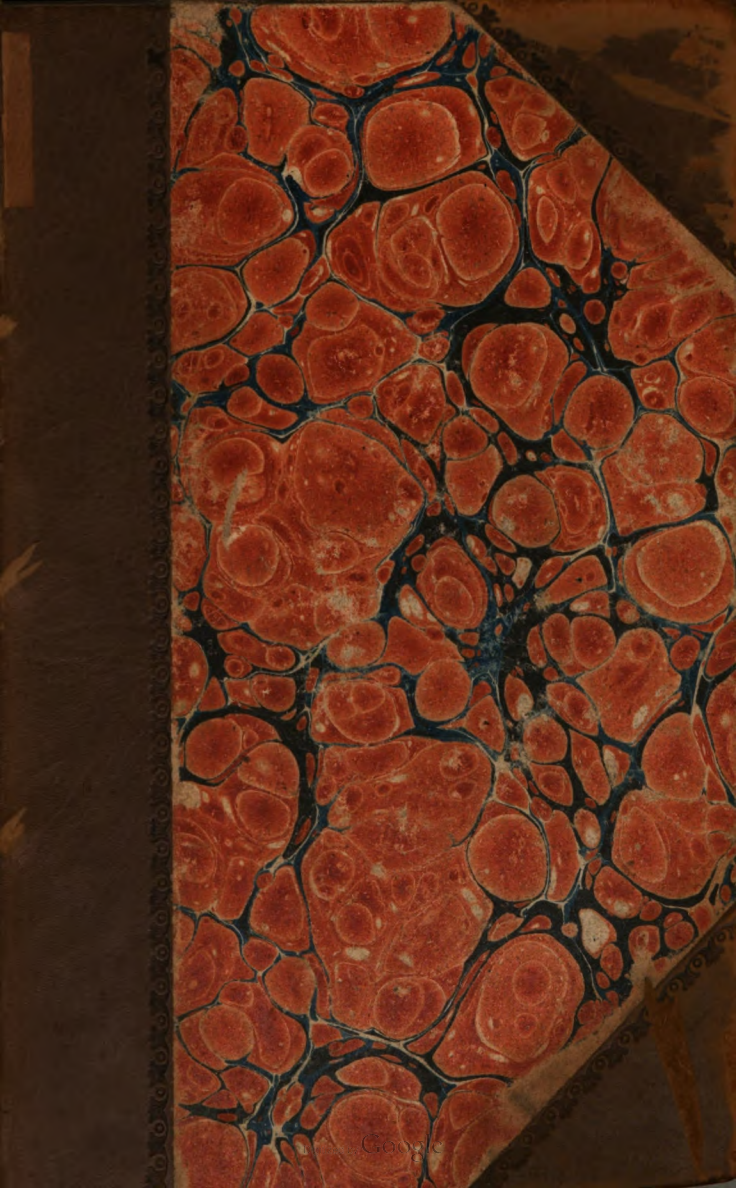


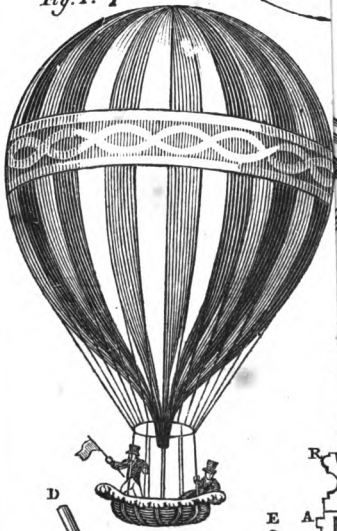


Fig. 1. p 136.

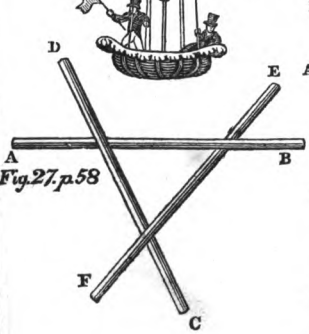
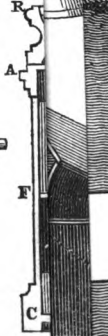


Fig. 27. p. 58



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ENDLESS

AMUSEMENT.

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.

Red Fire of the Theatres.

