observe, that the more natural and picturesque the painting is, the more natural will be the reflection.

On the other glass, (Fig. 16.) paint various vessels on the ocean, observing to let that end where the storm is, appear in a state of violent commotion, and the vessels as if raised on the waves in an unsettled position, with heavy clouds about them.

You then pass the glasses slowly through the groove and when you come to that part where the storm is supposed to begin, move them gently up and down, which will give the appearance of the sea and vessels being agitated; increase the motion till they come to the height of the storm. You will thus have a very natural representation of the sea and ships in a calm and storm; and as you gradually draw the glasses back, the tempest will subside, the sky appear clear, and the vessels glide gently over the waves.

By the means of two or three glasses, you may also represent a battle on land, or a naval engagement, with a variety of other pleasing experiments.

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 pasteboard. 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 black 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.

To produce the appearance of a Spectre on a Pedestal in the middle of a Table.

Enclose a small magic lantern in a box, (see Fig. 17) large enough to contain a small swing dressing-glass, which will reflect the light thrown upon it by the lantern in such a way, that it will pass out at the aperture made at the top of the box, which aperture should be oval, and of a size adapted to the cone of light to pass through it. There should be a flap with hinges, to cover the opening, that the inside of the box may not be seen.

There must be holes in that part of the box which is over the lantern, to let the smoke out: and over this must be placed a chafing-dish of an oblong figure, large enough to hold several lighted coals. This chafing-dish, for the better carrying on the deception, may be inclosed in a painted tin box, about a foot high, with a hole at top, and should stand on four feet, to let the smoke from the lantern escape.

There must also be a glass planned to rise up and down in the groove *a*, *b*, and so managed by a cord and pulley *c*, *d*, *e*, *f*, that it may be raised up and let down by the cord coming through the outside of the box. On this glass, the spectre, (or any other figure you please,) must be painted in a contracted or squat form, as the figure will reflect a greater length than it is drawn.

When you have lighted the lamp in the lantern, and placed the mirror in a proper direction, put the box on a table, and setting the chafing-dish in it, throw some incense, in powder, on the coals. You then open the trap-door, and let down the glass in the groove slowly, and when you perceive the smoke diminish, draw up the glass that the figure may disappear, and shut the trap-door.

This exhibition will afford a deal of wonder; but observe, that all the lights in the room must be extinguished; and the box should be placed on a high table, that the aperture through which the light comes out may not be seen.

Shadows.

Behind a transparent screen of white cloth, place a *very powerful* light, from which as the performer, whose image is formed on the screen, recedes, his figure will attain to gigantic proportions; again, when he approaches, and is between the light and the screen, his figure will be more accurately defined; by jumping over the light, he will appear to ascend to a great height, and disappear. By nimble and grotesque movements and attitudes—by the judicious introduction of any animal, &c.—the effect may be considerably heightened, and much laughter be excited.

This amusing optical exhibition was successfully employed at the Royal Gardens, Vauxhall, where it excited great applause.

Chinese Shadows.

This ingenious instrument consists in moving, by pegs fastened to them, small figures cut out of pasteboard, the joints of which are all pliable, behind a piece of fine painted gauze, placed before an opening in a curtain, in such a manner as to exhibit various scenes according to pleasure; while the opening, covered with gauze is illuminated, towards the apartment where the spectators sit, by means of light reflected back from a mirror, so that the shadows of the pegs are concealed. When it is requisite to cause a figure to perform a variety of movements, it is necessary to have several persons, who must be exceedingly expert. When a snake is to be represented gliding, the figure which consists of delicate rings, must be directed, at least, by three assistants.

This amusement, which one can hardly see the first time without pleasure, is a Chinese invention. Many years ago, Chinese boxes were seen, on which such moveable figures were apparent only when the box was held against the light. In China, these shadows are used at the well known feast of lanterns.

There are many other pleasing Experiments which might be made with the Magic Lantern, but the limits of our work will not permit us to specify them, without excluding many other equally interesting subjects of a different nature.

RECREATIONS WITH CARDS.

Many of the following recreations are performed by arithmetical calculations; and may therefore be considered as connected with science; but as it has been the aim of this work to unite amusement with instruction, some experiments on this subject are introduced, the performance of which depends on dexterity of hand. As this is only to be acquired by practice, and after all, is merely a mechanical operation, the study of it will produce little useful knowledge, though it may afford much entertainment; but as it must be gratifying to know the method by which they are performed by those persons skilled in such manœuvres, who publicly exhibit them to the astonishment of the spectator, they are presented to our readers, that when they recognize them at any of these exhibitions, their eyes may not be in danger of deceiving their judgment.

Three cards being presented to Three Persons, to guess that which each has chosen.

As it is necessary that the cards presented to the three persons should be distinguished, we shall call the first A, the second B, and the third C; but the three persons may be at liberty to choose any of them they please. This choice, which is susceptible of six different varieties, having been made, give to the first person twelve counters, to the second twenty-four, and to the third thirty-six; then desire the first person to add together the half of the counters of the person who has chosen the card A, the third of those of the person who has chosen B, and the fourth part of those of the person who has chosen C, and ask the sum, which must be either 23 or 24; 25 or 27; 28 or 29, as in the following table:—

First	Second	Third	Sums
12	24	36	
A	B	C	23
A	C	B	24
B	A	C	25
C	A	B	27
B	C	A	28
C	B	A	29

This table shews, that if the sum be 25, for example, the first person must have chosen the card B, the second the card A, and the third the card C: and that if it be 28, the first person must have chosen the card B, the second the card C, and the third the card A; and so of the rest.

A certain Number of Cards being shewn to a Person, to guess that which he thought of.

To perform this trick, the number of the cards must be divisible by 3; and it is more convenient that the number should be odd. Desire the person to think of a card, then place the cards on the table with their faces downward; and taking them up in order, arrange them in three heaps, with their faces upward, and in such a manner, that the first card of the packet shall be first of the first heap; the second the first of the second, and the third the first of the third; the fourth, the second of the first, and so on. When the heaps are completed, ask the person in which heap is the card thought of, and when told, place that containing the card thought of in the middle, then turning up the packet, form three heaps, as before, and again ask in which is the card thought of. Place the heap containing the card thought of still in the middle, and, having formed three new heaps, ask which of them contains the card thought of. When this is known, place it as before between the other two, and again form three heaps, asking the same question. Then take up the heaps for the last time; put that containing the card thought of in the middle, and placing the packet on the table, with the faces downward, turn up the cards till you count half the number of those contained in the packet; 12, for example, if there be 24, in which case the 12th card will be the one the person thought of. If the number of the cards be, at the same time, odd, and divisible by 3, as 15, 21, 27, &c. the trick will become much easier, for the card thought of will always be that in the middle of the heap in which it is found the third time; so that it may be easily distinguished without counting the cards; nothing will be necessary but to remember, while you are forming the heaps the third time, the card which is the middle one of each. Suppose, for example, that the middle card of the first heap is the ace of spades; that the second is the king of hearts, and that the third is the knave of hearts; if you are told that the heap containing the required card is the third, that card must be the knave of hearts. You may therefore have the cards shuffled, without touching them any more, and then, looking them over for form's sake, may name the knave of hearts when it occurs.

At the Game of Whist, what probability is there, that the four Honours will be in the hands of any two Partners.

De Moire, in his Doctrine of Chances, shews that the chance is nearly 27 to 2 that the partners, one of whom deals, will not have the four honours. That it is about 23 to 1 that the other two partners will not have them. That it is nearly 8 to 1 that they will not be found on any one side. That one may bet about 13 to 7, without disadvantage, that the partners who are first in hand will not count honours. That about 20 to 7 may be betted, that the other two will not count them. And in the last place, that it is 25 to 16, that one of the two sides will count honours, or that they will not be equally divided.

Sixteen Cards being disposed in Two Rows, to tell the Card which a Person has thought of.

The cards being arranged in two rows, as A and B, desire the person to think of one, and to observe well in which row it is.

A	B	C	B	D	E	B	F	H	B	I
0	0	0	0	0	0	0	0	0	0	*
0	0	0	0	0	*	0	0	0	0	0
0	0	*	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
*	0		0		0		0		0	
0	0		0		0		0		0	
0	0		0		0		0		0	
0	0		0		0		0		0	

Let us suppose that the card thought of, is in the row A, take up that whole row, in the order in which it stands, and dispose it in two rows C and D, on the right and left of the row B; but in arranging them, take care that the first of the row A may be the first of the row C; the second of the row A, the first of the row D; the third of the row A, the second of the row C, and so on; then ask again in vertical rows in which row, C or D, the card thought of is. Suppose it to be in C; take up that row, as well as the row D, putting the last at the end of the first, without deranging the order of the cards, and observing the rule already given, form into two other rows, as seen at E and F; then ask, as before, in which row the card thought of is. Let us suppose it to be in E; take up this row, and the row F, as above directed, and form them into two new rows, on the right and left of B; after these operations, the card thought of must be the first of one of the perpendicular rows, H and I; if you therefore ask in which row it is, you may easily point it out; having desired them to be shuffled, the better to conceal the artifice.

To tell how many Cards a Person takes out of a Pack, and to specify each Card.

To perform this, you must so dispose a PIQUET pack of cards, that you can easily remember the order in which they are placed. Suppose, for instance, they are placed according to the words in the following line:

Seven Aces, Eight Kings, Nine Queens, and Ten Knaves;

and that every card be of a different suite, following each other in this order: spades, clubs, hearts, and diamonds. Then the eight first cards will be the seven of spades, ace of clubs, eight of hearts, king of diamonds, nine of spades, queen of clubs, ten of hearts, and knave of diamonds, and so of the rest.

You shew that the cards are placed promiscuously, and you offer them with their backs upwards to any one, that he may draw what quantity he pleases; you then dexterously look at the card that precedes and that which follows those he has taken. When he has counted the cards, which is not to be done in your presence (and in order to give you time for recollection, you tell him to do it twice over, that he may be certain), you then take them from him, mix them with a pack, shuffle, and tell him to shuffle.

During all this time you recollect, by the foregoing line, all the cards he took out; and as you lay them down, one by one, you name each card.

Unless a person has a most excellent memory, he had better not attempt the performance of the above amusement, as the least forgetfulness will spoil the whole, and make the operator appear ridiculous.

To tell the number of Points on Three Cards, placed under Three different Parcels of Cards.

You first premise that the ace counts for eleven: the court cards ten each; and the others according to the number of their pips. You then propose to any person in company to choose three cards, and to place over each as many as will make the number of the points of that card, fifteen: take the remaining cards, and under the appearance of looking for a particular card, count how many there are, and by adding sixteen to that number, you will have the amount of the pips on the three cards.—For example:

Suppose a person choose a seven, a ten, and an ace; then over the seven he must place eight cards; over the ten, five cards; and over the ace, four cards. In this instance there will remain twelve cards; to which if you add sixteen, it will make twenty-eight, which is the amount of the pips on the three cards.

The Ten Duplicates.

Select any twenty cards: let any person shuffle them; lay them by pairs on the board, without looking at them. You next desire several persons, (as many persons as there are pairs on the table,) each to look at different pairs, and remember what cards compose them. You then take up all the cards in the order they lay, and replace them with their faces uppermost on the table, according to the order of the letters in the following words:

M	U	T	U	S
1	2	3	4	5
D	E	D	I	T
6	7	8	9	10
N	O	M	E	N
11	12	13	14	15
C	O	C	I	S
16	17	18	19	20

(These words convey no meaning.)—You will observe, that they contain ten letters repeated, or two of each sort. You therefore ask each person which row or rows the cards he looked at are in; if he say the first, you know they must be the second and fourth, there being two letters of a sort (two U's) in that row; if he say the second and fourth, they must be the ninth and nineteenth, (two I's) and so of the rest. This amusement, which is very simple, and requires very little practice, will be found to excite, in those who are unacquainted with the key, the greatest astonishment.

The readiest way is to have a fac-simile of the key drawn on a card, to which you refer.

To guess the Number of Spots on any Card, which a Person has drawn from a Pack.

Take the pack of 52 cards, and desire some person to draw out one, without shewing it. Call the knave 11, the queen 12, the king 13. Then add the spots of the first card to those of the second; the last sum to the spots of the third, and so on, always rejecting 13, and keeping the remainder to add to the following card. It is needless to reckon the kings which are counted 13. If any spots remain at the last card, subtract them from 13, and the remainder will indicate the spots of the card which has been drawn: if the remainder be 11, it has been a knave; if 12 a queen, but if nothing remains it has been a king. The colour of the king may be known by examining which one among the cards is wanting. The trick may thus be explained. In the pack of cards are 13 of each suite, the sum of all the spots of each suite, calling the knave 11, the queen 12, and the king 13, is seven times 13, or 91, which is a multiply of 13; consequently, the quadruple of this sum is a multiply of 13 also: if the spots then of all the cards be added together, always rejecting 13, we must at last find the remainder equal to nothing. If a card, the spots of which are less than 13, has been drawn from the pack, the difference between these spots and 13, will be what is wanting to complete that number; if at the end, then, instead of reaching 13, we reach only 10, for example, it is evident that the card wanting is a three, and if we reach 13, it is also evident that the card wanting is equivalent to 13, or a king.

To change a Pack of Cards into various Pictures.

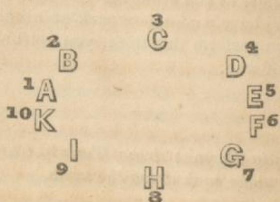
Take a pack of cards, and paint upon the white side of half the pack, any kind of figures, as men, women, birds, flowers, &c.; then paint the other half of the cards, on that side on which the spots are, in the same manner as the other half; so between them both, you will have a complete pack of all pictures; and when you perform this trick, you must shew the cards but half way.

To let Twenty Persons draw Twenty Cards, and make each draw the same.

Let any person draw a card from a pack, and put it in the pack again, but where you know where to find it again; shuffle the cards as before directed; then let another person draw a card, and be sure he takes the same the other did; proceed in the same way with all the persons but the last, who is to draw another card, which also return to the pack, and shuffle till you have brought both the cards together. Then, shewing the last card to the company, the other will shew the trick.

Several Numbers being disposed in a circular Form, according to their natural Series, to tell that which any one has thought of.

The first ten cards of any suite, disposed in a circular form, as seen in the figure below, may be employed for performing this trick. The ace is here represented by the letter A annexed to 1, and the 10 by the letter K joined to 10.



Having desired the person who has thought of a number or card, to touch also any other number or card, bid him add to the number of the card touched the number of the cards employed, which in this case is 10. Then desire him to count the sum in an order contrary to that of the natural numbers, beginning at the card he touched, and assigning to that card the number of the one which he thought of, for, by counting in this manner, he will end at the number or card which he had thought of, and consequently you will easily know it. Thus, for example, if the person has thought of the number 3, marked C, and has touched 6, marked F; if 10 be added to 6, it will make 16: and if 16 be then counted from F, the number touched, towards E, D, C, B, A, and so on in the retrograde order, counting 3 the number thought of, on F, 4 on E, 5 on D, 6 on C, and so round to 16, the number 16 will terminate on C, shewing that the person thought of 3, which corresponds to C. Of course, the person must not count the sum aloud.

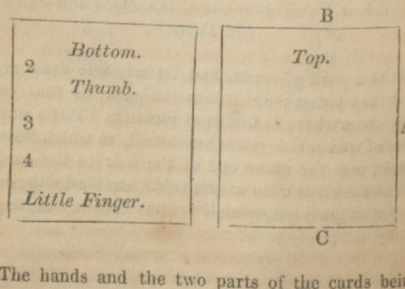
To make a Card jump out of the Pack and run on the Table.

Take a pack of cards, and let any one draw any card they please; put it into the pack, so that you may know where to find it at pleasure. Put a small piece of wax under your thumb-nail, to which fasten a hair, and the other end of the hair to the card; spread the cards open on the table, and desire the one chosen to jump out, which you may readily cause to do, by means of the hair.

The following amusements principally depend on dexterity of hand; and, as what is termed making the pass, *will be necessary to be acquired, to enable the operator to perform many of them, we subjoin the following explanation of this term:*

How to make the Pass.

Hold the pack of cards in your right hand, so that the palm of your hand may be under the cards: place the thumb of that hand on one side of the pack; the first, second, and third fingers on the other side, and your little finger between those cards that are to be brought to the top, and the rest of the pack. Then place your left hand over the cards in such a manner that the thumb may be at C, the fore-finger at A, and the other fingers at B, as in the following figure:



The hands and the two parts of the cards being thus disposed, you draw off the lower cards, confined by the little finger, and the other parts of the right hand, and place them, with an imperceptible motion, on the top of the pack.

But before you attempt any of the tricks that depend on *making the pass*, you must have great practice, and be able to perform it so dexterously and expeditiously, that the eye cannot detect the movement of the hand; or you may, instead of deceiving others, expose yourself.

The Long Card.—Another stratagem, connected with the performance of many of the following tricks, is what is termed the *Long Card;* that is, a card, either a trifle longer or wider than the other cards, not perceptible to the eye of the spectator, but easily to be distinguished by the touch of the operator.

The Divining Card.

Provide a pack in which there is a long card; open it at that part where the long card is, and present the pack to a person in such a manner that he will naturally draw that card. You then tell him to put it into one part of the pack, and shuffle the cards. You take a pack, and offer the same cards in like manner to the second and third person, taking care that they do not stand near enough to see the card each other draws.

You then draw several cards yourself, among which is the long card, and ask each of the parties if his card be among those cards, he will naturally say *yes*, as they have all drawn the same card. You then shuffle all the cards together, cutting them at the long card, you hold it before the first person so that others may not see it, and tell him that it is his card. You then put it in the pack, shuffle it, and cut it again at the same card, and hold it to the second person.

You can perform this recreation without the long card in the following manner:

Let any person draw a card, and replace it in the pack. You then *make the pass*, and bring that card to the top of the pack, and shuffle them without losing sight of that card. You then offer that card to the second person, that he may draw it and put it in the middle of the pack. You *make the pass*, and shuffle the cards the second time in the same manner, and offer the card to the third person, so again to the fourth or fifth.

The Four Confederate Cards.

A person draws four cards from the pack, and you tell him to remember one of them. He then returns them to the pack, and you dexterously place two under and two on the top of the pack. Under the bottom ones you place four cards of any sort, and then taking eight or ten from the bottom cards, you spread them on the table, and ask the person if the card he fixed on be among them. If he say *no*, you are sure it is one of the two cards on the top. You then pass those two cards to the bottom ; and drawing off the lowest of them, you ask if that is not his card. If he again say *no*, you take up that card, and bid him draw his card from the bottom of the pack.—If, on the contrary, he say his cards are among those you *first* drew from the bottom, you must dexterously take up the four cards you put under them, and placing those on the top, let the other two be the bottom cards of the pack, which you are to draw in the manner before described.

The Metamorphosed Cards.

In the middle of a pack place a card that is something wider than the rest, which we will suppose to be the knave of spades, under which place the seven of diamonds, and under that the ten of clubs. On the top of the pack put cards similar to these, and others on which are painted different objects, viz.

First card....A bird,
Second......A seven of diamonds,
Third........A flower,
Fourth......Another seven of diamonds,
Fifth........A bird,
Sixth ....A ten of clubs,
Seventh.....A flower,
Eighth ......Another ten of clubs.

Then seven or eight indifferent cards, the knave of spades, which is the wide card, the seven of diamonds, the ten of clubs, and the rest any indifferent cards.

Two persons are to draw the two cards that are under the wide card, which are the seven of diamonds and the ten of clubs. You take the pack in your left hand, and open it at the wide end, as you open a book, and tell the person who drew the seven of diamonds to place it in that opening. You then blow on the cards, and, without closing them, instantly bring the card which is at top, and on which a bird is painted, over that seven of diamonds. To do this dexterously, you must wet the middle finger of your left hand, with which you are to bring the card to the middle of the pack. You then bid the person look at his card, and when he has remarked the change, to place it where it was before. Then blow on the cards a second time, and bringing the seven of diamonds, which is at the top of the pack, to the opening, you bid him look at his card again, when he will see it is that which he drew.—You may do the same with all the other painted cards, either with the same person, or with him who drew the ten of clubs.

The whole artifice consists in bringing the card at the top of the pack to the opening in the middle, by the wet finger, which requires no great practice. Observe, not to let the pack go out of your hands.

To tell the Number of the Cards by their Weight.

Take a parcel of cards, suppose forty, among which insert two long cards; let the first be, for example, the fifteenth, and the other the twenty-sixth from the top. Seem to shuffle the cards, and then cutting them at the first long card, poise those you have cut off in your left hand, and say, *there should be here fifteen cards.* Cut them again at the second long card, and say, *there are here only eleven cards.* Then poising the remainder, you say, *here are fourteen cards*

To separate the two Colours of a Pack of Cards by one Cut.

To perform this amusement, all the cards of one colour must be cut something narrower at one end than the other. You shew the cards, and give them to any one that he may shuffle them, then holding them between your hands, one hand being at each extremity, with one motion you separate the hearts and diamonds from the spades and clubs.

The Four inseparable Kings.

Take the four kings, and behind the last of them place two other cards, so that they may not be seen. *Then spread open the four kings to the company, and put the six cards to the bottom of the pack.*— Draw one of the kings, and put it at the top of the pack. Draw one of the two cards at the bottom, and put it towards the middle. Draw the other, and put it at some distance from the last, and then shew that there remains a king at bottom. Then let any one cut the cards, and as there remained three kings at bottom, they will then be altogether in the middle of the pack.

How to tell a Person any Card he thinks of, and to convey it into a Nut.

Take a nut, in which burn a hole with a hot bodkin, and with a needle break and extract the kernel. Write the name of a card on a piece of thin paper, and roll it up hard, and put it in the nut, stop the hole with wax, which rub over with a little dust, that the puncture may not be perceived, then let some one draw a card; you must take care it be that which is written on the paper: desire him to break the nut, in which he will find the name of the card he has drawn.

To produce a Mouse from a Pack of Cards.

Have a pack of cards fastened together at the edges, but open in the middle like a box, a whole card being glued on as a cover, and many loose ones placed above it, which require to be dexterously shuffled, so that the entire may seem a real pack of cards. The bottom must likewise be a whole card, glued to the box on one side only, yielding immediately to interior pressure, and serving as a door by which you convey the mouse into the box. Being thus prepared, and holding the bottom tight with your hand, require one of the company to place his open hands together, and tell him you mean to produce something very marvellous from this pack of cards; place the cards then in his hands, and while you engage his attention in conversation, affect to want something out of your bag, and at the same moment take the pack by the middle, and throw it into the bag, when the mouse will remain in the hands of the person who held the cards.

To alter a Card to another which has been secured in a lock-up box.

A box must be made on purpose, with a double bottom: upon the false one is laid the card which the first person chooses. In locking the box by a secret spring, the false bottom is raised with the card, and firmly united with that part where the hinges are. On the real bottom lies another card, which had been previously and secretly deposited there. In making a person draw a card, a duplicate of this is forced upon him; for if he attempt to draw another, under some pretence you shuffle the cards again, till at last he takes the very card you intend him. This card you know by feeling it, it being purposely longer than any of the rest, and is, in fact, a conjuror's secret card. You must never let one of those particular or brief cards remain in a pack when you give it to be examined.*

To name several Cards which Two Persons have drawn from a Pack.

Divide a piquet pack into two parts by a long card; let the first part contain a quint to a king in clubs and spades, the four eights, the ten of diamonds, and ten of hearts, and let the other part contain the two quart majors in hearts and diamonds, the four sevens and the four nines. The cards may be divided in any other way that is easy to be remembered.

Then shuffle the cards, but be careful not to displace any of those cards of the last part which are under the long card: you then cut at that card, and leave the pack in two parts; next, present the first of these parts to a person, and tell him to draw two or three cards, and place the remainder on the table; you present the second parcel in like manner to another; then having dexterously placed the cards

* This feat may be varied. A five-pound note may be changed into a ten, &c. but it ought to be something which will lie in a narrow compass, in order that the false bottom may fall closely into its place. Formerly bird-seed was converted into a living bird, by false lids, but these are more liable to detection than false bottoms to the lid: bird-seed was glued, and the box, when shewn to the company, appeared to be full of it. By drawing up the false lid close to the real one, a bird, which had been previously placed there, was then discovered. The false bottoms are certainly preferable.

drawn by the first person in the second parcel, and those drawn by the second person in the first parcel, you shuffle the cards, observing not to displace any but the upper cards; then spreading the cards on the table, you name those that each person drew, which you may very easily do, by observing the cards that are changed in each parcel.

The Card found out by the Point of the Sword.

When a card has been drawn, you place it under the long card, and by shuffling them dexterously, you bring it to the top of the pack. Then lay or throw the pack on the ground, observing where the top card lies. A handkerchief is then bound over your eyes, which ought to be done by a confederate, in such a way that you can see the ground. A sword is put into your hand, with which you touch several of the cards, as if in doubt, but never losing sight of the top card, in which at last you fix the point of the sword, and present it to the party who drew it.

The Card changed by the 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 shew a person that the bottom 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, telling 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 Ring.

Get a ring made of any metal, in which is set a large transparent stone or piece of glass, to the bottom of which is fastened a small piece of black silk; under the silk is to be the figure of a small card: and the silk must be so constructed, that it may be either drawn aside or spread, by turning the stone round.

You then cause a person to draw the same sort of card as that at the bottom of the ring; and tell him to burn it in the candle. Now the ring being so constructed, that the silk conceals the card underneath it, you first shew him the ring, that he may see it is not there, and tell him you will make it appear; then rubbing the ashes of the card on the ring, you manage to turn the stone or glass dexterously round, and exhibit to him the small card at the bottom.

The Card discovered under the Handkerchief.

Let a person draw any card from the rest, and put it in the middle of the pack; you make the pass at that place, and the card will consequently be at top; then placing the pack on the table, cover it with a handkerchief, and putting your hand under it, take off the top card, and after seeming to search among the cards for some time, draw it out.

This amusement may be performed by putting the cards in another person's pocket, after the pass is made. Several cards may also be drawn and placed together in the middle of the pack, and the pass then made.

To tell the Card that a Person has touched with his Finger.

This amusement is to be performed by confederacy. You previously agree with your confederate on certain signs, by which he is to denote the suite, and the particular card of each suite; thus: if he touch the first button of his coat, it signifies an ace; if the second, a king, &c., and then again, if he take out his handkerchief, it denotes the suite to be hearts: if he take snuff,—diamonds, &c. These preliminaries being settled, you give the pack to a person who is near your confederate, and tell him to separate any one card from the rest, while you are absent, and draw his finger once over it. He is then to return you the pack, and while you are shuffling the cards, you carefully note the signals made by your confederate; then turning the aces over one by one, you directly fix on the card he touched.

To hold four Kings or four Knaves, in your Hand, and to change them suddenly into blank Cards, then into four Aces.

You must have cards made for the purpose of this feat; half cards, as they may be properly termed; that is one half kings or knaves, and the other half aces. When you lay the aces one over the other, nothing but the king or knaves will be seen. Then turning the kings or knaves downwards, the four aces will be seen. You must have two perfect cards, one a king, or knave, to cover one of the aces, or else it will be seen; and the other an ace to lay over the kings or knaves. When you wish to make them all appear blank cards, lay the cards a little lower, and by hiding the aces they will all appear white on both sides. You may then ask the company which they choose, and exhibit the kings, aces, or blanks, as required.

The Card in the Pocket Book.

A confederate is previously to know the card you have taken from the pack, and put into your pocket book. You then present the pack to him, and desire him to fix on a card, (which we will suppose to be the queen of diamonds,) and place the pack on the table. You then ask him the name of the card, and when he says the queen of diamonds, you ask him if he is not mistaken, and if he be sure that the card is in the pack: when he replies in the affirmative, you say, "It might be there when you looked over the cards, but I believe it is now in my pocket;" then desire a third person to put his hand in your pocket, aad take out your book, and when it is opened, the card will appear.

To shuffle Cards in such a manner, as always to keep one certain Card at the Bottom.

In shuffling, let the bottom card be always a little before, or, which is best, a little behind all the rest of the cards; put it a little beyond the rest before, right over your fore finger, or else, which is the best a little behind the rest, so that the little finger of the left hand may slip up and meet with it; at the first, shuffle as thick as you can; and, at last, throw upon the board the bottom card, with as many more as you would preserve for any purpose, a little before or a little behind the rest; and be sure to let your fore finger, if the pack be laid before, or your little finger, if the pack be laid behind, always creep up to meet with the bottom card; and when you feel it, you may there hold it till you have shuffled over again; which being done, the card which was first at the bottom will come there again: having perfected yourself in this manner of shuffling, you may accomplish any thing you please with a pack of ten, twelve, or twenty cards, always leaving it at the bottom, however frequently you may shuffle them.

The Card in the Egg.

Take a card, the same as your long card, and rolling it up very close, put it in 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 egg, and shew that the only one that contains a card is that in which you directed it to be.

The Card discovered by the Touch or Smell.

You offer the long card, or any other that you know, and as the person who draws it holds it in his hand, to pretend to feel the pip or figure on the under side, by your fore-finger; or you sagaciously smell it, and then pronounce what card it is.

If it be the long card, you may give the pack to the person who drew it, and leave him at liberty either to replace it or not. Then taking the pack, you feel immediately whether it be there or not, and shuffling the cards in a careless manner, without looking at them, you pronounce accordingly.

The Transmuted cards.

In a common pack of cards let the ace of hearts and nine of spades be something larger than the rest.

With the juice of lemon draw over the ace of hearts a spade, large enough to cover it entirely, and on each side draw four other spades.

Present the pack to two persons, so adroitly, that one of them shall draw the ace of hearts, and the other the nine of spades, and tell him who draws the latter, to burn it on a chafing dish. You then take the ashes of that card, put them in a small metal box, and give it to him that has the ace of hearts, that he may himself put that card into the box and fasten it. Then put the box for a short time on the chafing-dish, and let the person who put the card in it, take it off, and take out the card, which he will see is changed into the nine of spades.

The Card hit upon by the Guess.

Spread part of a pack before a person, in such a way, that only one court card is visible; and so arrange it, that it shall appear the most prominent and striking card. You desire him to think on one; and observe if he fix his eye on the court card. When he tells you he has determined on one, shuffle the cards, and turning them up one by one, when you come to the court card tell him that is the one.

If he does not seem to fix his eye on the court card, you should not hazard the experiment; but frame an excuse for performing some other amusement; neither should it be attempted with those who are conversant with these sort of deceptions.

The Numerical Cards.

Let the long card be the sixteenth in the pack of picquet cards. Take ten or twelve cards from the top of the pack, and spreading them on the table, desire a person to think on any one of them, and to observe the number it is from the first card. Make the pass at the long card, which will then be at the bottom. Then ask the party the number his card was at, and counting to yourself from that number to sixteen, turn the cards up, one by one, from the bottom. Then stop at the seventeenth card, and ask the person if he has seen his card, when he will say *no.* You then ask him how many more cards you shall draw before his card appears; and when he has named the number, you draw the card aside with your finger, turn up the number of cards he proposed, and throw down the card he fixed on.

The Three Magical Parties.

Offer the long card to a person that he may draw it, and replace it in any part of the pack he pleases. *Make the pass,* and bring that card to the top. Next divide the pack in three parcels, putting the long card in the middle heap. You then ask the person which of the three heaps his card shall be in. He will, probably, say the middle; in which case you immediately shew it to him. But if he say either of the others, you take all the cards in your hand, placing the parcel he has named over the other two, and observing to put your little finger between that and the middle heap, at the top of which is the card he drew. You then ask at what number in that heap he will have his card appear. If, for example, he say the sixth, you tell down five cards from the top of the pack, and then dexterously making the pass, you bring the long card to the top, and tell it down as the sixth.

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 three 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 tne 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 the 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 proceed 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 cards 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 the two cards drawn.

For example,—Suppose the person has drawn a ten and a seven, then he must add fifteen cards to the first to make the number twenty-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, leave 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 cards, 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, and deducting seven from twenty-six, there remain nineteen; these two remainders added together make thirty-five, which you subtract from fifty-two, and there must remain seventeen for the amount of the two cards, as before.

To discover the Card which is drawn, by the throw of a Die.

Prepare a pack of Cards, in which there are only six sorts of cards. Dispose these cards in such manner that each of the six different cards shall follow each other, and let the last of each suite be a long card. The cards being thus disposed, it follows, that if you divide them into six parcels, by cutting at each of the long cards, those parcels will all consist of similar cards.

Let a person draw a card from the pack, and let him replace it in the parcel from whence it was drawn, by dexterously offering that part. Cut the cards several times, so that a long card be always at bottom. Divide the cards in this manner into six heaps, and giving a die to the person who drew the card, tell him that the point he throws shall indicate the parcel in which is the card he drew; then take up that parcel and show him the card.

The Convertible Aces.

On the ace of spades fix with soap, a heart, and on the ace of hearts a spade, in such manner that they will easily slip off.

Show these two aces to the company; then taking the ace of spades, you desire a person to put his foot upon it, and as you place it on the ground, draw away the spade. In like manner you place the seeming ace of hearts under the foot of another person. You then command the two cards to change their places; and that they obey your command, the two persons, on taking up their cards, will have ocular demonstration.

A deception similar to this is sometimes practised with one card, suppose the ace of spades, over which a heart is pasted lightly. After shewing a person the card, you let him hold one end of it, and you hold the other, and while you amuse him with discourse, you slide off the heart. Then laying the card on the table, you bid him cover it with his hand; you then knock under the table, and command the heart to turn into the ace of spades.

MAGICAL PROPFRTIES OF FIGURES.

The Magical Square.

THE Chinese have discovered mystical letters on the back of the tortoise, which is the common magical square, making each way 15, viz.

2	9	4
7	5	3
6	1	8

Writing in Cipher.

A cipher, consisting of nine radical characters, (those, for instance, composing the well-known figure †† with one, two, three, or more points at pleasure, ‡‡ above, below, or in the body of the figure,) is sufficient to compose a great enough variety of secret symbols for any purpose.

The Number Nine.

The following discovery of remarkable properties of the number 9 was accidently made by Mr. V.

Green, more than fifty years since, though, we believe, not generally known.

9
1
—
9...9
2
—
18...1+8=9
3
—
27...2+7=9
4
—
36...3+6=9
5
—
45...4+5=9

9
6
—
54...5+4=9
7
—
63...6+3=9
8
—
72...7+2=9
9
—
81...8+1=9

Ingenious Problem.

Place ten halfpence in a row upon a table; then taking up any one of the series, place it upon some other, with this proviso, that you pass over just one penny. Repeat this until there are no single halfpence left.

SOLUTION.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, halfpence.

Place 4 upon 1, 7 upon 3, 5 upon 9, 2 upon 6, and 8 upon 10.

Another.

The sum of four figures in value shall be
Above seven thousand nine hundred and three;
But when they are halved, you'll see very plain,
The sum shall be nothing—the mystery explain?

SOLUTION.

The sum is 8, 8, 8, 8, which should be written down; then by wiping off the upper or lower part of each of the figures, there will remain 0, 0, 0, 0 = to nothing.

A countrywoman carrying eggs to a garrison, where she had three guards to pass, sold at the first half the number she had, and half an egg more; at the second the half of what remained, and half an egg more; and at the third, the half of the remainder and half an egg more; when she arrived at the market-place, she had three dozen still to sell, how was this possible, without breaking any of the eggs?

SOLUTION.

It would appear on the first view, that this problem is impossible; for how can half an egg be sold without breaking any; The possibility of it however will be evident when it is considered, that by taking the greater half of an odd number, we take the exact half †½. It will be found, therefore, that the woman, before she passed the last guard, had 73 eggs remaining, for by selling 37 of them at that guard, which is the half†½, she would have 36 remaining. In like manner, before she came to the second guard, she had 147; and before she came to the first, 295.

To place Four Poles in the Ground, precisely at an equal distance from each other.

Let three of the poles be placed at equal distances, so as to form a triangle; when, imagining a mound of earth in the shape of a pyramid to be raised on that triangle as a base, having one of its slant sides equal to the distance between any two poles, then placing the fourth pole on the apex of the pyramid, the puzzle is answered.

Magic Squares.

The magic square is a square figure formed of a series of numbers, in mathematical proportion, so disposed in parallel and equal ranks as that the sums of each row taken either perpendicularly, horizontally, or diagonally, are equal.

The several numbers which compose any square number (for instance, 1, 2, 3, 4, 5, &c. to 25 inclusive, which compose the square number 25) being disposed after each other, in a square figure of 25 cells, each in its cell—if, then, you change the order of these numbers, and dispose them in the cells in such a manner, as that the five numbers which fill an horizontal rank of cells being added together, shall make the same sum with the five numbers on any other rank of cells, whether horizontal or vertical, and even the same number with the five in each of the two diagonal ranks: this disposition of numbers is called a magic square, in opposition to the former disposition, which is called a natural square.

Natural Square.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Magic Square.

11	24	7	20	3
4	12	25	8	16
17	5	13	21	9
10	18	1	14	22
23	6	19	2	15

Suppose a square of cells, whose root is uneven, for instance , 7, and that its 49 cells are to be filled magically with numbers, for instance, the first 7, on the one side take the first seven numbers, beginning with unity and ending with the root 7, and on the other 7 and all its multiplies to 49 exclusively; and as these only make six numbers, add 8, which makes this an arithmetical progression of seven terms as well as the other, 0, 7, 14, 21, 28, 35, 42. This done with the first progression repeated, fill the square of the root 7 magically: in order to do this, write in the first seven cells of the first horizontal rank the seven numbers proposed, in what order you please, for that is perfectly indifferent; and it is proper to observe here, that those seven numbers may be ranged in 5040 different manners in the same rank. The order in which they are placed in the first horizontal rank, be what it will, is that which determines their order in all the rest. For the second horizontal rank, place in its first cell either the third, the fourth, the fifth, or the sixth number, from the first number of the first rank, and after that write the six others in order as they follow. For the third horizontal rank, observe the same method with regard to the second that you observed in the second with regard to the first, and so of the rest. For instance, suppose the first horizontal rank filled with the seven numbers in their natural order, 1, 2, 3, 4, 5, 6, 7, the second horizontal rank may either commence with 3, with 4, with 5, or with 6, but in this it commences with 3.

1	2	3	4	5	6	7
3	4	5	6	7	1	2
5	6	7	1	2	3	4
7	1	2	3	4	5	6
2	3	4	5	6	7	1
4	5	6	7	1	2	3
6	7	1	2	3	4	5

The third rank, therefore, must commence with 5, the fourth with 7, the fifth with 2, the sixth with 4, and the seventh with 6. The commencement of the ranks which follow, the first being thus determined, the other numbers, as we have already observed, must be written down in the order wherein they stand in the first, going on to 5, 6, and 7, and returning to 1, 2, &c., till every number in the first rank be found in every rank underneath, according to the order arbitrarily pitched upon at first. By this means, it is evident, that no number whatever can be repeated twice in the same rank; and, by consequence, that the seven numbers, 1, 2, 3, 4, 5, 6, 7, being in each rank, must, of necessity, make the same sum.