The beautiful red fire, which is now so frequently used in the theatres, is composed of the following ingredients: forty parts of dry nitrate of strontian, thirteen parts of finely powdered sulphur, five parts of chlorate of potash, and four parts of sulphuret of antimony. The chlorate of potash, and sulphuret of antimony, should

be powdered separately in a mortar, and then mixed together on paper; after which they may be added to the other ingredients, previously powdered and mixed.

Green Fire.

Green fire has long been a desideratum in pyrotechny, and when burned in a reflector, sheds a beautiful green light upon all surrounding objects. Take of flowers of sulphur thirteen parts, of nitrate of baryta seventy-seven, of oxymuriate of potassa five, of metallic arsenic two, of charcoal three. The nitrate of baryta should be well dried and powdered: it should then be mixed with the other ingredients, all finely pulverised, and the whole triturated until perfectly blended together. A little calamine may be occasionally added, in order to make the compound slower of combustion; and it is above all things requisite that the rubbing together of the materials should be continued until they are completely mixed.

Improved Copal Varnish.

It appears from actual experiment, that the solution of gum copal, in spirits of wine, or alcohol, an operation usually attended with considerable difficulty, may readily be performed by the following simple process. Dissolve one ounce of camphor, in a quart of alcohol; put it in a circular glass, and add eight ounces of copal in small pieces; set it in a sand heat, so regulated, that the bubbles may be counted, as they rise from the bottom, and continue the same heat, till the solution is completed. Camphor acts more powerfully upon copal than any substance yet tried. If copal be finely powdered, and a small quantity of dry camphor rubbed with it in the mortar, the whole becomes, in a few minutes, a tough coherent mass. The process above described will dissolve more copal than the menstruum will retain when cold; the most economical method will therefore be to set the vessel which contains

the solution by, for a few days, and when it is perfectly settled, to pour off the clear varnish, and leave the residuum for a future operation.

To illuminate the Surface of the Water.

Wet a lump 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.

Method of beautifully ornamenting Glass or Slate.

Spread on a plate of glass or smooth slate, a few drops of nitrate of silver, previously diluted with double its quantity of soft water; place at the bottom of it, flat upon the glass, and in contact with the fluid, a copper or zinc wire, bent to any figure, and let the whole remain undisturbed in a horizontal position. In a few hours a brilliant crystalization of metallic silver will make its appearance around the wire upon the glass, and this arrangement of crystals will extend gradually till the whole quantity of fluid has been acted on by the wire.

To preserve Fruit and Flowers the whole year, without spoiling.

Mix one pound of nitre with two pounds of bole ammoniac, and three pounds of clean common sand; then, in dry weather, take fruit of any sort, which is not fully

ripe, allowing the stalks to remain, and put them one by one into an open glass till it is quite full; cover the glass with oiled cloth tied closely down. Put it three or four inches down in the earth, in a dry cellar, and surround it on all sides to the depth of three or four inches with the above mixture. The fruit will thus be preserved quite fresh all the year round.

Perfumes, a Preventive against Mouldiness.

Dr. Mac Culloch, of Edinburgh, has published a paper, in which he points out that all essential oils possess the property of preventing the growth of mouldiness. Ink, leather, paste, and seeds, are among the common articles which suffer from this cause, and to which the remedy is easily applicable. With respect to articles of food, such as bread, cold meats, or dried fish, it is less easy to apply a remedy, on account of the taste. Cloves, however, and other spices, whose flavours are grateful, may sometimes be used for this end; and that they may act in consequence of this principle, and not by any particular antiseptic virtue, seems plain, by their preventing equally the growth of those minute plants on ink, and other substances not of an animal nature. He observes:

"The effect of cloves in preventing the mouldiness in ink, is indeed generally known: and it is obtained in the same way by oil of lavender, in a very minute quantity, or by any other of the perfumed oils. To preserve leather in the same manner from this effect, is a matter of great importance, particularly in military storehouses, where the labour employed in cleaning harness and shoes occasions considerable expense, and where much injury is occasionally sustained from this cause. The same essential oils answer the purpose, as far as I have had an opportunity of trying effectually. The cheapest of course, should be selected; and it would be necessary to try oil of turpentine for this reason. It is a remarkable confirmation of this circumstance, that