Ingenious artists, how may I dispose
Of five-and-twenty trees, in just twelve rows;
That every row five lofty trees may grace,
Explain the scheme—the trees completely place.

SOLUTION.

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

To distribute among three persons 21 casks of wine, 7 of them full, 7 of them empty, and 7 of them half full; so that each of them shall have the same quantity of wine, and the same number of casks.

SOLUTION.

This problem admits of two solutions, which may be clearly comprehended by means of the two following tables:

	Persons.	full casks.	empty.	half full.
I	1st.	2	2	3
	2nd.	2	2	3
	3rd.	3	3	1

	Persons.	full casks.	empty.	half full.
II	1st.	3	3	1
	2nd.	3	3	1
	3rd.	1	1	5

Singular Property of the Figure Nine.

Take the difference between any number, and the same reversed, then the said difference is always divisible by 9, without a remainder. Thus—

Number.... 86342983
Reversed .. 38924368

9)47418615

5268735

It is not necessary that they be reversed, but placed in any order, provided the lesser sum is at the bottom, and the same figures used. Thus—

739165248
562841793

9)176323455(19591495

If you take any number with three figures in it only, and reverse it, and take the difference, it will be divisible by 9, without a remainder, and the figures in the quotient will read backwards and forwards the same. Thus—

961	957	785	397
169	752	587	397
9)792(88	9)198(22	9)198(22	9)396(33

If you take more than three figures to the number, the case will still be the same, if the first two or three figures of the number you take do not exceed the last two, or last three figures, more than 9 in the difference, when each are added up and subtracted. Thus,—

6	1	625121
2	2	121526
5	1	
		9)503595
13	4	
4		55955

The Difference 9

A row of any number of figures, whose sum is any of the multiplies of 9, may be divided by 9 without a remainder.

Place in a row 9 different figures, the sum of which shall be 45, directly under these place another row of 9 different figures, the sum of which shall also be 45. Subtract the lower from the upper line, and the remainder will always consist of nine different figures, the sum of which will be also 45.

A ship was in a situation with a hole in one of her planks of twelve inches square, and the only piece of plank that could be had, was sixteen inches long by nine inches broad. Required to know how this said piece must be cut into four pieces, so as to repair the hole perfectly and without waste.

SOLUTION.

Cut off four inches from the narrow end of the given piece, and divide the piece so cut off into three equal pieces by cuts in the shortest direction. When arranging these three pieces lengthways on the top of the remainder, a square of twelve inches will be formed.

To name five weights, which added together, make 121 pounds; by means of which may be weighed any intermediate weight, excluding fractions.

SOLUTION.

The five weights, which, added together, make 121, and by means of which may be weighed any intermediate weight, are, 1, 3, 9, 27, 81,=121.

MISCELLANEOUS EXPERIMENTS.

Illuminated Writing.

It is well known that if any words are written on a wall with solid phosphorus, the writing will appear as if on fire; but it is necessary to give this caution, lest accidents should occur. In using it, let a cup of water be always near you; and do not keep it more than a minute and a half in your hand, for fear the warmth of your hand should set it on fire. When you have written a few words with it, put the phosphorus into the cup of water, and let it stay a little to cool: then take it out, and write with it again.

The Chameleon Spirit.

Put into a decanter, volatile spirit, in which you have dissolved copper filings, and it will produce a fine blue. If the bottle be stopped, the colour will disappear; but when unstopped, it will return. This experiment may be often repeated.

A Ball of Ice.

Introduce a small portion of water into a thin glass ball, and keep it moistened for a considerable length of time by the application of sulphuric ether; and the water will be converted into ice.

Beautiful Metallic Crystals.

Over one ounce of iron filings in a tea-cup, pour a table-spoon full of sulphuric acid, diluted with four times its quantity of water; boil it for a short time, and set it aside to cool, when beautiful crystals of sulphate of iron will be formed.

To change a Blue Liquid to a Red.

Pour a little of the infusion of litmus, or blue cabbage, into a wine-glass, and add to it a single drop of nitric or sulphuric acid, and it will be instantly changed to a beautiful red colour.

To change Red or Blue Liquid, to Green.

Take a little of the liquid mentioned in the above experiment, either before or after it has been converted to red, and add a few drops of the solution of potash of soda, and upon stirring it, a fine green colour will be produced.

To convert a Colourless Liquid to a Deep Brown.

A drop of nitrate of copper let fall into a glass of water, will not produce any change on the colour of the water, but, if a crystal, or a drop of the solution of prussiate of potash be added, the water will become a dark brown colour.

To produce a deep Blue Colour, by mixing two colourless Liquids.

Let a drop of nitrate of copper fall into a glass, then fill it up with water, it will appear to have no colour, but, upon letting a drop of liquid of ammonia (which is also without colour) fall into the glass, the liquid will become of a beautiful deep blue colour.

To render a Blue-Coloured Liquid, perfectly Colourless.

Take the blue liquid produced by the last experiment, and let a drop or two of nitric acid fall into it, and it will become perfectly colourless.

To make the same liquid assume various Colours.

Mix a little powdered manganese with a little nitre, and throw the mixture into a red-hot crucible, and a compound will be obtained, possessed of the singular property of different colours, according to the quantity of water that is added to it. A small quantity gives a green solution, a greater quantity changes it to blue; more still, to a purple, and a still larger quantity, to a beautiful deep purple. The last experiment may be varied by putting equal quantities of this substance into separate glasses, and pouring hot water on the one, and a portion of cold water on the other. The hot solution will have a beautiful green colour, and the cold one a deep purple.

To convert Green-Coloured Liquid to White.

Pour a little of the solution of nickel into a glass, and add to it a few drops of the infusion of galls, which will convert it to a grayish white colour. If a few drops of ammonia be added to this solution of nickel, it will convert it to a deep blue; in the course of an hour or two it will change to red, and violet; if a drop of sulphuric or nitric acid be added, it will become green, and by adding a few drops of ammonia it will again become blue.

Luminous Liquor.

Put a little phosphorus, with essence of cloves into a bottle, which must be kept closely stopped. Every time the bottle is unclosed, the liquor will appear luminous. This experiment must be performed in the dark.

Golden Ink.

Take some white gum-arabic, reduce it to an impalpable powder, in a brass mortar; dissolve it in strong brandy, and add a little common water to render it more liquid. Provide some gold in a shell, which must be detached, in order to reduce it to a powder. When this is done, moisten it with the gummy solution, and stir the whole with a small hair brush, or your finger; then leave it for a night, that the gold may be better dissolved. If the composition become dry during the night, dilute it with more gum-water, in which a little saffron has been infused; but take care that the gold solution be sufficiently liquid to flow freely in a pen. When the writing is dry, polish it with a dry tooth.

The Changeable Rose.

Take a common full-blown rose, and having thrown a piece of sulphur finely pounded into a chafing dish with coals, expose the rose to the vapour. By this process the rose will become whitish; but if it be afterwards held some time in water, it will resume its former colour.

To set Fire to a Combustible Body by Reflection.

Place two concave mirrors at about twelve feet distance from each other, and let the axis of each be in the same line. In the focus of one of them place a live coal, and in the focus of the other some gunpowder. With a pair of strong bellows keep blowing the coal, and notwithstanding the distance between them, the powder will presently take fire.

The mirrors may either be made of glass, metal, or pasteboard, gilt.

To cause a Green Lambent Flame to appear, and alternately disappear, at the Mouth of a Flask.

Put a few pieces of phosphorus of the size of a bean into a Florence flask half filled with water, and make the water boil over a lamp: when the water has boiled for a few minutes, the empty part of the flask becomes filled with dense white vapours; and when the ebullition is suffered to go on, the fumes gradually disappear, and a lambent green flame makes its appearance with an undulatory motion at the orifice of the flask, and continues as long as the water is kept boiling. When the lamp is withdrawn, the phosphorescent flame gradually rushes down, and the internal surface of the vessel exhibits, in a dark place, illuminated clouds rolling over each other. When the heat is again applied to the flask, the flame re-appears, and again vanishes, and descends into the body of the vessel the moment the water ceases to boil; and these appearances may be repeated as long as any water is left in the flask.

Curious Change of Colour.

Put into an ounce phial a slip of copper scraped bright, fill up the phial with liquid ammonia, and cork it air-tight. No apparent change will take place; but if the bottle be left open for some hours, and then be closed, a solution of the colour is affected, which is absolutely colourless, and turns blue on re-opening the bottle, beginning at the surface, and gradually extending downwards through the mass. Again, if this blue solution has not been too long exposed to the air, and fresh pieces of copper be put in, stopping the bottle again, the solution is deprived of all its tinge, and recovers its colour by the admission of air; and this effect may be produced repeatedly.

The Distorting Mirror.

Opticians sometimes grind a glass mirror concave in one direction only, or longitudinally; it is in fact a concave portion of a cylinder, the breadth of which may be considered that of the mirror. A person looking at his face in this mirror, in the direction of its concavity, will see it curiously distorted in a very lengthened appearance; and by turning the cylindrical mirror a quarter round, his visage will appear distorted another way, by an apparent increase in width only. If in a very near situation before it, you put your finger on the right hand side of your nose, it will appear the same in the mirror: but if in a distant situation, somewhat beyond the centre of concavity, you again look at your face in the mirror, your finger will appear to be removed to the other side of your nose.

Exploding Salt.

If a small quantity of powdered charcoal and hyperoxymuriate of potash be rubbed together in a mortar, an explosion will be produced, and the charcoal inflamed. Three parts of this salt, and one of sulphur, rubbed together in a mortar, produce a violent detonation. If struck with a hammer, on an anvil, there is an explosion like the report of a pistol.

When concentrated sulphuric acid is poured upon this salt, there is a considerable explosion; it is thrown about to a great distance, sometimes with a red flame: and there is exhaled a brown vapour, accompanied with a strong odour.

Method of taking an Impression of Butterflies on Paper.

Clip the wings off the butterfly, lay them on clean, in the form of a butterfly when flying. Spread some thick clean gum-water on another piece of paper, press it on the wings, and it will take them up; lay a piece of white paper over it, and rub it gently with your finger, or the smooth handle of a knife. The bodies are to be drawn in the space which you leave between the wings.

To soften Horn.

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

To make Moulds of Horn.

If you wish to take the impression of any coin, medal, &c. previously anoint it with oil; and lay the horn shavings over it in its softened state. When dry, the impression will be sunk into the horn; and this will serve as a mould to re-produce, either by plaster of Paris, putty, and glue, or isinglass and ground egg-shells, the exact resemblance of the coin or medal.

To observe an Eclipse of the Sun, without Injury to the Eye.

Take a burning glass, or spectacle glass, that magnifies very much; hold it before a book or pasteboard, twice the distance of its focus, and you will see the round body of the sun, and the manner in which the moon passes between the glass and the sun, during the whole eclipse.

To extract the silver out of a Ring that is thick gilded, so that the Gold may remain entire.

Take a silver ring that is thick gilded. Make a little hole through the gold into the silver; then put the ring into aquafortis, in a warm place; it will dissolve the silver, and the gold will remain whole.

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 aquafortis. 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 a piece of leather; but observe, that previously 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 gum 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 cast Figures in Imitation of Ivory.

Make isinglass and strong brandy into a paste, with powder of egg-shells, very finely ground. You may give it what colour you please; but cast it warm into your mould, which you previously oil over. Leave the figure in the mould till dry, and you will find, on taking it out, that it bears a very strong resemblance to ivory.

To give Plaster Figures the appearance of Marble.

Put into four pounds of clear water, one ounce of pure curd-soap grated, and dissolved in a well glazed earthen vessel. Then add one ounce of white bees'-wax, cut into thin slices ; as soon as the whole is incorporated it is fit for use. Having well dried the figure before the fire, suspend it by a twine, and dip it once in the varnish ; upon taking it out, the moisture will appear to have been absorbed ; in two minutes' time, stir the compost, and dip it a second time, and this generally suffices. Cover it carefully from the dust for a week ; then with a soft muslin rag, or cotton wool, rub the figure gently, when a most brilliant gloss will be produced.

Excellent method of taking off Impressions of Leaves, Plants, &c.

Take fine wove paper, which oil well with sweet oil ; let it stand a minute or two to soak through, then remove the superfluous oil with a piece of paper, and hang it in the air to dry ; when the oil is pretty well dried in, take a lighted candle or lamp, and move the paper slowly over it in an horizontal direction, so as to touch the flame, till it is perfectly black. When you wish to take off impressions of plants, lay your plant carefully on the oiled paper, and a piece of clean paper over it, and rub it with your finger equally in all parts for about half a minute; then take up your plant, and be careful not to disturb the order of the leaves, and place it on the paper on which you wish to have the impression; cover it with a piece of blotting paper, and rub it with your finger for a short time, and you will have an impression superior to the finest engraving. The same piece of black paper will serve to take off a great number of impressions; so that when you have once gone through the process of blacking it, you may make several impressions in a very short time. The principal excellence of this method is, that the paper receives the impression of the most minute veins and fibres, so that you may obtain the general character of most flowers, superior to any engraving. The impressions may afterwards be coloured according to nature.

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 you look off the seal for a few moments, when you view it again, instead of seeing it, as at first, engraved, it will appear in relief.

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 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.

Alarum.

Against the wall of a room, near the ceiling, fix a wheel of twelve or eighteen inches 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 enclosed 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 the sand is run out, the weight will descend, and put 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.

Two Experiments to be made with a Concave Mirror, which may be easily tried.

If a fire be made in a large room, and a smooth well-polished mahogany table be placed at a good distance near the wall, before a large concave mirror, so that the light of the fire may be reflected from the mirror to its focus on the table, and you stand by the table, you will see nothing but a long beam of light; but if you stand at some distance as towards the fire, you will see, on the table, an image of the fire, large and erect; if another person, knowing nothing of the matter, enters the room, he will be startled at the appearance, for the table will seem to be on fire, and being near the wainscot, to endanger the whole room. There should be no other light than the fire in the room. If the fire be darkened by a screen, and a large candle be placed at the back of the screen, a person standing by the candle will see the appearance of a fine large star, or rather planet, on the table, as large as Jupiter or Venus; and if the paper be moved round the candle, the satellite will be seen to go round the planet.

Composition of an Ink similar to China Ink.

Take six parts of isinglass, which are to be dissolved in double their weight of boiling water; in like manner dissolve in two parts of water one part of Spanish liquorice: mix the two liquors warm, and gradually incorporate with them, by means of a wooden spatula, one part of the best ivory black. When this mixture is properly made, it is heated in a water-bath, that the whole of the water may be evaporated. The requisite form is then given to the paste which remains. The colour and goodness of this ink are equal to those of the true China Ink.

To produce a Carmine-Red Flame.

The flame of the spirit of wine may be coloured by the addition of various bodies which the spirit holds in solution. The flame of alcohol is tinged red in the following manner:—Put into a small iron ladle one part of muriate of strontia, and pour over it three or four of alcohol, then set it on fire with a candle, or a 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 lamp or candle to cause the alcohol to boil rapidly.

To produce an Emerald-Green Flame.

Cause alcohol to burn in a ladle upon nitrate of copper.

To produce an Orange-coloured Flame.

Put muriate of lime, deprived of its water of crystallization into an iron ladle, cover it with spirits of wine, and cause it to burn in the manner stated.

Timber in a Seventy-four Gun Ship.

A seventy-four gun ship will swallow up nearly 3,000 loads of oak timber; a load of oak timber contains fifty cubical feet, and a ton forty feet; so that a seventy-four gun ship takes 2,000 large well-grown timber trees, of perhaps two tons each. The distance recommended for planting trees is thirty feet; but supposing trees to stand at the distance of two rods, (thirty-three feet) each statute acre would contain forty trees; of course the building of a seventy-four gun ship would clear the timber of fifty acres. Even supposing the trees to stand one rod apart, (a short distance for trees of the magnitude above-mentioned) it would clear twelve acres and a half; no inconsiderable plot of ground. The complaints relative to the decrease of our timber are not to be wondered at under such circumstances; and this calculation points out to landed proprietors the necessity and patriotism of continually planting more trees to supply our future wants.

Subaqueous Exhalation.

Pour a little clear water into a small glass tumbler, and put one or two small pieces of phosphoret of lime into it. In a short time, flashes of fire will dart from the surface of the water, and terminate in ringlets of smoke, which will ascend in regular succession.

Flowers curiously affected by the Sun and the Weather.

The petals of many flowers expand in the sun, but contract all night, or on the approach of rain. After the seeds are fecundated, the petals no longer contract. All the trefoil may serve as a barometer to the husbandman: they always contract their leaves on an impending storm.

To make Luminous Writing in the Dark.

Fix a small piece of solid phosphorus in a quill, and write with it upon paper; if the paper be carried into a dark room, the writing will appear beautifully luminous.

The Sublimated Tree.

Into a large glass jar inverted upon a flat brick tile, and containing near its top a branch of fresh rosemary, or any other such shrub, moistened with water, introduce a flat thick piece of heated iron, on which place some gum benzoin in gross powder. The benzoin, in consequence of the heat, will be separated, and ascend in white fumes, which will at length condense, and form a most beautiful appearance upon the leaves of the vegetable.

Writing on Glass by the Rays of the Sun.

Dissolve chalk in aquafortis to the consistence of milk, and add to that a strong solution of silver.— Keep this liquor in a glass decanter, well stopped, then cut out from a paper the letters you would have appear, and paste the paper on the decanter, which you are to place in the sun, in such a manner that its rays may pass through the spaces cut out of the paper, and fall on the surface of the liquor. The part of the glass through which the rays pass will turn black, and that under the paper will remain white. You must observe not to move the bottle during the time of the operation.

To cause a Report like that of a Gun, with a Tobacco Pipe.

Compose a powder with one ounce of saltpetre, one ounce of cream of tartar, and half an ounce of sulphur, pulverized singly, then mixed. Put a single grain of this powder into a tobacco-pipe, and when it takes fire, it will produce a very loud report without breaking the pipe.

To break a Stone with a blow of the Fist.

Select two stones from three to six inches long, and about half as thick, lay one flat on the ground on which place one end of the other, raising the reverse end to an angle of forty-five degrees, and just over the centre of the stone (with which it must form a T,) supporting it in that position by a piece of thin twig, or stick, one, or one and a half inch long; if the raised stone be now smartly struck about the centre, with the little finger side of the fist, the stick will give way, and the stone will be broken to pieces: the stones must be laid so as not to slip, otherwise the experiment will fail.

Extreme Tenuity.

The thinnest substance ever observed is the aqueous film of the soap bubble previous to its bursting; yet it is capable of reflecting a faint image of a candle, or the sun.

Friction.

Sir H. Davy melted two pieces of ice by their mutual friction, in a room cooled below the freezing temperature.

Preparation of Phosphorized Ether.

Phosphorized ether is prepared, by suffering sulphuric ether to stand, for some weeks, over a considerable quantity of phosphorus in a well stopped phial.

Permanent Expansion of Glass.

It has been ascertained, that after glass has been exposed to a great heat, on cooling, it never regains its original volume.

How to Write in the Dark.

Two planes of ebony, of equal length and breadth, similar to a parallel ruler, and joined at each end by racks, the side of which being graduated to the width of the line intended, will serve as a certain guide, and by use of this instrument, a blind person, or a person in the dark, may write with the greatest accuracy. If ivory tablets or a slate is used, a fine wire drawn with a steel point may be readily felt by the point of the pencil.

To obtain exquisite Skeletons of Small Animals.

Put any small subject, such as a mouse, frog, (if a bird strip it of its feathers,) in a box perforated with a number of holes; let it be properly distended to prevent the parts from collapsing, or being crushed together by the pressure of the earth. Then place the box and its contents in an ant-hole; and in a few days it will have become an exquisitely beautiful and perfect skeleton, by the ants having consumed every part of it except the bones and ligaments.

To measure the Focal Distance of a Globe of Water and of Glass.

Take a hollow globe of glass, or, instead of it, a thin round flask or decanter, and making a moderate round hole about an inch diameter, in a piece of brown paper, paste it on one side of the belly of the decanter; and having filled it with water, hold the covered side to the sun, that the perpendicular rays may pass through the middle of the water, and the emergent rays will be collected to a focus, whose nearest distance from the decanter will be equal to the semi-diameter of the belly of it; as will appear by receiving the rays upon a paper, held at that distance. That this effect is owing to the water, and not to the glass, will be evident by emptying the decanter; for the light that passes then through the hole, will be as broad as the hole itself, at all distances of the paper from the decanter. If a similar experiment be tried, with a solid globe or ball of glass, the distance of the focus from the nearest part of the ball will be one quarter of its diameter.

Phosphorescence of Wood.

Dr. Carradori, on a paper on the phosphorescence of wood, asserts that phosphoric wood acquires by putrefaction the property of attracting and absorbing light, and of retaining it mechanically. To make it shine, it is sufficient to expose it for some time to the sun. A bit of wood, which the author examined, continued to shine under oil for two whole days. In that situation, says Dr. Carradori, it was not in contact with oxygen gas.

How Light Wood may be made to Lie at the Bottom of Water.

Let two pieces of wood be planed quite flat, so as no water may get between them when they are put together: let one of the pieces be cemented to the bottom of a vessel, and the other piece be laid flat and close upon it, and held down to it by a stick, whilst water is poured into the vessel; then remove the stick, and the upper piece of wood will not arise from the lower one; for, as the upper one is pressed down, both by its own weight, and the weight of all the water over it, whilst the contrary pressure of the water is kept off by the wood under it, it will lie as still as a stone would do in its place. But if it be raised ever so little at any edge, some water will then get under it, which, being acted upon by the water above, will immediately press it upwards: and, as it is lighter than its bulk of water, it will rise, and float upon the surface of the water.

To Imitate the Luminous Appearance of the Lunar Disc.

Introduce a few pieces of phosphorus of the size of a pea, into a hollow glass ball of three or four inches in diameter, and having heated it to cause the phosphorus to catch fire, keep turning the ball round, till half the inner surface is covered with phosphorus.

When the inflammation has ceased, there will be left a whitish crust or lining, which in a dark place shines for some considerable time. Broad spaces will assume by degrees an obscure aspect, while circular spots, frequently interspersed, will yet glow with a vivid lustre.

Easy Method of obtaining Flowers of different Colours from the same Stem.

Scoop out the pith from a small twig of elder, and having split it lengthwise, fill up each of the parts with small seeds that produce flowers of different colours, but that blossom nearly at the same time. Surround them with earth; and then tying together the two bits of wood, plant the whole in a pot filled with earth, properly prepared.

To fix Black Lead Pencil Drawings.

Dissolve a small quantity of isinglass, and dilute it with warm water, till so thin that when spread upon paper, and dry, it shall be free from those sparkling particles which never fail to appear. Take a broad flat camel-hair pencil, set in tin, and fill it plentifully with the solution, and draw it slightly over the work intended to be fixed, once or twice, or according as the size of the picture may require: it must be very carefully done, to prevent disturbing the sharpness of the pencil work: when dry, it will be found to resist the effect of Indian rubber. It is advantageous to sponge the back of the paper or Bristol-board before applying the solution, in order that the paper may dry level, as it is apt to contract round the edges when only one side is wet. If there be a margin round the drawing, it is not requisite to sponge the back.

To exhibit the Pressure of Fluids at different Depths.

The pressure of fluids at very great depths is finely illustrated by making a well corked empty bottle descend to a great depth, and then pulling it up again: however well corked it may be, the cork is always found in the inside, and the bottle full of water, when pulled up.

Two inodorous Bodies become very pungent and odorous by Mixture.

When equal parts of muriate of ammonia and slaked lime, both substances destitute of odour, are intimately blended together in a mortar, a very pungent gas (ammonia) becomes evolved.

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.

Experiment to shew the Separation of Bodies by Weight.

Take a bottle with a long neck, and fill part of it with water; take a glass, and pour claret and water into it; reverse the bottle with the bottom upwards, stopping the mouth of it with your finger; then dip the mouth within the glass, and remove the finger, keep the bottle in that position for a time, and the wine will separate from the water, ascend and settle in the top of the bottle, and the water will descend from the bottle and settle in the bottom of the glass, the passage will be apparent to the eye, for you will see the wine, as it were in a small vein, rising through the water.

Let the upper glass be wine and the lower water, there follows no motion at all; this separation of the wine and water appears to be made by weight, the water being made pensile, and a considerable weight of it in the belly of the bottle, supported by a small pillar of the same liquid in the neck of the bottle, it is this circumstance which sets the motion at work, for wine and water in a vessel will not separate by long standing.

Brilliant Combustion.

If a piece of inflamed phosphorus be plunged in a jar of nitrous acid gas, a very beautiful and brilliant combustion will be the consequence.

Another.

Pour some of Homberg's pyrophorus into a jar containing nitrous gas, a very beautiful stream of fire will be seen to flow at the bottom of the jar.

Curious Optical Deception.

Provide a sufficient number of small equilatera prisms, a few lines only in breadth, and in length equal to the height of the painting which you intend to make, and place them all close to each other on the ground to be occupied by the painting. Then cut the painting into bands equal to each of the faces of the prisms, and cement them, in order, to the faces of the same side. When this is done, take a painting quite different from the former, and having divided it into bands as before, cement them to the faces of the opposite side. It is hence evident, that when on one side you can see only the faces of the prism turned towards that side, one of the paintings will be seen; and if the picture be looked at on the opposite side, the first will disappear, and the second only will be seen. A painting may even be made, which, when seen in front, and on the sides, shall exhibit three different subjects. For this purpose, the picture of the ground must be cut into bands, and be cemented to that ground in such a manner, that a space shall be left between them, equal to the thickness of a very fine card. On these intervals raise, in a direction perpendicular to the ground, bands of the same card, nearly equal in height to the interval between them; and on the right faces of these pieces of card, cement the parts of a second painting, also cut into bands. In the last place, cement the parts of a third picture, cut in the same manner, on the left faces of the pieces of card. It is evident, that when this picture is viewed in front, at a certain distance, the bottom painting only will be seen; but if you stand on one side, in such a manner that the height of the slips of card conceals from you the bottom, you will see only the picture cemented in detached portions to the faces turned towards that side; if you move on the other side a third painting will be seen.

To exhibit the combustion of Iron-wire in Oxygen Gas.

Take a piece of fine iron wire, and coil it up in a spiral form. Fasten a little flax, or cotton, to one end of it, which must be dipped in sulphur. The other end of the wire is to be fixed to a cork, so that the spiral end may hang straight down. Fill a bottle capable of holding about a quart, with oxygen gas, and set its mouth upwards; then light the sulphur, and introduce the wire into the bottle of gas, suspending it by the cork, which is simply to be laid on the mouth of the bottle. The iron will immediately begin to burn with the most brilliant light, throwing out a number of sparks which fall to the bottom, and generally break it. This may, however, be prevented, by pouring sand into the bottle.

Curious Transcolourations.

If you put a tea-spoonful of a liquor composed of copper infused in acid of vitriol, into a glass, and add two or three table-spoonsful of water to it, there will be no sensible colour produced; but if you add a little volatile alkali to it, and stir it, you will perceive a very beautiful blue colour. Add a little acid of vitriol, the colour will instantly disappear upon stirring it; and by adding a little fixed alkali dissolved, it will return again.

Another.

Put half a tea-spoonful of a liquor composed of iron infused in acid of vitriol, into half a glass of water; and add a few drops of phlogisticated alkali, and a beautiful Prussian blue will appear.

Iron transformed into Silver.

Dissolve mercury in marine acid, and dip a piece of iron into it, or rub the solution over the iron, and it will assume a silver appearance.

It is scarcely necessary to state that these transmutations are only apparent, though to the credulous, it would seem that they were actually transformed.

The Phial of the Four Elements.

Take a phial, six or seven inches long, and about three-quarters of an inch in diameter. In this phial put, first, glass coarsely powdered; secondly, oil of tartar per deliquum; thirdly, tincture of salt of tartar; and lastly, distilled rock oil.

The glass and the various liquors being of different densities, if you shake the phial, and then let it rest a few moments, the three liquors will entirely separate, and each assume its place; thus forming no indifferent resemblance of the four elements, earth, fire, water, and air: the powdered glass (which should be of some dark colour) representing the earth; the oil of tartar, water; the tincture, air: and the rock oil, fire.

The Æolipiles.

The æolipile is a small hollow globe of brass, or other metal, in which a slender neck or pipe is inserted. This ball, when made red hot, is cast into a vessel of water, which will rush into its cavity, then almost void of air. The ball being then set on the fire, the water, by the rarefaction of the internal air, will be forced out in steam by fits, with great violence, and with a strange noise.

If to the necks of two or more of these balls, there be fitted those balls that are used by fowlers and hunters, and the balls placed on the fire, the steam rushing from them will make such a horrible noise, that it will astonish any person who is ignorant of the contrivance.

The Wheel Barometer in the form of a Syphon.

A small float of iron or glass rests on the exterior surface of the mercury, suspended by a slender thread, passed round a small wheel, or cylindrical axis, that carries the index. By this construction, the variation of the height of the mercurial column is reduced to half the ordinary measure, yet the circumference traversed by the needle is greatly augmented.

Ideal Spectrum.

I was surprised, and agreeably amused, (says Dr. Darwin,) with the following experiment. I covered a paper about four inches square with yellow, and with a pen filled with a blue colour wrote upon the middle of it the word BANKS in capitals, and sitting with my back to the sun, fixed my eyes for a minute exactly on the centre of the letter N in the middle of the word; after closing my eyes, and shading them somewhat with my hand, the word was distinctly seen in the spectrum in yellow letters on a blue field; and then, on opening my eyes on a yellowish wall at twenty feet distance, the magnified name of BANKS appeared written on the wall in golden characters.

Cohesion of Water.

If a glass be filled to the brim with water, and several small articles, as counters for instance, dropped in, what is the reason the water does not run over the brim of the glass?

It is the natural quality of all dry substances to resist water in a small degree; hence the top of the glass being dry, the counters not being so great as to overcome the resistance, and slipped in with a steady hand, the water will rise above the dry edge, without running over, till so many are put in as to cause the weight of the heaped up part to overcome the repulsion of the dry edge. The truth of this may be proved by dipping your finger in the water, and wetting the edge of the cup with it, upon which all the water which is above .he rim of the cup will run over.

Botanical Experiment.

A singular and ingenious method of multiplying the tongue-leaved eucomis, or futillary, is described in Professor Hedgwig's collection of memoirs and observations on subjects of Botany and Economy. This futillary is called by Lamarck, *Basile a epi couronne.* When this beautiful plant of the lily kind is in full flower and vigour, the flowers, leaves, and the upper part of the bulb must be cut, and wrapped up in several folds of sized writing paper, so that the whole be exactly covered. They are then to be moderately compressed between two pieces of board: and at the end of some months several small bulbs will be seen formed at the lower extremity. I cultivate, (says C. Willeret, who has made known the above conversation,) this charming unilobed plant in the National Botanic Garden, at

Nancy. It requires to be kept during winter in the hot-house.

To exhibit the Pressure of the Atmosphere.

Procure two hollow hemispheres of Brass, (A & B Fig. 19,) to one of which let there be a pipe annexed having a stop cock C. the pipe terminating in a screw so as to fit the plate of the air pump; bring the other hemispheres in contact, with a wet leather between them, and having exhausted the air from the inside, turn the stop-cock C, take the whole from the pump and screw on the handle; and then try if you can separate them. You will find that there is a tremendous pressure to overcome, a pressure which if the diameter of the cups were only four inches, would be equal to 180 pounds weight.

Artificial Mahogany.

The following method of giving any species of wood of a close grain the appearance of mahogany in texture, density, and polish, is said to be practised in France with such success, that the best judges are incapable of distinguishing between the imitation and mahogany. The surface is first planed smooth, and the wood is then rubbed with a solution of nitrous acid. One ounce and a half of dragon's blood, dissolved in a pint of spirits of wine, and one third of an ounce of carbonate of soda, are then to be mixed together and filtered, and the liquid in this thin state is to be laid on with a brush. This process is repeated, and in a short interval afterwards the wood possesses the external appearance we have described. When the polish diminishes in brilliancy, it may be restored by the use of a little cold-drawn linseed oil.

To make any Linen appear like Diaper.

When the cloths have been washed, spread upon a table, after being a little damped, then, having at hand a solution of alum in rose-water, dip into it a loose-haired painter's brush, and holding it upwards, discharge its contents gradually, by hitting its handle against a poker, held crosswise as high as one's head. If paper figures, or chimney ornaments, be laid upon the cloth, they will intercept the descent of the solution upon the cloth, and thus produce their own figures in a kind of relief.

Chimney Ornaments made of Variegated Eggs.

The eggs should be those of the wild goose or swan, as being of thicker shell, and more absorbent than those of some other feathered animals. Round one of these, let there be twined a yard or more of bright-coloured narrow ribband, rather traversely or lozenge-wise, a like quantity of quite another colour; then another and another, until the whole egg is nearly covered. Wrap it in a cloth, and boil three or four hours, and you shall have the impression of the ribbands upon the egg, in a kind of plaid pattern. They will last many years.

Pearls.

The Chinese are reported to have constructed natural pearls (if the antithetical term may be used) by means of oysters; and we see no reason why the same way may not be adopted in our country; if indeed, as has been shrewdly suspected, the practice does not already prevail secretly. Buffon had long ago suggested, and (in 1773) when this information reached Europe, that the puncturing of oysters, while yet alive, might produce pearls, and we know that they were often found in this shell-fish on our own coasts. But two characters belonged to *the naturalist*: he was a visionary—a fabulist also; and he left us in the dark, as to the secret of *puncturing*, which the industry and discrimination of the present day has fully developed. *The process*, which is worthy of trial, whenever it can be put in execution, consists in taking the oysters alive, and having perforated holes with a wire or awl, so as not to hurt vitality, a small iron wire is to be introduced, having knobs at a small distance from each other, formed probably of knots tied in the wire. The oysters are then to be replaced in their beds, and by the time the *season* comes round again, a concretion of pearly matter will be found to have covered the knobs of wire, which will become more perfect and larger the longer the oysters are suffered to remain.

The coasts of Dorsetshire, where the oyster-shells arrive at a great size, and the south-west coasts of Ireland, offer the fairest harvests to this new pearl-fishery.

To make Pomatum of Water and Wax.

Water and wax are two substances that do not readily unite together; therefore, to those who witness the following process, without knowing the cause, it will have the appearance of something marvellous. Into a new glazed earthen pot, put six ounces of river water and two ounces of white wax, in which you must previously conceal a strong dose of salt of tartar. If the whole be then exposed to a considerable degree of heat, it will assume the consistence of pomatum, and may be used as such.

Iron Transformed into Copper.

Dissolve blue vitriol in water, till the water is well impregnated with it; and immerse into the solution small plates of iron, or coarse iron filings. These will be attacked and dissolved by the acid of the vitriol, while the copper naturally contained in the vitriol will sink, and be deposited in the place of the iron dissolved. If the piece of iron be too large for dissolving, it will be so completely covered with particles of copper, as to resemble that metal itself.

Art of Bronzing Plaster Figures.

Lay the figure over with isinglass-*size*, until it *holds out*, or without any part of its surface becoming dry; then with a brush, such as is termed by painters a 'sash-tool,' go over the whole; taking care to remove, while it is yet soft, any of the size that may lodge on the delicate parts of the figure. When it is dry, take a little very thin oil gold-size, and with as much as just damps the brush, go over the figure with it, allowing no more to remain than causes it to shine: set it aside in a dry place, free from smoke, and in eight-and-forty hours the figure is prepared to receive the bronze.

The *bronze*, which is a powder almost impalpable, may be found at the colour-shops, resembling all the metals, and should be dabbed on with a little cotton-wool. After having thus touched over the whole figure, let it stand another day, and then with a soft, dry brush, rub off all the loose powder, particularly from the *points*, or more prominent parts of the figure: it will then resemble the metal intended, and possess the quality of resisting the weather.

Brass being the metal commonly imitated, the operator may choose to make it himself. In that case, let him dissolve copper filings in *aqua fortis*. When the acid is well impregnated with the copper, pour off the solution upon some scraps of iron, whereby the powder will be precipitated to the bottom of the liquid: this being now poured off, the powder is to be repeatedly washed in clean water. When dry, it is fit for use.

How to make a Cone, or Pyramid, move upon a Table, without Springs or any other artificial Means.

Roll up a piece of paper, or any other light substance, and put a lady-bird, a beetle, or some such small insect, privately under it; then, as the animal will naturally endeavour to free itself from its captivity, it will move the cone towards the edge of the table, and as soon as it comes there, will immediately return, for fear of falling; and by moving backwards and forwards in this manner, will occasion much diversion to those who are ignorant of the cause.

Impenetrable Winter Cloaks, made of Feathers.

The women of Hudson's Bay prepare cloaks for their husbands of the feathers of birds, which naturally resist all kinds of weather, and are an admirable defence against *sleet* in particular. They constantly boast that 'the animals have been all killed by their own hands;' and this is indeed necessary to the preservation of the dress, as the feathers which come away in moulting, or through disease, would decay. A coarse linen *shape* is stretched out, and the feathers having the quill part thrust through its meshes, are attached on the wrong side by needle and thread, and then lined with baize. Some sort of pattern, or, patch-work, is generally attempted by arranging the feathers, which may be improved upon by our fair countrywomen, especially with the deeply coloured and variegated tinted plumage of South American, or Brazilian birds.

Method of making Muffs and Tippets from the Plumage and Skins of Birds.

We are indebted to a Frenchman for having brought to perfection this useful and ornamental art. Domestic animals of all the feathered kinds, afford the material of which these articles may be made; but those with rich, variegated colours for gay wear, as they are less liable to decay than the sable coverings of birds of prey, would no doubt be preferred. Above all, those animals should be selected whose plumage lies close and smooth upon their backs—for obvious reasons. Diseased birds, or those killed in moulting time, are to be rejected, as the feathers would drop off at no distant period; but the birds must therefore be killed in full health, and the skin carefully stript off soon after their death, especially when the weather is hot, otherwise the same effects would be produced from corruption as from disease. When the skin has been freed from its impurities, it is spread upon a small table, the plumage downwards,—the feathers having been previously arranged over each other, according to the natural order. To keep it well stretched, tacks or pins may be driven in, or threads passed round underneath the table.