Russia leather, which is perfumed with the tar of the birch-tree, is not subject to mouldiness, as must be well known to all who possess books thus bound. They even prevent it from taking place in those books bound in calf, near to which they happen to lie. This fact is particularly well known to Russia merchants, as they suffer bales of this article to lie in the London Docks in the most careless manner, for a great length of time, knowing well that they can sustain no injury of this nature from dampness, whereas common curried leather requires to be opened, cleaned, and ventilated. Collectors of books will not be sorry to learn, that a few drops of any perfumed oil will ensure their libraries from this pest." Dr. M. began some experiments with the same agents on wood, to prevent the dry rot, but not having time to carry them on, he recommends the important investigation to others. With regard to paste, he prefers rosin to alum as a preservative; but lavender, or any other strong perfume, such as peppermint, anise, bergamot, are perfectly effectual for years, however the paste be composed. That which the Dr. himself employs in labelling, &c. is made of flour in the usual way, but rather thick, with a proportion of brown sugar, and a small quantity of corrosive sublimate. The use of the sugar is to keep it flexible, so as to prevent its scaling off from smooth surfaces: and that of the corrosive sublimate, independently of preserving it from insects, is an effectual check against its fermentation. This salt, however, does not prevent the formation of mouldiness. But as a drop or two of the essential oils above mentioned is a complete security againt this, all the causes of destruction are effectually guarded against. Paste made in this manner, and exposed to the air, dries without change to a state resembling horn; so that it may at any time be wetted again, and applied to use. When left in a close covered pot, it may be preserved in a state for use at all times. This principle seems also applicable to the preservation of seeds, particularly in cases where they are sent from distant countries by sea, when, it is well known, they often perish from this cause. Dampness, of course, will perform its office at any rate, if moisture

is not excluded; yet it is certain, that the growth of the vegetables which constitute mouldiness, accelerate the evil; whether by retaining moisture, or by what means, is very apparent. This, in fact, happens equally in the case of dry rot in wood, and indeed in all others where this cause operates. It is a curious illustration of the truth of this view of a remedy, that the aromatic seeds of all kinds are not subject to mouldiness, and that their vicinity prevents it in others with which they are packed. They also produce the same effect daily, even in animal matters, without its being suspected. Not to repeat any thing on the subject of cookery, we need only remark, that it is common to put pepper into collections of insects or birds, without its having been remarked, that it had the same power of keeping off mould, as of discouraging or killing the *ptinna omnivorus*, or other insects that commit ravages in these cases.

Method of giving a fine Black Colour to Wood.

Steep the wood for two or three days in lukewarm water, in which a little alum has been dissolved; then put a handful of logwood, cut small into a pint of water, and boil it down to less than half a pint. If you then add a little indigo, the colour will be more beautiful. Spread a layer of this liquor quite hot on your wood, with a pencil, which will give it a violet colour. When it is dry, spread on another layer; dry it again, and give it a third; then boil verdigris at discretion, in its own vinegar, and spread a layer of it on the wood; when it is dry, rub it with a brush, and then with oiled chamois skin. This gives a fine black, and imitates perfectly the colour of ebony.

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.

Test of Poison in Confectionery.

Many of the preparations of sugar and flour are coloured with red lead, and preparations of copper and pipe-clay are sometimes employed.

The presence of red lead may be detected by pouring a little water, saturated with sulphuretted hydrogen gas, on the article. If it contain lead, the liquid will become of a blackish colour. Copper may be discovered by pouring on it liquid ammonia, which soon acquires a blue colour, if this metal be present. Clay may be detected in articles composed of sugar, such as comfits, by dissolving them in a large quantity of boiling water, and letting the mixture stand for twenty-four hours; if clay be present it will fall to the bottom, and when the clear liquid is poured off, it may be had in a separate state: expose it to a strong heat, and if it contract and become hard, the adulteration with clay is proved.

Luminous Characters on Walls coated with Lime.

Take a piece of phosphorus from the bottle in which it is kept, and, during candle-light, write upon a white-washed wall, any sentence or word; or draw any figure, according to fancy. Withdraw the candle from the room, and direct the attention of the spectators to the writing. Whatever part the phosphorus has touched,

will be rendered quite luminous, emitting a whitish smoke or vapour. Care must be taken, whilst using the pencil of phosphorus, to dip it frequently in a basin of cold water; or the repeated friction will throw it into a state of the most active combustion, to the manifest detriment of the operator.