Next clear away the grease or fleshy parts that remain, and close up the rents, if any; the skin is then covered with a size made of glue, in which a small quantity of common salt and a glass of white wine has been mixed up to bring it to the proper consistency. The skin, thus covered, being exposed to the direct action of the wind, the glue will begin to scale off, and the whole must be scraped away. Should any dampness still remain on the skin, apply the glue again, dry and scrape it as before. When well dried, the skin is to be placed away in a box, in which dried wormwood, (absinthe), aloes, or some other bitter vegetable, is placed. The skins of large, or rank-feeding birds, require vinegar and salt to be dissolved in the glue; and the whole to be passed over with a solution of alum.

A Picture that Changes with the Weather.

Make a green ink, which is termed sympathetic or invisible green, from its being only to be seen when heated—thus: Dissolve salt of tartar, clear and dry, in a sufficient quantity of river water.

With this ink, take a brush and trace over the trees and fields of a print that represents the dreary aspect of winter, observing the usual rules of perspective, to make some parts deeper than others, according to their distance, leaving the remainder of their natural colours. Then put the print into a frame with a glass, and cover the back with paper that is pasted only at the extremities.

When it becomes desirable the picture should change, a solution of violets or tansies, must be passed over the greens, and the picture be exposed to the warm rays of the sun: all the grass and foliage will then turn to a pleasing green. But if a yellow tint be given to some parts of the print, before the sympathetic ink is drawn upon it, different shades will be produced, and the scene that a minute before represented winter, be changed into spring. Place the picture in the cold, and winter re-appears; but admit the sun, or the heat of fire, it is then driven away once more, and this may be often repeated.

How to Make a Peg that will exactly fit Three different kinds of Holes.

Let one of the holes be circular, the other square, and the third an oval; then it is evident, that any cylindrical body, of a proper size, may be made to pass through the first hole perpendicularly; and if its length be just equal to its diameter, it may be passed horizontally through the second, or square hole; also, if the breadth of the oval be made equal to the diameter of the base of the cylinder, and its longest diameter of any length whatever, the cylinder, being put in obliquely, will fill it as exactly as any of the former.

Mutual Exchange of different Liquors in two Bottles, without using any other Vessel.

Two bottles having been procured as nearly equal as possible, both in neck and belly, let one be filled with wine, the other with water. Then clap the one that is full of water dexterously upon the other, so that the two necks shall exactly fit each other; and as the water is heavier than the wine, it will naturally descend into the lower bottle, and make the wine ascend into its place; but it must be observed, that the wine, by this experiment, will be considerably altered, both in taste and quality; and, therefore, if this be thought too expensive, the same thing may be done with any other two liquors of different specific gravities.

To extinguish Ladies' Clothes, catching Fire.

We often hear, and read in newspapers, when one of those deplorable accidents has happened, which generally deprive us of the youthful and most lovely of our kind, dry recommendations, that ladies, whose dresses may catch fire, should *lie down*. This, though undoubtedly the right method of extinguishing a flame, is better illustrated, and imprinted more deeply on our recollection, by the following experiment. Take two pieces of muslin, (the article which usually catches fire), or paper, or any other light ignitible substance, and having set on fire the lower part of both, hold one piece *upright*, as female dresses are worn; it will burn out in about one minute, blazing up to a great height, where the neck and face may be supposed to be burnt. Meantime, fling the other piece of burning muslin on the ground; it will burn slowly, the flame at no time ascending more than an inch or two, and although the burning article might not be moved—as must happen when a living person is enveloped in it—nearly ten minutes would elapse before it would be consumed. In short, it is evident that a *perpendicular* female dress, though fifty feet high, would burn out with a destructive flame in less than a single yard of the same material laid in a *horizontal* position. It results, therefore, from the foregoing experiment, that as soon as a *lady's dress* is discovered to be on fire, she should instantly lie down; and she may then call for assistance, or confidently set about extinguishing the flame herself.

N. B. A current of air always prevails near the floor, particularly between the door and fire-place, and therefore it must be kept in mind, not to run out of the room, nor to open a window, in such cases, as that would be fatal.

A Substitute for Ostrich Feathers.

The extreme scarcity and dearness of this article of funeral pomp, appear to warrant us, in a commercial point of consideration, in seeking after a good substitute, at a seemingly great expense. On the hinder parts of the thighs of the turkey, when white, are those feathers to be found that so nearly resemble the ostrich's as to answer the same purposes, and to deceive tolerable good judges of the commodity. White turkeys, though not very common, are by no means scarce.

The Pressure of the Atmosphere,

Is known to pervade all space. It removes water, and may be so compressed, as to remove the more substantial bodies. Some have even asserted, that, but for it, some parts of this globe would fly off into unmeasurable space, and never return. Its effects on water may be judged by the following experiment: Take a tall drinking glass, at the edges whereof is fastened, by means of sealing-wax, a piece of string made tight, and having in its centre a lighted wax taper. This being balanced, so as to retain its position, when the glass is turned upside down, place its mouth in a vessel filled with water; as the taper consumes the air within the glass, its pressure is withdrawn; but the pressure from without still continuing, will force part of the water up into the glass to supply the place of the air which the taper has consumed. It must be evident, that nothing but the pressure of the atmosphere could thus cause the water within the glass to rise above its own level.

Artificial Flowers.

Make paste of divers colours, with gum-dragon, well steeped and mixed up with sugar, beating it up with the paste in a mortar. For *red*, take cochineal; for *yellow*, use gamboge, indigo and orris for *blue;* and, for the *green*, the juice of beet leaves, scalded over the fire to take away their crudeness. Mould the parts thus ordered into thin pieces, in *forms* resembling the flowers of roses, tulips, &c. by means of tin moulds, or cut out with the points of knives: finish the whole as nearly together as possible, and dry them on egg-shells, or some such substance. Out of the green paste, cut different shaped leaves, which may be mixed among the flowers, in various situations, so as to make them appear larger or smaller; make the stalks of slips of lemon-peel, or wire covered with green silk, which may be bought ready covered. Garnish the tops of pyramids of sweetmeats, fruits, &c. with those flowers, or make a separate *bouquet* of the leaves alone, to be placed in the centre of a dessert dish. It is usual also to lay such in a basket, or kind of shell, made of fine pastry work of crackling crust, neatly cut and dried for that purpose.

Artificial Fruit, with Stems of the Natural Fruit.

At the proper season of the year, pluck and put by the stalks of the fruit meant to be imitated, if possible with the *stones* thereon. Then get some pretty neat tins made in the form of the fruit meant to be imitated, but capable of being divided into two, and with a hole to admit the stalk. Care must be laken too, that the tins be smooth inside, and that the *joint* be well made.

Then take cow heels and calves feet, and boil it to a jelly; strain it through a sieve, put it into a saucepan, and sweeten it; put in some lemon-peel with perfume, and colour it like the fruit intended to be imitated. Stir up each sort well, give it a boil up, and fill your tins while it is warm, having placed the ends of the stalks (with the stones on) in the most natural way possible. Should the fruit be rather too heavy while wet, the stalks and tins must be suspended, whilst drying, by pieces of thread made fast above to nails in the wall, or on the case or box in which they may be placed to dry.

When the whole jelly may be considered quite cold, and a little consistent, open your tins, and prepare for laying on the bloom. *Powder blue* is that bloom, and beautiful specimens are to be produced by practice, which alone, it will be easily seen, must teach, 1*st*, The mode of placing the tins upon the stalks, so as to dry in the proper position, and without a seam at the joint; 2*nd*, The time and mode of taking them off again, to say nothing of repairing any defect that may occur. The stalks of other than fruit trees may also suffice, but they should in either case be plucked while in full vigour, or they are apt to break during the manufacture.

How to make a Piece of Metal, or any other Heavy Body, swim upon the surface of the Water, like a Cork.

The specific gravity of water is inferior to that of metals, and consequently water, absolutely speaking, cannot support a globe of iron or lead; but if this ball be flattened, and beat out to a very thin plate, it will, if put softly upon still water, be prevented from sinking, and will swim upon its surface like any light substance. In like manner, if a fine steel needle, which is perfectly dry, be placed gently upon some still water in a vessel, it will float upon the surface without sinking.

But if you would have a metallic body of large dimensions to swim upon water, you must reduce it into a thin concave plate, like a kettle, in which case, as the air it contains, together with the body itself, weighs less than the same bulk of water; it cannot possibly sink, as is evident from large copper boats, or pontoons, by which whole armies are frequently passed over rivers without danger.

And if this concave metallic vessel be placed upon the water with its mouth downwards, it will swim as before, and the contained air will keep the bottom of it from being wet; for that the water will not rise into any hollow vessel which is immerged into it, may be made evident thus:—Take a glass tumbler, and plunge it in water with its mouth downwards, and you will find when you take it out, that the inside of the vessel is perfectly dry, so that if a live coal was put there, it would not be extinguished.

Patterns for Working Muslin Dresses, &c. may be multiplied by the following easy process.—Termed Stencilling.

Lay the print or drawing, which it is intended to copy over a sheet of paper, and with a pin or fine needle, as the case may require, prick the outlines of the print through both papers; then take the clean paper with the holes in it, and lay it upon the article you wish to have the *design* transferred to, fasten it there tolerably close, and dust it over with finely powdered charcoal, placed in a coarse bag, through the meshes whereof the dust will penetrate, and leave a correct copy of the original. Its adherence may be rendered more sure, by previously moistening the substance that is to receive the pattern, with a thin gum.

The pricked paper will serve again immediately for taking another pattern, and in the case of forming a border, or continuous pattern, care should be taken that the figure at one end begins where the other side leaves off.

By knowing the last Figure of the Product of two Numbers, to tell the other Figures.

If the number 73 be multiplied by each of the numbers in the following arithmetical progression, 3, 6, 9, 12, 15, 18, 21, 24, 27, the products will terminate with the nine digits, in this order, 9, 8, 7, 6, 5, 4, 3, 2, 1; the numbers themselves being as follows, 219, 438, 657, 876, 1095, 1314, 1533, 1752, and 1971.

Let therefore a little bag be provided, consisting of two partitions, into one of which put several tickets, marked with the number 73; and into the other parts, as many tickets numbered 3, 6, 9, 12, 15, 18, 21, 24, and 27.

Then open that part of the bag which contains the number 73, and desire a person to take out one ticket only; after which, dexterously change the opening, and desire another person to take a ticket from the other part.

Let them now multiply their two numbers together, and tell you the last figure of the product, and you will readily determine, from the foregoing series, what the remaining figures must be.

Suppose, for example, the numbers taken out of the bag were 73, and 12; then, as the product of these two numbers, which is 876, has 6 for its last figure, you will readily know that it is the fourth in the series, and that the remaining figures are 87.

A curious Recreation with a Hundred Numbers, usually called the Magical Century.

If the number 11 be multiplied by any one of the nine digits, the two figures of the product will always be alike, as appears from the following example:

11	11	11	11	11	11	11	11	11
1	2	3	4	5	6	7	8	9
—	—	—	—	—	—	—	—	—
11	22	33	44	55	66	77	88	99

Now, if another person and yourself have fifty counters a-piece, and agree never to stake more than ten at a time, you may tell him, that if he will permit you to stake first, you will always undertake to make the even century before him.

In order to do this, you must first stake one, and remember the order of the above series, constantly add to what he stakes as many as will make one more than the numbers 11, 22, 33, &c. of which it is composed, till you come to 99; after which, the other party cannot possibly make the even century himself, or prevent you from making it.

If the person who is your opponent has no knowledge of numbers, you may stake any other number first, under 10, provided you afterwards take care to secure one of the last terms, 56, 67, 78, &c. or you may even let him stake first, provided you take care afterwards to secure one of these numbers.

This recreation may be performed with other numbers; but, in order to succeed, you must divide the number to be attained, by a number which is a unit greater than what you can stake each time: and the remainder will then be the number you must first stake. Suppose, for example, the number to be attained is 52, (making use of a pack of cards instead of counters,) and that you are never to add more than six; then dividing 52 by 7, the remainder which is 3, will be the number you must stake first; and whatever the other stakes, you must add as much to it as will make it equal to 7, the number by which you divided; and so on.

Two Dice being thrown, to find the Number of Points on each Die, without seeing them.

After any person has thrown two dice, upon a table, bid him double the number of points on one of them, and add 5 to it; then let him multiply this sum by 5, and add the number of points on the other die to it. This being done, desire him to tell you the sum, and having thrown out of it 25, the remainder will be a number consisting of two figures, the first of which, to the left, is the number of points on the first die, and the second figure, to the right, the number on the other.

Suppose, for example, that the number of points of the first die which comes up, is 2, and that of the other 3; then if to 4, the double of the points of the first, there be added 5, and the sum which is 9, be multiplied by 5, the product will be 45; to which if we add 3, the number of the points on the other die, it will make 48. Then if 25 be thrown out of this number, the remainder is 23; the first figure of which 2, is the number of points of the first die, and the second figure, 3, the number of the other.

Varnish for Silk, which renders it impervious to Water or Air.

Take of linseed oil, and add to it for every pint two ounces of sugar of lead, and three ounces of litharge; boil until these ingredients are dissolved. Then, to a half pint of the drying oil, (as we will now consider it,) add a pound of bird-lime, and in an iron pot of a gallon measure, let it boil gently over a slow charcoal fire, until the bird-lime ceases to make a crackling noise. Then pour upon it two pints and a half of drying oil, and boil it about an hour longer, stirring it often with an iron or wooden *spatula.* As the varnish, in boiling, swells much, the pot should then be removed from the fire, and be again replaced when the swelling subsides. While boiling, it should be occasionally examined, in order to ascertain whether it has boiled enough: for this purpose, take some of the varnish upon the blade of a large knife, and after rubbing the blade of another knife upon it, separate the knives; and when, on their separation, the varnish begins to form threads between the two knives, it has boiled enough, and should be removed from the fire. When it is almost cold, add nearly about an equal quantity of spirits of turpentine; mix both well together, and let the mass rest till the next day. Then having warmed it a little, strain and bottle it; if too thick, add more spirits of turpentine.

N. B. This varnish should be laid upon the silk when perfectly dry, in a lukewarm state; a thin coat of it upon one side, and, about twelve hours after, two other coats should be laid on, one on each side; and in twenty-four hours the silk may be used.

Method of Preserving Sea Plants.

These grow on the rocks from which the sea occasionally recedes; they are termed *fuci,* and when dried and preserved, are exceedingly beautiful; the *curious,* therefore, and especially those who prosecute the study of botany, must be anxious to know the best method of preserving them, without destroying their colour and beauty. The following is recommended by M. Mauduyt:—Take a sheet of paper, or rather of pasteboard, and cover it with varnish on both sides, and having rowed in a boat to the rock where the fuci abounds, plunge your varnished paper into the water, and detaching the fuci, receive it upon the paper, agitate the paper gently in the water, that the plant may be properly spread over it, and lift them up together softly out of the water, then fix down with pins the strong stalks, that they may not be displaced, and leave the plant lying upon the varnished paper, to dry in the open air: when it is fully dry, the different parts will retain their position, and the plant may be preserved within the leaves of a book. If you wish to free it from the slime and salt which adheres to it, it may be washed gently in fresh water, after being removed from the rock on which it grew.

An easy and expeditious Method of providing a Substitute for Indian Ink.

Boil parchment slips, or cuttings of glove leather, in water, till it forms a *size*, which, when cold, becomes of the consistence of jelly; then, having blackened an earthen plate, by holding it over the flame of a candle, mix up with a camel hair pencil, the fine lamp black thus obtained, with some of the above *size*, while the plate is still warm. This black requires no grinding, and produces an ink of the very same colour, which works as freely with the pencil, and is as perfectly transparent as the best Indian Ink. It likewise possesses the advantage of furnishing artists with a substitute for that article, which may be prepared in situations, where it might be difficult to obtain the ink itself.

The Almond Trick.

Get three almonds, or any other eatables, and having placed them upon the table a short distance apart, put a hat over each. Tell the company that you will eat the three almonds, and, having done so, will bring them under whichever hat they please. When you have swallowed each separately, request one of the spectators to point out the hat under which they shall all be. When choice has been made of one of the hats, put it upon your head, and ask the company if you have not fulfilled your promise.

The Three Knives.

Wager any sum with a person that you will give him three knives to hide, one after the other, and will tell him where he deposits the *last*. He will doubtless stipulate that he shall be permitted to hide them out of the room. This you readily agree to, and on presenting him with the first and second knives, he will go out and carefully deposit them in some secret hole or corner. During his absence, put the third knife into the fire, so that it will be moderately heated by the time he is prepared to receive it. As soon as he takes hold of it, he will very naturally deposit it upon the floor, with sundry ejaculations incidental to the touching any thing too hot to hold. You then say, "There it is, you have deposited the *last* upon the floor, and I have won the wager." This trick generally causes much laughter.

The Glass of Wine under the Hat.

Place a glass of wine upon a table, and, having put a hat over it, offer to lay any of the company a wager, that you will drink the wine without raising up the hat. When your wager is accepted, particularly request that no person will touch the hat; then get underneath the table, and commence sucking and smacking your lips as though you were swallowing the wine with considerable gusto. After a minute or two has elapsed, come from under the table, and say to the person who accepted your wager, "Now, sir." His credulity will immediately induce him to raise up the hat, in order to ascertain if the wine be drunk. Immediately he does so, take up the glass, and having swallowed its contents, say, "You have lost, sir, I have drunk the wine without lifting up the hat." This trick generally excites much laughter against the simpleton who thus dupes himself.

Beautiful Golden Yellow Dye, for Silks, Cotton, &c.

This fine lively and durable yellow dye, has recently been discovered by M. Lasteyrie, who thus describes the process by which it is obtained from the shaggy spunk, or boletus hirsutus of Linnæus, a species of mushroom or fungus, growing chiefly on apple or walnut trees. This vegetable substance is replete with colouring matter, which must be expressed by pounding in a mortar; after which the liquid thus acquired is to be boiled about a quarter of an hour. Six pints of water may be well tinged for dyeing by a single ounce of the expressed fluid. This being strained, the silk, cotton, &c. intended to be dyed, must be immersed and boiled in it for about fifteen or twenty minutes, when fine silk in particular, if it be afterwards passed through soft soap water, will appear of a bright golden hue, equal in lustre to that of the silk hitherto imported from China at a great expense, for imitating gold embroidery. In short, every sort of stuff retains a fine yellow colour; but it is, of course, less bright on linen and cotton. Nor is the use of this vegetable substance confined to dyeing, since it has been ascertained, that the yellow extract which it yields is applicable to the purposes of painting both in oil and in water colours.

To Prepare a Hortus Siccus.

This is a Latin term, signifying "dry garden," inasmuch as specimens of all sorts of plants may be thus preserved, in order to have recourse to them upon future occasions, when botany is pursued as a science in-doors. The value of such a collection is evident, since a thousand minutiæ may be preserved in the well dried specimens of plants, which the most accurate engraver would have omitted.

Among the different methods adopted by botanists for obtaining a hortus siccus, the following suggested by the ingenious Mr. Whately, appears to be the most practicable.

He directs those who intend to follow his plan, previously to procure—1. A strong oak box of the same size and shape as those employed for packing up tin plates—2. A quantity of fine sifted sand, sufficient to fill the box—3. A considerable number of pieces of pliant paper, from one to four inches square; and, 4. Some small flat leaden weights, and a few small bound books.

The plant is first to be cleared from the soil as well as the decayed leaves, and then laid on the inside of one of the leaves of a sheet of common cap paper; the upper leaves and flowers are next to be covered, when expanded, by pieces of the prepared paper, and one or two of the leaden weights placed on them. The remainder of the plant is now to be treated in a similar manner.

The weights ought next to be gently removed, and the other leaf of the sheet of paper folded over the opposite one, so as to contain the loose pieces of paper and plants between them; a book or two is now to be applied to the outside of the paper, till the intended number of plants is thus prepared, when a box is to be filled with sand to the depth of an inch, one of the plants put in, and covered with sand sufficient to prevent the form of the plant from varying. —The other plants may then be placed in succession, and likewise covered with a layer of sand, one inch thick between each, after which, the whole is to be gently pressed down in a greater or less degree, according to the tenderness or firmness of the plants. The box is next to be carefully placed before a fire, one side being occasionally a little raised, as may be most convenient, the sides being alternately presented to the fire two or three times in the day, or the whole may be put into an oven gently heated; in the course of two or three days the plants will be perfectly dry, when the sand ought to be taken out and put into another box, the plants should likewise be removed to a sheet of writing paper.

Easy Method of Gilding Steel.

Immerse a piece of highly polished steel, in a solution of nitro-muriatic gold, which will leave a coat of gold upon the steel, which must be immersed in water the moment it is gilt. The adhesion and appearance of the gold are considerably improved by the use of the burnisher. All kinds of figures may be delineated on highly polished steel instruments, by applying a fine brush or pen dipped in the above solution.

Water-Proof Cloth.

An able practical chemist of Glasgow has discovered a simple and most efficacious method of rendering woollen, silk, or cotton cloth, completely water-proof. The mode adopted is to dissolve caoutchouc (Indian rubber) in mineral oil, which is procured in abundance at the gas works: by a brush to put five or six coatings of this mixture on one side of the cloth or silk, on which another piece of cloth is laid, and the whole passed between two rollers. The adhesion is most complete; so much so, that it is easier to tear the cloth than to separate either piece from the caoutchouc.

Neptune's Fire.

Pour a little clean water into a small glass tumbler, and put one or two pieces of phosphoret of lime into it. In a short time flashes of fire will dart from the surface of the water, and terminate in ringlets of smoke, ascending in regular succession.

Composition of Tutanag, or Chinese White Copper.

This celebrated alloy has been analyzed by Dr. Fyfe, who gives the following as its composition:—

Copper	40	4
Zinc	25	4
Nickel	31	6
Iron	2	6
	100	0

The Incombustible Handkerchief.

Mix the whites of eggs and alum together; then smear a handkerchief with it, all over. Wash it in salt and water, and when dry, fire will not consume it.

To Freeze Water by Heat.

This trick can only be performed in the winter. Set a quart mug upon a stool before the fire, throwing a little water upon the stool first. Then put a handful of snow into the pot, having privately conveyed into it a handful of salt. Stir it for about ten minutes, and the congelation will be effected.

The Magic Spider.

Take a piece of burnt cork, as big as a pea, and cut it to the shape of a spider; make its legs with threads of hemp; put a grain of lead into the cork to give it some weight: then hang this artificial spider by a bit of gray sewing silk (that is not twisted) between two bodies, the one electrified and the other not; or between two bodies endowed with different electricities: it will go and come between these two bodies, and the movement of the legs will be seen as plainly as if it were a living spider.

The Extinguisher and Re-Illuminator.

Make two little figures of wood, or clay, or any other material you please, only taking care there is a small hole at the mouth of each. Put in the mouth of one a few grains of bruised gunpowder, and a little piece of phosphorus in that of the other, taking care that these preparations are made beforehand; then take a lighted wax candle, and present it to the mouth of the figure with the gunpowder, which, taking fire, will put the candle out; then present your candle, having the snuff quite hot, to the other figure; it will light again immediately by means of the phosphorus. You may produce the same effect by two figures, drawn on a wall, with a pencil or piece of charcoal, by applying, with starch or a wafer, a few grains of gunpowder to the mouth of one, and a piece of phosphorus to the mouth of the other.

The Bottle Conjuror.

State to the company that it was proved some years ago, at the Haymarket Theatre, that to crawl into a quart bottle was an impossibility; but the rapid progress made by the march of intellect in these enlightened times has proved that any person *may* crawl into a pint bottle as easily as into his bed. Having thus prefaced your intentions, you get a pint bottle, and place it in the middle of the room; then go outside the door, and creeping into the room upon all fours, say, "Ladies and gentlemen, this is crawling *in to* the pint bottle!"

The Geological Phial.

In a large sized phial, three parts full of clear water, infuse pure alumine, precipitated by ammonia, till the bottle is nearly filled. Expose the bottle to the cold air in frosty weather; or, at other times, to artificial frost. As soon as the frigorific effect ensues, the alumine will divide all over the surface of the water, and form itself into separate and very regular strata.

To Dye White Gloves a Beautiful Purple.

Boil four ounces of logwood and two ounces of roche alum in three pints of soft water till half wasted. Let it stand to be cold after straining. Let the gloves be nicely mended, then with a brush rub it over them, and when dry repeat it. Twice is sufficient, unless the colour is to be very dark; when dry rub off the loose dye with a coarse cloth; beat up the white of an egg, and with a sponge rub it over the leather. The dye will stain the hands, but wetting them with vinegar will take it off before they are washed.

Amusing Explosion.

There is a tree growing in America, which they call the Devil's tree; its fruit, in a state of maturity, is elastic, and when dried by the heat of the sun, noisily splits, and bursts forth its grains. To this sport of nature, the tree owes its name; for, at the moment of bursting, the effect of a piece of artillery is produced, the noise of which succeeds rapidly, and is heard tolerably far off. If its fruit be transplanted, before it is ripe, to a dry place, or exposed on a chimney-piece to a gentle heat, it will have the same effect, and produce the same phenomenon.

The Floating Needle.

Pour some water in a plate: then drop a needle lightly and carefully upon the surface, and it will float.

The Dancing Ring.

Procure a hollow ring, and fill it with quicksilver by means of a small hole; stop up the hole with clay, and, having heated the ring over a candle, put it down upon the table, and it will dance about until the quicksilver becomes cold.

French Way of Washing fine Lace or Linen.

Take a gallon of furze blossoms and burn them to ashes, then boil them in six quarts of soft water; this water, when fine, you are to use in washing with your suds as occasion requires, and you will have the linen, &c. not only exceeding white, but it is done with half the soap and little trouble.

The Dancing Ball.

Place on the spout of a fountain, an inverted cone of wire net-work; throw into it a light hollow copper ball, two inches and a-half in diameter, which let fall to the narrow part of the cone to reach the spout: it will rise and remain suspended in the air till brought down by the wind, and repeatedly ascend and descend.

To Silver Paper without Silver, after the Chinese manner, very useful in Fancy Work.

Take two scruples of clear glue (Indian glue is the best) one scruple of alum, and half a pint of clear water, simmer the whole over a slow fire till it is nearly two-thirds evaporated, then your sheets of paper being laid on a smooth table, dip a varnishing brush in the preparation, and go quickly over the paper twice, sift powder of talc through a fine sieve made of gauze, hang it to dry, and when dry, rub off the superfluous talc, which serves again for the same purpose. The talc is to be prepared in the following manner:—Take one pound of Muscovy talc, boil it in fresh water four hours, then take it off the fire, and let it stand in the water two days, wash it well, beat it to pieces in a mortar, and add to it six ounces of alum, which, when reduced to a fine powder, put again into clear water, and just give it a boil, pour off the water, and place the powder in the sun, or a warm place to dry, it will become a hard consistence. This beat in a mortar to an impalpable powder, and it is fit for use; keep it in a bottle to keep the dust from it, which is apt to make it appear dingy.

To make a Candle Burn under Water.

Take a glass, and, fastening a piece of wood across the mouth, stick upon it a piece of lighted candle, and steadily convey the glass to the surface of the water; then push it carefully down, and the candle will be seen burning under the water, and may be brought up again alight. In the same manner, a handkerchief may be immersed without being wetted, if rolled very tightly together. The principal art consists in bringing the mouth of the glass exactly level with the surface of the water, for if it be put the least on one side, the water will rush in, and consequently defeat the object.

Two Cold Liquids produce Fire.

Put a small quantity of aquafortis into a saucer; add a few drops of oil of turpentine, oil of carraways, or any other essential oil, and a flame will instantly be produced.

The three Haloes.

The following experiment, which illustrates in a pleasing manner the actual formation of haloes, has been given by Dr. Brewster:—"Take a saturated solution of alum, and having spread a few drops of it over a plate of glass, it will rapidly crystallize in small flat octohedrons, scarcely visible to the eye. When this plate is held between the observer and the sun, or a candle, with the eye very close to the smooth side of the glass plate, there will be seen three beautiful haloes of light, at different distances from the luminous body. The innermost haloe, which is the whitest, is formed by the images refracted by a pair of faces of the octohedral crystals, not much inclined to each other; the second haloe, which is more coloured, with the blue rays outwards, is formed by a pair of faces more inclined; and the third haloe, which is very large and high coloured, is formed by a still more inclined pair of faces. Each separate crystal forms three images of the luminous body, placed at points 120 degrees distant from each other, in all the three haloes; and as the numerous small crystals have their refracting faces turned in every possible direction, the whole circumference of the haloes will be completely filled up. The same effects may be obtained with other crystals; and when they have the property of double refraction, each haloe will be either doubled, when the double refraction is considerable, or rendered broader, and otherwise modified in point of colour, when the double refraction is small. The effects may be curiously varied, by crystallizing upon the same plate of glass, crystals of a decided colour, by which means we should have white and coloured haloes succeeding each other.

Application of the Moire Metallique to Tin-Foil.

All leaves of beaten tin are susceptible of crystallizing, because the hammer has only broken, more or less, the tin crystals; and, without any other preparation, they give a larger or smaller grain. It is not the same with laminated tin: the crystals are so exceedingly broken, that on being taken out of the acid-bath, the leaves of tin shew only an oxidized surface, proving that the porosity is not the same as that of beaten leaves. The means employed for moiring tin-plates becomes impracticable on leaves of tin in complete fusion; thus there was no need of employing a blast of air or water. Tin has so strong an attachment to the surface of iron, as to facilitate crystallization by the different means employed, and under different forms. It was requisite to make these leaves of tin undergo partial fusion, more or less extensive, but not general. Therefore take a leaf of brass, what is called in commerce yellow tinsel (a very fine piece of woven wire would produce the same effect): after it is heated red-hot, to anneal it, nail it on a frame, mounted on four feet, about eight inches long, to stand level on a table. Take a leaf of tin, which extend upon the brass by rubbing it with a brush; afterwards pass a small spirit-lamp under it, in different places, to fuse the tin, which will produce a very fine *moire*. The ground will be in grains, in a natural crystallization. To produce grounds, filled with flowers, take round and flat irons; after having heated them red-hot, and pressed them beneath the foil without friction, the contact will melt the tin to the width of the iron. But care must be taken to withdraw the iron as soon as the tin appears to be melted, and not to replace it but at a certain distance from the part first brought into fusion, in order that the latter may have time to solidify, and not be confounded with the other. Afterwards we may follow the same process between them. By running leaves of tin upon fine cambric, or upon stone, different *moires* may be formed in succession, at pleasure. It now remains only to subject these leaves to the action of the acid, in order to develope the *moire* produced by the heat. For this purpose, pass the composition over the foil with a sponge, or rather dip the foil into the liquid, and draw it out again as soon as it has acquired its brilliancy, to rinse it in pure water, and wipe it dry. But in the latter case, care must be taken to coat the back of the foil with varnish, that the acid may not penetrate through it by acting on both sides. The varnish should be composed of Jews' pitch *(asphaltum)* dissolved in oil of turpentine. The nitro-muriatic composition is made of two parts of nitric acid and one part of muriatic acid, diluted with ten parts of water.

To make Crocant or Ornamental Paste, for covering preserved Fruits.

A crocant frame is made of copper, in the form of an egg cut through the middle, and about the size of two quarts: take about half a pound of flour and an ounce of fine grated sugar, which make up in a paste with the yolk of an egg or two, and a little water; roll it out very thin and even; butter the outside of your crocant, and lay the paste over it quite smooth, and with a sharp pointed penknife cut it in what figure you please; but it is only those who understand drawing can do it to perfection, as it ought to be done in coats of arms, flowers, foliage, &c. when done set it in the oven to harden, and make it a cover for preserved fruits of any kind.

You may boil sugar till it be quite tough and ropy, and butter your frame, and with a small twig lay it on the frame in what figure you please: take it off when quite hard, and use it as the other.

To make Wax Candles.

Tie a dozen of wicks on an iron circle, at equal distances, over a large copper vessel, tinned and full of melted wax, pour a ladle full of wax on the tops of the wicks, one after another ; what the wick does not take, will drop into the vessel, which must be kept warm by a pan of coals ; so poured on till you have your candles as big as you chuse. If you want to have them of a pyramidical form, let the three first ladles be poured on at the top of the wick, the fourth at the height of $\frac{3}{4}$, the fifth at $\frac{1}{2}$, and the sixth at $\frac{1}{4}$; then take them down hot, and lay them aside of each other in a feather bed folded in two, to preserve their warmth and keep the wax soft ; then take them down, and roll them one by one on a smooth table, and cut off the thick end as you please.

Electric Spark from Brown Paper.

Thoroughly dry before the fire a quarter of a sheet of rather strong brown paper ; place it on your thigh, holding it at the edge, while with the cuff of your sleeve on the other hand, you rub it smartly backwards and forwards for about a minute : if the knuckle be then placed near the paper, it will emit a brilliant spark, accompanied by a snapping noise : the prongs of a fork similarly placed, will produce three distinct streams of light. The experiment must, of course, be performed in the dark, and the trousers and coat be of woollen cloth.

The Magic Book.

Provide an octavo book of plain paper, of whatever thickness you please. Turn over seven leaves from the beginning, and paint a group of flowers; then turn over seven more leaves and paint the same again; and so on, until you have turned the book through to the end. Then paste a slip of paper or parchment to each of the painted leaves. Turn the book over again, and paint upon every sixth leaf a parrot, and then paste strips upon them as you did upon the first, only a little lower down. Proceed in this manner, until you have painted the book full of pictures of various sorts, taking care one side of the leaves is left white paper. Having made the book, when you use it, hold it in your left hand, and set the thumb of your right hand upon the first of the parchment stays; run the book through, and it will appear full of flowers; then stop, and, blowing upon the book, run it through again, with the thumb upon the second slips of parchment, and it will appear full of parrots, and so on. Afterwards reverse the book, and run it through as before, and it will appear to be composed of blank paper.

To draw Beer from a Knife.

To do this, you must have a small piece of sponge, which privately soak in some beer, taking care that the sponge be neither too large or too full of liquor, lest you be discovered. Place this either in the cavity of the right ear, or behind the ear under the hair; then, taking a knife, stick it, with the handle upwards, in a table or stool (but observe that your company is placed opposite you); then bid them look, saying, "Then you see there is no liquid either on this handle, or on the table;" stretch your empty hand towards your ear, saying, "Now, somebody cross my arm," and, speaking some powerful words, as "*Jubio bisco,*" you will then have a fair opportunity to take the sponge into your hand from behind your ear. Stretch forth your hand, take up the knife, and squeeze it gently, and afterwards a little harder, which will make the beer run the faster, to the amazement of the company; at the same time saying, "Thus could I do till I had drowned you all." Then sprinkle a little in their faces, which will cause them to shut their eyes, whilst you convey away the sponge.

Method of Painting on Silk or Satin.

First make an outline according to your fancy, then lay on a wash of isinglass with great care, which will remove the glare and sleekiness of the silk, being necessary to make your colours work freely; melt the isinglass in clear water so as not to be very glutinous, otherwise it would spoil your colours and discolour your silk; observe your lights are to be made by a small tint mixed with flake white, of the colour of the intended flower, just sufficient to make a degree from the colour of the silk; for instance, if a blue flower, a very small quantity of bice or blue verditure mixed with the white, using less of the white in proportion as the shades grow darker, indigo may be used alone in the darkest. Take care never to lay your colours on the silk thick, as then they will be apt to crack, to prevent which it may be proper to mix a little white sugar candy with the gum water. If your flower is so deep as not to admit of a pure white in any part, lay on a priming of white, which being thoroughly dry, proceed to the ground colour of the flower, advancing gradually with the shades as before directed.

To make Fine Blue Sealing Wax.

Take an ounce of mountain blue, or blue ashes, an ounce of fine mastic, the fifth of an ounce of true Venice turpentine; then get a small iron pot or pan well cleaned, and made so as to have a little spout or beak, put the mastic in first, which is to be melted on the fire, taking care that it does not burn: then mix the turpentine with it: this mixture being done, take the pan from the fire and put the blue ashes in it, then stir it all well with a little stick; take care when you put in the blue ashes that the other ingredients are not too hot, as that would make the colour too black, when all is well mixed, and before it is quite cold, take two pieces of glass, which must be made wet with water, then pour on one of them this composition in order to roll it in sticks under your fingers, which must be wet.

In order to give this wax the necessary polish, pass the sticks over the flame of spirits of wine, which are to be lighted for this purpose.

Method of Teaching Drawing or Writing to Young Persons.

An artist proposes to teach young persons the elements of drawing by making them first practise on a slate; because it may be soon cleaned with a wet cloth or sponge. This method indeed would save the expense of paper, and afford the pupils an opportunity of easily correcting their faults, without being obliged to begin their drawing again entirely.

For my part, I think it would be more advantageous to employ, instead of a slate, a piece of Bohemian glass, which might be made rough on one side, by rubbing it with a pumice-stone, or a flat bit of freestone, or fine sand well moistened. Whatever figures have been drawn on this glass, may be effaced by a wet cloth in the same manner as from a slate; and besides this advantage, as the glass is transparent, correct copies may be placed below it, which the scholars ought to follow till their hand is properly formed. What is here said of drawing may be applied also to writing.

How to Make a Drawing Desk.

Let a frame be made of a reasonable size, so that a tolerably large piece of crown glass may rest upon it, supported by a ledge at the bottom part; where, by two hinges, it may be fastened to a drawer of the same dimension, which may be divided to serve for pen, ink, and paper, and other small utensils or instruments for drawing. To the top of the frame, fix two stays, by which the frame may be raised higher or lower, as occasion may require.

The manner of using this frame is thus:—lay the print or drawing you intend to copy on the glass, and fasten a sheet of fine white paper, with some wafers or paste, upon it; if you work in the day-time, place the back, after you have raised the frame to a proper height, against the window; but if by night, put a *lamp* behind it, and you will see every stroke of the print or drawing, which with your pen you may copy very accurately, and finish according to the manner you think proper. If it be a solid piece you intend to copy, then place it behind the desk, and having fastened your paper to the frame, put the lamp so as to produce a strong shade on the object you have before you to draw, and you will plainly see to trace the outlines with black lead pencil: after which, fill up the shades in the manner it appears *without the desk.*

The Confederate Shilling.

Having previously marked a shilling with a cross, conceal it under some object in the room; then request one of the company to lend you a shilling, and say, "Now I am going to perform a trick with this, and that you may know it again, I will mark it." Take a penknife, and cross it on the same side as the concealed shilling. Ask him if he will know it again, and then knock under the table and say, "Presto, be gone." Convey it secretly up your sleeve, and tell the company it has vanished; but you have an idea where they will find it. Name the place where you concealed the first shilling, which will be immediately discovered, and from the similarity of the mark, will be taken for that which was lent you.

Effect of Heat on the Ruby.

In subjecting rubies to a high degree of heat, Dr. Brewster observed a very singular effect produced by their cooling. At a high temperature, the red ruby becomes green; as the cooling advances, this green tint gradually fades and becomes brown, and the redness of this brown tint gradually increases till the mineral has recovered its primitive brilliant red colour. A green ruby suffered no change of colour from heat, and a bluish green sapphire became much paler at a high heat, but resumed its original colour by cooling.

To Bleach Prints and Printed Books.

Simple immersion in oxygenated muriatic acid, letting the article remain in it, a longer or shorter space of time, according to the strength of the liquor, will be sufficient to whiten an engraving: if it be required to whiten the paper of a bound book, as it is necessary that all the leaves should be moistened by the acid, care must be taken to open the book well, and to make the boards rest on the edge of the vessel, in such a manner that the paper alone shall be dipped in the liquid; the leaves must be separated from each other, in order that they may be equally moistened on both sides. The liquor assumes a yellow tint, and the paper becomes white in the same proportion; at the end of two or three hours, the book may be taken from the acid liquor, and plunged into pure water with the same care and precaution as recommended in regard to the acid liquor, that the water may touch both sides of each leaf. The water must be renewed every hour, to extract the acid remaining in the paper, and to dissipate the disagreeable smell.

To Remove the Stains of Ink.

The stains of ink, on cloth, paper, or wood, may be removed by all acids; but those acids are to be preferred, which are least likely to injure the texture of the stained substance. The muriatic acid, diluted with five or six times its weight of water, may be applied to the spot, and after a minute or two washed off; repeating the application as often as may be found necessary. Less risk attends the use of vegetable acids. A solution of the oxalic, citric, (acid of lemons,) or tartareous acids, in water, may be applied to the most delicate fabrics without danger of injuring them; and the same solution will discharge writing, but not printing ink. Hence it may be employed in cleaning books, which have been defaced by writing on the margin, without impairing the text.

Dr. Wollaston's Ice Apparatus.

The cold produced by evaporation is under certain circumstances, very great. Spirit of wine, and ether, which readily evaporate, produce considerable cold during that process. Upon this principle, wine-coolers, and similar porous vessels, refrigerate the fluids they contain; and thus, by accelerating the evaporation of water, by exposing it under an exhausted receiver, containing bodies that quickly absorb its vapour, Professor Leslie has contrived to effect its congelation; the heat required for the conversion of one portion of the water into vapour, being taken from the other portion, which is thus reduced to ice. The instrument invented by Dr. Wollaston, and called by him the cryophorus, acts upon a similar principle. It consists of a glass tube with a bulb at each extremity. One of the bulbs is about half filled with water, and a good vacuum is produced in the other by boiling the water, and sealing the tube whilst full of steam. On immersing the empty bulb in a freezing mixture, the water soon congeals in the other, although the intervening tube be two or three feet long. The vapour in the empty bulb is condensed by the cold, and a fresh quantity of vapour arises successively from the water in the other, by which so much heat is carried off as to cause it to congeal.

Method of Colouring Alum Crystals.

In making these crystals, the colouring should be added to the solution of alum in proportion to the shade which it is desired to produce. Coke, with a piece of lead attached to it, in order to make it sink in the solution, is the best substance for a nucleus; or, if a smooth surface be used, it will be necessary to wind it round with cotton or worsted, otherwise no crystals will adhere to it. *Yellow.*—Muriate of iron. *Blue.*—Solution of indigo in sulphuric acid. *Pale-blue.*—Equal parts of alum and blue vitriol. *Crimson.*—Infusion of madder and cochineal. *Black*

—Japan ink thickened with gum. *Green.*—Equal parts of alum and blue vitriol, with a few drops of muriate of iron. *Milk-white.*—A crystal of alum held over a glass containing ammonia, the vapour of which precipitates the alumina on its surface.

Valuable Transformation.

Pour half an ounce of diluted nitro-muriate of gold into an ale-glass, and immerse in it a piece of very smooth charcoal: expose the glass to the rays of the sun, in a warm place. The charcoal will very soon be covered over with a beautiful golden coat. Take it out with a foreceps, dry it, and enclose it in a glass for shew.

Another.

Put two or three small crystals of nitrate of silver into a crucible, containing the charcoal you intend to silver, red hot; violent detonation and combustion will take place. The charcoal will be beautifully covered with silver when taken out. Enclose it in a glass for show.

Easy Method of Silvering Ivory.

Prepare a diluted solution of nitrate of silver, in which immerse the figure or slip of ivory, polished, you intend to silver, till it has become of a bright yellow colour; then take it out of the solution, and immerse it into a tumbler of distilled water, in which expose it to the direct rays of the sun; and in two or three days it will become intensely black; but on rubbing it a little the black surface will be changed to a bright metallic one, resembling silver. As the silver wears off, a new coating of revived metal will be found to replace it, if the ivory be well impregnated with the subnitrate of silver.

Beautiful Metallic Crystallization.

Melt a ladle-full of bismuth, and allow it to cool slowly and gently, till a thin crust has formed on the surface; and then by means of a pointed iron, make two small opposite apertures through the crust, and quickly pour out by one the fluid portion, as carefully and with as little motion of the mass as possible, whilst the air enters by the other aperture: there will appear, on removing the upper crust by means of a chisel, when the vessel has become cold, a cup-shape concavity, studded with very brilliant crystals, and more or less regular, according to the magnitude of the quantity of mass employed, the tranquillity and slowness with which it has cooled, and the dexterity with which the fluid portion, at the moment before it commenced to solidify, was decanted from the crystallized part. The same effect will be produced by fusing the substance in a crucible which has a hole at its bottom, lightly closed by an iron rod or stopper, which is to be drawn out when the mass begins to congeal: by this means the superior portion, which is fluid, is made to run off, and a cake studded over with crystals is obtained.

To Remove a Gold Ring from the Finger when it has become too tight.

Take a little quicksilver, and rub it upon the ring, which will soon be penetrated with it, and become so fragile that it will break without the least exertion.

Experiment in Respiration.

Place a mouse or other small animal, under a jar of chlorine gas; or drop it into one from the aperture at the top of a jar filled with it. The animal will instantly expire.—Immerse a mouse or small bird in a jar of hydrogen gas; the animal will instantly die from suffocation, and the want of respirable nourishment.—If a mouse or sparrow be dropped into a jar of nitrogen gas, it will fall down exhausted, and gasping for breath: extinction of life will immediately follow.—Prepare a jar of nitrous oxide gas, and immerse in it any small animal; at first it will appear lively, but afterwards very uneasy and languishing, and life will quickly become extinct.—If a mouse or other animal be immersed in a jar of sulphuric acid gas, it will instantly expire. There are few gases more deleterious to animal life than this, and too much care cannot be taken not to breathe an atmosphere charged with it, even in a small degree.—If a mouse be dropped into a jar containing carbonic acid gas, it will expire in two or three seconds. In this way butterflies, &c. may be preserved for cabinets.—Confine a mouse or other small animal in a jar of nitrous gas; life will immediately become extinct.—Immerse a mouse in a jar of atmospheric air; it will at first give no signs of uneasiness; but as its respiration proceeds, and the oxygen is consumed (the atmospheric air in the glass being loaded with carbonic acid gas from the lungs), the animal will gradually become faint, and if kept in much longer, will die.—Let two jars be placed on a table; the one containing oxygen gas, and the other pure atmospheric air. Into each of these let a mouse be dropped. The animal immersed in the oxygen will live four times as long as that in the jar of atmospheric air.

An Infallible Barometer.

Put two drams of pure nitre and half a dram of choride of ammonia, reduced to powder, into two ounces of spirit of wine, or pure alcohol, and place this mixture in a glass tube, ten inches long and eight inches in diameter, the upper extremity of which must be covered with a piece of skin or bladder, pierced with small holes. If the weather is to be fine, the solid matters remain at the bottom of the tube, and the alcohol is as transparent as usual. If rain is to fall in a short time, some of the solid particles rise and fall in the alcohol, which becomes somewhat thick and troubled. When a storm, tempest, or even a squall is about to come on, all the solid matters rise from the bottom of the tube, and form a crust on the surface of the alcohol, which appears in a state of fermentation. These appearances take place 24 hours before the tempest ensues; and the point of the horizon from which it is to blow, is indicated by the particles gathering most on the side of the tube, opposite to that part whence the wind is to come.

The Green Tint of Plants preserved by Gas.

It has been lately discovered that the gas which is now employed for the purpose of illumination (carbonated hydrogen), and which is almost always present in coal-mines, has the curious property of preserving the green-tints of plants unimpaired after all light has been withdrawn from them; various plants having lately been discovered growing in such situations, whose green colour was quite as perfect as those growing in the light.

To Paint Gold Flowers on Silk.

Paint flowers or other ornaments with a very fine camel-hair pencil dipped in a solution of nitro-muriate of gold, (in the proportion of one part of the nitro-muriate to three of distilled water) on silk, satin, &c. and hold them over a Florence flask, from which hydrogen gas is evolved, during the decomposition of water, by sulphuric acid and iron filings. The painted flowers, &c. in a few minutes, will shine with all the splendour of the purest gold. A coating of this kind will not tarnish on exposure to the air, or in washing.

To Paint Silver Flowers on Silk.

Paint flowers, &c. on white silk, with a camel's hair pencil dipped in a solution of nitrate of silver; immerse this while wet in a jar of sulphurous acid gas, by burning sulphur under a jar of atmospheric air. The penciling will assume a beautiful metallic brilliance.

Crystallization of Tin.

The process is as follows:—Dissolve four ounces of muriate of soda in eight ounces of water, and add two ounces of nitric acid; or eight ounces of water, two ounces of nitric acid, and three ounces of muriatic acid ; or eight ounces of water, two ounces of muriatic, and one ounce of sulphuric acid. Either of these mixtures is to be poured warm upon a sheet of tinned iron, placed upon a vessel of stone ware; it is to be poured on in separate portions, till the sheet is completely watered ; it is then to be plunged into water, slightly acidulated, and washed. The operation is completed by drying. By subjecting the iron to different degrees of heat, the variety of the forms is increased; some parts are granular, others are like architectural ruins ; others grand natural phenomena of wood, and mountain, and cataract; in fine, there is no shape which the imagination can conceive, that accident may not produce in these exquisite sports of chemical power. The natural result of the crystallization is, to produce a surface of the shade of mother of pearl. The hues of gold, green, blue, &c. are effected by varnishes, laid on in a peculiar manner, and rubbed to the utmost degree of polish by the soft part of the hand.

Pleasing Experiments with Glass Tubes.

A most remarkable phenomenon is produced in glass tubes, placed in certain circumstances. When these are laid before a fire in an horizontal position, having their extremities properly supported, they acquire a rotatory motion round their axis, and also a progressive motion towards the fire, even when their supports are declining from the fire, so that the tubes will move a little way upwards to the fire. When the progressive motion of the tubes towards the fire is stopped by any obstacle, their rotation still continues. When the tubes are placed in a nearly upright posture, leaning to the right hand, the motion will be from east to west; but if they lean to the left hand, the motion will be from west to east; and the nearer they are placed to the upright posture, the less will the motion be either way. If the tube be placed horizontally on a glass plane, the fragment for instance of coach window glass, instead of moving towards the fire, it will move from it, and about its axis in a contrary direction to what it had done before; nay, it will recede from the fire, and move a little upwards when the plane inclines towards the fire.—These experiments succeed best with tubes about 20 to 22 inches long, which have in each end a pretty strong pin fixed in cork for their axis.

To detect Adulteration in Champagne.

This celebrated wine is indebted for its characteristic properties to the presence of carbonic acid. It produces rapid intoxication, in consequence of the alcohol, which is suspended in, or combined with this gas, being thus applied in a sudden and very divided state to a larger extent of nervous surface: for the same reason its effects are as transitory as it is sudden. The following simple test invented by Doctor

Haknemann, may be relied upon in all cases when an adulteration of lead is suspected:—Expose equal parts of sulphur and powdered oyster-shells to a white heat for fifteen minutes, and, when cold, add an equal quantity of cream of tartar: these are to be put into a strong bottle with common water, to boil for an hour; and the solution is afterwards to be decanted into ounce phials, adding twenty drops of muriatic acid to each. This liqour will precipitate the least possible quantity of lead in the most rapid manner; the muriatic acid being added to prevent a precipitation of iron, which is innoxious, and might accidentally be contained in the wine.

Art of Making the best Writing Ink.

To prepare the best ink, the following ingredients are to be used, viz.:—

4 ounces of good galls,
2 .... chipped logwood.
2 .... sulphate of iron,
1½ .... gum arabic,
½ .... sulphate of copper,
½ .... brown sugar.

Boil the galls and logwood in six pints of spring or distilled water, until nearly three pints are evaporated, then strain through a piece of flannel. Powder the salts in a mortar, dissolve the gum in a little warm water, then mix the whole together, and shake it frequently for two or three days; during which time, exposure to the air will be beneficial. Now decant the liquor into well corked bottles of stone. It is fit for use immediately.

Extemporaneous Preparation of a Saline Draught.

Pulverise one ounce of citric acid, and divide it into twenty-four parts, which are to be put into separate blue papers. Pulverise also one ounce of the sub-carbonate of soda, and divide it into twenty-four like packages, in white paper. When the draught is to be prepared, put the carbonate into a tumbler, half filled with spring or filtered water. When this is completely dissolved, add the acid, which will immediately cause an effervescing discharge of carbonic acid. During this effervescence swallow the draught, which will be found very refreshing in warm weather.

Restoration of Paintings.

The white used in oil-painting, is generally prepared from lead, and forms the basis of many other pigments; and is extremely liable to turn brown or black, when affected by sulphureous vapours. M. Thenard, of Paris, has restored a painting of Raphael's, thus injured, by means of oxygenated water, applied with a pencil, which instantly took out the spots and restored the white. The fluid was so weak, as to contain not more than five or six times its volume of oxygen, and had no taste.

Looking-Glasses.

Professor Lancellotti, of Naples, has discovered a new composition for the fabrication of looking-glasses, which unites economy to facility of execution. He employs three parts of lead and two of mercury. This composition is then melted on the heated and dry glass: it attaches itself strongly to the surface, and the images or objects are faithfully reflected by it; but care must be taken not to let the oxide which is formed in the fusion of this amalgam remain between the glass and the metallic surface.

Conversion of Rags into Sugar.

Dr. Volgel, Member of the Royal Academy of Sciences, has submitted to a careful examination in the Laboratory of the Academy of Munich, the surprising discovery of Braconnet, of Nancy, of the effects of concentrated sulphuric acid on wood and linen. He has not only fully confirmed this discovery, but also extended his own experiments, with equal success, to other similar vegetable substances, such as old paper, both printed and written upon, and cut straw. By diluting the sulphuric acid with a due addition of water, sawdust, cut linen, paper, &c. were converted into gum and saccharine matter. It must excite great interest in reflecting minds, to see an indissoluble, tasteless substance, like the filaments of wood, converted, by chemical re-action, into two new bodies, and chemistry thus exercise a power, which, till lately, appeared to belong to nature alone, and in particular to vegetation. For this artificial formation of sugar and gum, now discovered, must not be confounded with the extraction of these two substances from bodies in which they already existed, a process which has been known from time immemorial. What has now been discovered, is a transformation—a metamorphosis, of which the most ingenious chemist had previously no idea; and it affords a new proof of the boundless extent of the domain of practical chemistry.

To Destroy Caterpillars.

A mode of destroying caterpillars, has been discovered by accident. A piece of woollen rag had been blown by the wind into a currant-bush, and when taken out was found covered by these leaf-devouring insects. Pieces of woollen cloth were immediately placed on every bush in the garden, and next day the caterpillars had universally taken to them for shelter. In this way thousands were destroyed every morning.

Cheap Mode of preserving Anatomical Preparations.

It has been usual to employ, for this purpose, spirit of wine, somewhat above proof, and which costs about 18*s*. or 20*s*. per gallon. It has been ascertained by Mr. Cooke, of London, that a saturated solution of muriate of soda (common salt) answers the purpose equally well; and this solution (about three pounds of salt to the gallon) does not cost above 10d. per gallon. Mr. Cooke has received from the Society of Arts, for this discovery, the society's silver medal.

Infallible Antiseptic.

For ensuring the sweetness of fish conveyed by land-carriage, the belly of the fish should be opened, and the internal parts sprinkled with powdered charcoal. The same material will restore impure, or even putrescent water, to a state of perfect freshness.

Quadrature of the Circle.—Simple method of solving this Problem.

Let a sphere be made, likewise a perfect hollow cube, one of the internal sides of which must be equal to the diameter of the sphere; then let the sphere be placed in the hollow cube, and pour water into the vacant space around the sphere, until the water is exactly level with the edge of the cube, and consequently with the top of the sphere, after which, take the sphere carefully out, and measure the proportion which the depth of water left in the cube bears, to the vacant space lately occupied by the sphere; deduct the quantity of space occupied by the water, from the entire space contained by the cube, and the remainder will be the solid contents of the sphere. In order to find the proportion between the circle and the superficial square, let a cylinder be made of the same diameter as the sphere abovementioned, and equal in height to one of the internal sides of the cube, place the cylinder in the cube, pour water around it, until the water is level with the edge of the cube, then carefully take out the cylinder, find the proportion as previously directed for the sphere; and as the proportion of the cylinder is to the cube, so will the proportion of the circle be to the square.

M. Rieussec's Chronograph.

This chronographihas the form and size of a large pocket chronometer. The dial is moveable, and turns round an axis, passing through its centre perpendicular to its plane. When the chronograph is in motion, the dial turns round once in a minute; and as its circumference bears sixty divisions, the angular motion of one division corresponds to one second of time.

The minutes are marked separately. The chronograph being in motion, the observer who wishes to mark the instant of a phenomenon, presses a stud, and that very instant a pen or metallic point passing through the open summit of a cone, filled with oil-black, and placed opposite to the fixed zero, from which the dial begins to move, marks on the circumference bearing the divisions for seconds, a point which serves to shew with what second and fraction of second the beginning as well as end of the time to be measured corresponded. The play of the mechanism which darts the pen, neither stops nor retards the motion of the rotatory dial; the stud may therefore be pressed several times while the motion continues, thus forming on the division of sixty, a number of black points, each of which will indicate by its position the instant in which it was marked. The pressure on the stud, and the formation of the black point, are simultaneous, and the diameter of this point is such, that one-fourth of the interval between two consecutive divisions may be readily estimated. This estimate will be more exact and easy, the larger the dial. It has succeeded well in measuring the speed in horse-races, machines in motion, running water, &c.

To preserve Fresco Paintings.

Frequent attempts have been made to separate fresco paintings from the walls on which they are executed, in order to rescue them from the destructive effects of time and weather, but all have been unsuccessful. Antonio Contri, of Ferara, was the first who made a public attempt in the beginning of the 18th century, at Mantua. He succeeded in taking several heads of Giulio Romano from the wall, and transferring them to canvass; but this work required long and difficult preparations, which were besides only calculated for even walls, and for taking off smaller paintings. Later trials in France and other countries, were confined, with more or less success, to transferring paintings, piece by piece, from walls or linen, to new linens, but never to panels. Subsequently, the mode of sawing the paintings from the wall was adopted; this method, however, which was always attended with danger, was only applicable to pictures of a small size. Steffano Barezzi, a native of Milan, has the honour of having been the first to render an essential service to the arts, in transferring to panels, by a most simple, expeditious, and safe process, fresco paintings, of whatsoever size, from the wall, whether level or not, without doing the least damage to the original design. His method consists in laying a piece of prepared linen against the wall, which extracts the painting, in such a manner, that the artist, with a sure and uniform motion, can draw off the linen in a perfect state with the painting, so that the wall itself remains quite white. This linen is then stretched upon a panel, and again drawn from this, so that the painting itself remains fixed upon the panel without sustaining the smallest injury.

Working and joining of Tortoise-shell.

Tortoise-shell and horn become soft in a moderate heat, as that of boiling water, so as to be pressed in a mould, into any form, the shell or horn being previously cut into plates of a proper size. Plumier informs us, in his *Art de Tourner*, that two plates are likewise united into one by heating and pressing them; the edges being thoroughly cleaned, and made to fit close to one another. The tortoise-shell is conveniently heated for this purpose by applying a hot iron above and beneath the juncture, with the interposition of wet cloth to prevent the shell from being scorched by the irons; these irons should be pretty thick, that they may not lose their heat, before the union is effected. Both tortoise-shell and horn may be stained of a variety of colours, by means of the colouring drugs commonly used in dyeing, and by certain metallic solutions.

Substitute for a Copying Machine.

Write with common writing ink, in which lump sugar has been dissolved, in the droportion of four scruples, or a drachm and a half of sugar to one ounce of ink. Moisten copying paper, (a paper which is sold at the stationers at 1*s.* 10*d.* per quire, for the use of copying machines) by passing a wet soft brush over it, then press it gently between soft cap paper, so as to smoothen it, and absorb the superabundant moisture. Put the paper so moistened upon the writing, and both between cap or other smooth soft paper, placing the whole on the carpet or hearth-rug, one end of which is to be folded over. By standing and treading upon this, an impression will be taken, equal, if not superior, to what would have been taken by a copying machine.

Artificial Jewels.

The base of all these imitations is strass, or white crystal. The materials employed are melted in Hessian crucibles, and a porcelain furnace, or what is preferable, a potter's furnace is afterwards used. The more tranquil and prolonged the fusion is, the more hardness and beauty does the strass acquire.

STRASS.

The following three mixtures give a very fine strass:

Rock Crystal	0,321	0,3170	0,300
Minium	0,490	0,4855	0,565
Potash, pure	0,170	0,1770	0,105
Borax	0,021	0,0200	0,030
Arsenic, oxide of	0,001	0,0005	
	1,000	1,0000	1,000

M. Lancon recommends the following mixture for a pure strass:

Litharge	0,540
White Lead	0,406
White Tartar, or Potash	0,054
	1,000

TOPAZ.

The imitation of topaz is difficult. It passes from the white of strass, to sulphur-yellow, violet, and red purple, according to circumstances which are not determined. The following are two of M. Wieland's recipes:

White Strass	0,95816	0,99
Glass of Antimony	0,04089	
Purple of Cassius	0,00095	
Oxide of Iron		0,01
	1,00000	1,00

These mixtures sometimes yield an opaque mass, translucent at the edges, and of a red colour in thin plates. By mixing it with eight times its weight of strass, and keeping the mixture in fusion for thirty hours in a potter's furnace, the result is a fine yellowish crystal. This crystal re-melted by the blowpipe, produces the finest imitation of eastern *ruby*.

RUBY.

A ruby less beautiful, and of a different tint, may be made thus:

Strass	0,9755

Oxide of Manganese ..	0,0245
	1,0000

EMERALD.

This paste is very easily made; and that which approaches the nearest to the mineral, is the following:

Strass..................	0,98743
Green Oxide of Copper ..	0,01200
Oxide of Chrome........	0,00057
	1,00000

The following is M. Lançon's recipe for emerald:

Strass	0,9905
Acetate of Copper	0,0080
Peroxide of Iron	0,0015
	1,0000

PERIDOT.

By augmenting the proportion of oxide of chrome and oxide of copper in the first composition of emerald, and adding oxide of iron, we may vary the green shades, and imitate the peridot and deep coloured emerald.

SAPPHIRE.

The composition for this paste is,

Strass, very white	0,9855
Oxide of Cobalt, very pure	0,0145
	1,0000

This mixture must be put into a Hessian crucible, carefully luted, and remain thirty hours in the fire. If the process be well conducted, the result will be a very hard glass, without bubbles.

AMETHYST.

Very deep amethyst may be obtained with,

Strass	0,9870
Oxide of Manganese	0,0078
Oxide of Cobalt	0,0050
Purple of Cassius	0,0002
	1,0000

M. Lançon uses

Strass	0,9977
Oxide of Manganese	0,0022
Oxide of Cobalt	0,0001
	1,0000

BERYL, OR AQUAMARINE,

Is made with

Strass	0,9926
Glass of Antimony	0,0070

Oxide of Cobalt	0,0004
	1,0000

SYRIAN GARNET.

This paste is used for small jewels, and is made with

Strass	0,6630
Glass of Antimony	0,3320
Purple of Cassius	0,0025
Oxide of Manganese	0,0025
	1,0000

In the fabrication of these pastes, many precautions are necessary, which can only be learned by experience. The materials should, in general, be carefully pulverised. The mixtures should be properly sifted, and the same sieve should not be used for different compositions. In order to obtain the glass well melted, and homogenous, and without striæ or bubbles, materials of great purity must be employed; they must be mixed in a state of extreme tenuity; the best crucibles must be used; the fire must be graduated, and kept equal to the maximum temperature, and the mass must be left in the fire from 24 to 30 hours, and allowed to cool very slowly.

Perpetual Engravings on Steel, and other Metals.

The merit of this invention consists in obtaining, with great facility, from *one* engraving, any required number of plates, all of which are equal to the *original*, and by which millions of impressions may be produced, while by the common process, one engraving produces only a few thousands. The process of multiplying engravings, etchings, or engine work, is as follows: Steel blocks, or plates of sufficient size to receive the intended engraving, having their surfaces softened or decarbonated, and thereby rendered a better material for receiving all kinds of work than copper itself. After the intended engraving has been executed upon the block, it is then hardened by a new process, which prevents injury to the most delicate work. A cylinder of steel previously softened, is then placed in the transferring press, and repeatedly passed over the engraved block, by which the engraving is transferred *in relief*, to the periphery of the cylinder; the press having a vibrating motion equalling that of the cylinder upon its periphery, by which new surfaces of the cylinder are presented, equal to the extent of the engraving. The cylinder is then hardened, and is employed to indent copper or steel plates, with engravings *identically* the same with that upon the *original* block; and this may be repeated *ad infinitum*, as the original engraving will remain, from which other cylinders may be impressed if required. This invention promises to be of great advantage to some of our manufacturers, particularly that of pottery, which may now be embellished with beautiful engravings, so as to place the successful competition of other nations at a great distance. It is also applied with great advantage to calico printing, by producing entire new patterns upon the cylinders from which they are printed. It would be superfluous to mention the beautiful highly-finished engravings which now adorn our books, rooms, &c.

Engravings of greater size than can be transferred, are executed upon steel plates, which, when hardened, will print 200,000 perfect impressions.

It is to Messrs. Perkins, Fairman, and Heath, that the world is indebted for this valuable invention.

Bees.

Our cruel mode of taking honey by destroying the innocent and beautiful insects that produce it, can no longer be defended by the plea of necessity. A late traveller in the northern part of India, describes the following easy method by which the honey-gatherers there effect their purpose. A hollow tree, or an earthen pot, is built in the wall of a house, or out-house, with apertures externally, through which the bees enter and go out. The internal end of this hive can be opened or shut at pleasure, by various simple contrivances; a sliding door is one. In the centre of the hive there is a valve. When the hive is full, and the honey is to be taken, a great noise is made at the inner extremity. This drives the bees out; the valve is then closed, and the honey is taken out by the sliding-door. The superior part of our readers will doubtless take a pleasure in communicating this easy mode of avoiding cruelty, to those whom the information might not otherwise reach.

To make Roses blow very late.

First, cut off the tops of the rose-trees immediately after they have done bearing, and then they will flower again in November; but they will not come just on the tops where they have been cut, but on the side shoots. Second, pull off the buds of the roses when they are newly knotted; for then the side branches will bear in the autumn: in both these cases the effect is the same, the sap is restrained for a time, and diverted into new channels. Third, lay the roots bare for some days, about Christmas; by this means the sap is stopped in its progress upwards. Cover the roots again with earth, and it will ascend, but slower and later. Fourth, gird the body or stem of the rose-tree with packthread, and that will restrain the sap from rising through the bark, which is full of sap-vessels, and cause it to leaf and flower late.

Method of Painting Japan Work.

Japan work ought properly to be painted with colours in varnish; though for the greater dispatch and in some very small works, for the freer use of the pencil, the colours are sometimes tempered in oil, which should previously have a fourth part of its weight of gum animi dissolved in it; or, in default of that, gum sandarach, or gum mastich. When the oil is thus used, it should be well diluted with oil of turpentine, that the colours may lay more evenly and thin, by which means, fewer of the polishing or upper coats of varnishing will be necessary. In some instances, water colours are laid on grounds of gold, in the manner of other paintings, and are best when so used in their proper appearance, without any varnish over them; and they are also sometimes so managed as to have the effect of embossed work. The colours employed in this way, for painting, are best prepared by means of isinglass size, corrected by honey or sugar-candy. The body of which the embossed work is raised, need not, however, be tinged with the exterior colour, but may be best formed of very strong gum water, thickened to a proper consistence by bole armenian and whiting in equal parts, which being laid on the proper figure, and repaired when dry, may be then painted the proper colours, tempered with the isinglass size, or in the usual manner, with shell-lac varnish.

Manner of Varnishing Japan-work.

The finishing of Japan-work lies in the laying on, and polishing the outer coats of varnish that are necessary, which is generally done with the best common seed lac varnish, which is thus applied:—The work to be varnished should be placed near a fire, and made perfectly dry; then the varnish rubbed over, beginning in the middle and passing to one end, again from the middle passing to the other, avoiding to go twice over the same place in forming one coat; when one coat is dry, lay on another, till you have a sufficient thickness to bear the polish, which must be done by rubbing it with a rag dipped in tripoli, or rotten-stone, finely powdered; but towards the end of the rubbing, a little oil of any kind should be used along with the powder; and when the work appears sufficiently bright and glossy, it should be well rubbed with the oil alone to clear it from the powder, and give it a still brighter lustre. In case of white grounds, fine putty or whiting must be used.

River Spectacles.

This useful instrument is a tube which may be varied in length as occasion requires. The diameter at top, where the eye is applied, is about an inch. There is a gradual enlargement of tube to the centre, where the diameter is ten times that of the other extremity. There is a glass at each end. The tube is intended to examine the bottoms of rivers, lakes, &c. The great reason why we cannot see with the naked eye through the water, is the effect of reflection and refraction at the moment light falls on the surface. This glass overcomes the difficulty of transporting the sight as it were to the dense centre of the water, where it takes advantage of the light in the water, and it is carried in a straight line, as it is in the air. To make use of this apparatus during the night, lights are placed all round the center of the cylinder, which are shorter as they descend to the base of the tube. These lights throw a strong light around, and enable the inspector to see distinctly the bottom of the river.

Preserving of Birds, &c.

Mr. Ternminck, director of the Dutch Museum, has for many years, made use of no other means of saving preserved birds and quadrupeds from the attacks of minute insects, than placing a small wooden basin, containing tallow, in each case, which he finds to be more effectual than either camphor or Russia leather.

Chinese Paints.

The peculiar beauty of Chinese drawings is owing, not to the particular nature of the colouring substances, but merely to their being mixed with glue or size, instead of gum-water, as is the common practice in Europe. In regard to the preparation, two things must be observed; first, that the beauty depends, in a very great measure, upon the fineness of its particles, the finest being always the most beautiful. A Chinese painter employs a man for three or four days to grind a small quantity of vermilion in a porcelain mortar, and it is from this they derive their fine reds. Secondly, it must be considered, that most mineral colours are prepared with acids, alkalies, or other salts, and that a small superabundance of those saline substances generally remains with them, which, after a longer or shorter time, produces considerable alteration in their brilliancy, and often entirely changes their colour. In order to obviate this inconvenience, the paint, after having been levigated, must be repeatedly washed in clean water: distilled water is the fittest. In order to effect this properly, put half an ounce of the paint in a half pint glass phial, and fill the rest of the phial almost entirely with water; shake it well: then let it stand for a while, and the coloured powder will soon fall to the bottom; then pour off the water, by inclining the phial gently, so as not to disturb the sediment, and fill it again with clean water, and so on for five or six times; after which, the colour being gently dried, must be ground a little longer, and then it is fit for use. The glue or size to be mixed with the paints is extracted from parchment in the following manner: —Take about four ounces of clean parchment, cut it into bits, and put it to soak in a quart of clean water for about twelve hours; then boil the whole on a gentle fire, and in the beginning take off the scum with a spoon. The vessel must remain always uncovered, and the liquor must be stirred occasionally.

After boiling about an hour, take off the pot from the fire, and strain the liquor while hot, through a coarse sieve. The liquor must be again put over the fire in a clean pot, and gently boiled till half is evaporated: the remainder is then spread very thinly upon panes of glass, which being kept in a warm place for a day or two, the size will dry, and become very hard. When it is wanted for use, put a small quantity of it in a cup of luke-warm water, and dip the hair pencil in it. The properties of this glue, which render it much superior to gum-water, are the following:—It does not deaden, nor otherwise alter the colours with which it is mixed: it does not crack like gum; and it becomes so soon hard, as not only to defend the colours from being affected by smoke and other vapours, but even to bear the surface of the drawing being cleaned by means of a wet sponge.

THE ART OF MAKING FIRE-WORKS.

Above all things it is necessary to have good materials, and that these be prepared in a proper manner, in order to execute any task combining so many ingenious contrivances as the making of fire-works undoubtedly require. The manufacture of your own gunpowder is not desirable, and therefore postpone the description of that art—you will no doubt buy the best; but as the admixture of charcoal is necessary, and much of your success depends upon having it good—observe that the less of *sap* there may be in the wood before it is made into charcoal, the better will be the gunpowder that is made with such charcoal. Dr. Watson made the discovery, and communicated the fact to his Majesty's Government, but the French and Germans were in the secret many years before, and always beat us at *long shot*. The wood is to be dried in an oven or *iron boiler*, with a slow fire, and the charcoal kept in close boxes from the influence of atmospheric air, until the moment of being brought to use.

How to meal Gunpowder, Brimstone, and Charcoal.

There have been many methods used to grind these ingredients to a powder for fireworks, such as large mortars and pestles made of ebony, and other hard woods; but none of these methods have proved so effectual and speedy as the new invention, of the *mealing table.* It is made of elm, with a rim round its edge, four or five inches high; and one end is a slider, which runs in a groove and forms part of the rim, so that when you have taken out of the table as much powder as you wish, with a copper shovel, you may sweep all clean out at the slider. When you are going to meal a quantity of powder, do not put too much on the table at once, but when you have put in a good proportion, take a muller and rub it therewith till all the grains are broke; then sift it in a lawn sieve, that has a receiver and top to it; and that which does not pass through the sieve, return again to the table and grind it more, till you have brought it all fine enough to go through the sieve. Brimstone and charcoal are ground in the same manner as gunpower, only the muller must be made of ebony, for these ingredients being harder than powder, would stick in the grain of the elm, and be very difficult to grind; and as the brimstone is apt to stick and clog to the table, it would be best to keep one for that purpose only, by which means you will always have your brimstone clean and well ground.

To make Touch-paper.

Dissolve in some spirits of wine or vinegar, a little saltpetre; 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 little above the mouth of the case not pasted; then prime the case with *meal powder*, and twist the paper to a point.

Of the vertical Scrole Wheel.

This wheel may be made of any diameter, but must be constructed thus:—Have a block of moderate size, into which fix four flat spokes, and on them fix a flat circular fell of wood. Round the front of this fell place port-first; then on the front of the spokes form a scrole either with a hoop or strong iron wire; on this scrole tie cases of brilliant fire, in proportion to the wheel, head to tail. When you fire this wheel, light the first case near the fell; then as the cases fire successively, you will see the circle of fire gradually diminish; but whether the illuminations on the fell begin with the scrole or not, is immaterial.

A slow Fire for Wheels,

Must be composed of saltpetre, four ounces; brimstone, two ounces; and meal powder, one ounce and a half.

A dead Fire for Wheels.

Saltpetre, one ounce and a quarter; brimstone, a quarter of an ounce; lapis-calaminaris, a quarter of an ounce; and antimony two drachms.

For a Blue Flame.

Meal powder, saltpetre, and sulphur vivum: the sulphur must be the chief part. Or, meal powder, saltpetre, brimstone, spirit of wine, and oil of spike, but let the powder be the principal part.

Of Port or Wild Fires.

Saltpetre, one pound two ounces; meal powder, one pound and a half; and brimstone, ten ounces. This composition must be moistened with one gill of linseed oil.

A Brilliant Fire.

Meal powder, six pounds; saltpetre, half a pound; brimstone, two ounces; and steel-dust, twelve ounces.

Of such Ingredients as show themselves in Sparks when rammed into choaked Cases.

The set colours of fire produced by sparks are divided into four sorts, viz. the black, white, grey, and red; the black charges are composed of two ingredients, which are meal powder and charcoal; the white of three, viz. saltpetre, sulphur, and charcoal; the grey of four, viz. meal powder, saltpetre, brimstone, and charcoal; and the red of three, viz. meal powder, charcoal, and saw-dust.

There are, besides these four regular or set charges, two others, which are distinguished by the names of compound and brilliant charges; the compound charge being made of many ingredients, such as meal powder, saltpetre, brimstone, charcoal, saw-dust, sea-coal, antimony, glass-dust, brass-dust, steel-filings, cast iron, tanners' dust, &c. or any thing that will yield sparks; all which must be managed with discretion. The brilliant fires are composed of meal powder, saltpetre, brimstone, and steel-dust; or with meal powder and steel filings only.

Of Saltpetre.

Saltpetre being the principal ingredient in fire-works, and a volatile body, by reason of its inflammable and ærial parts, is easily rarefied by fire; but not so soon when foul and gross, as when purified from its crude and earthy parts, which greatly retard its velocity; therefore when any quantity of fire-works is intended to be made, it would be necessary first to examine the saltpetre; for if it be not well cleansed from all impurities, and of a good sort, your works will not have their proper effect.

To Pulverize Saltpetre.

Take a copper kettle, the bottom being spherical, and put into it fourteen pounds of refined saltpetre, with two quarts or five pints of clean water; then put the kettle on a slow fire, and when the saltpetre is dissolved, if any impurities arise, skim them off, and keep constantly stirring it with two large sticks till all the water exhales. When done enough, it will appear like white sand, and as fine as flour; but if it should boil too fast, take the kettle off the fire, and set it on some wet sand, which will prevent the saltpetre from sticking to the kettle. When you have pulverized a quantity, be careful to keep it in a dry place, not exposed to the air.

To make Squibs and Serpents.

First make the cases, of about six inches in length, by rolling slips of stout cartridge paper three times round a roller, and pasting the last fold : tying it near the bottom as tight as possible, and making it air-tight at the end with sealing-wax. Then take of gun-powder 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 very 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.

To make Crackers.

Cut some stout cartridge paper into pieces, three inches and a half broad, and one foot long ; fold down one edge of each of these pieces lengthwise, about three quarters of an inch broad ; then fold the double edge down a quarter of an inch, and turn the single edge back half 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 and over till the paper is doubled up, rubbing it down 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.

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THE END.

WILLIAM MILNER, PRINTER, CHEAPSIDE, HALIFAX.

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DE, HALIFAX.