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.

Fulminating Powder.

Mix together one dram of sulphur, three drams of nitrate of potass, and two drams 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, or 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.

(See also Endless Amusement, First Series, p. 34.)

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.

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.

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.

To make a Room seem on Fire.

(See also Endless Amusement, First Series, p. 88.)

Take half an ounce of sal ammoniac, one ounce of camphor, and two ounces of aqua vitæ; put them into an earthen vessel, which is small at the top; then set fire to the contents, and the room will appear very strongly to be on fire.

Imitative Medallions.

Medallions, after the antique, cameos and intaglios, are made by fusing the iron with a small quantity of an-

timony, performing the operation in a very small furnace. When finished from the mould, rub them over with burnt porcelain earth, from which they will receive the rich hue of jet; rendering them fit to be set, even in gold.

Easy method of gilding Steel.

Immerse a piece of highly polished steel, in a solution of nitro-muriate of 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.

A Green Colour extracted from Coffee-Berries.

At Venice a method has been lately discovered for composing a fine unchangeable emerald-green colour. A certain quantity of coffee is boiled in river-water; spoiled coffee *(café avarié)* is preferable. By means of a proportional quantity of pure soda, a green precipitate is obtained, which is suffered to dry for six or seven days, upon polished marble, stirring it about occasionally, in order that every part of it may be in contact with atmospheric air, from which it receives a new vivacity of tint. The green lake obtained by this process has resisted the action of the acids, and even the influence of light and moisture.

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 (India 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.

Cement for Glass, &c.

It has been erroneously stated that India rubber will make good glue: it will never set or harden. For a strong, firm, cheap glue, nothing has yet been discovered superior to the best kind of that which is in general use; and for a fine, clear, and transparent kind, which will even unite glass so as to render the fracture almost imperceptible, nothing is equal to isinglass boiled in spirits of wine.

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 crystalize in small flat octoledrons, 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 halo, 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 halo, which is more coloured, with the blue rays outwards, is formed by a pair of faces more inclined; and the third halo, which is very large and highly 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 halo 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 crystalizing 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 Moiré Métallique to Tin-Foil.

All leaves of beaten tin are susceptible of crytalizing, 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 become 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 crystalization 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 *moiré*. The ground will be in grains, in a natural crystalization. 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. Afterward we may follow the same process between them. By running leaves of tin upon fine cambric, or upon stone, different *moirés* 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 *moiré* 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 rince 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 obtain very large ornamental Crystals.

To obtain large artificial crystals of a regular shape, requires considerable address, and much patient attention; but the result fully recompenses the trouble. The method of M. Leblanc is as follows:—The salt to be crystalized is to be dissolved in water, and evaporated to such a consistency that it shall crystalize on cooling. Set it by, and when quite cold, pour the liquid part off

the mass of crystals at the bottom, and put it into a flat-bottomed vessel. Solitary crystals form at some distance from each other, and these may be observed gradually increasing. Pick out the most regular of these, put them into a flat-bottomed vessel at some distance from each other, and pour over them a quantity of liquid obtained in the same way, by evaporating a solution of the salt, till it crystalizes on cooling. Alter the position of every crystal, once at least every day, with a glass rod, that all the faces may be alternately exposed to the action of the liquid; for the face on which the crystal rests, never receives any increase. By this process, the crystals gradually increase in size. When they have acquired such a magnitude that their forms can easily be distinguished, the most regular are to be chosen, or those which have the exact shape which we wish to obtain; and each of them is to be put separately into a vessel filled with a portion of the same liquid, and turned in the same manner several times a day. By this treatment, they may be obtained of almost any size we think proper. Whenever it is observed that the angles and edges of the crystal become blunted, the liquid must immediately be poured off, and a portion of new liquid put in its place; otherwse the crystal is infallibly destroyed.

Beautiful Star-like Crystals.

Pour three ounces of diluted nitric acid into a glass vessel, and add gradually to it two ounces of bismuth, broken by a hammer into small pieces. The metal will be attacked with great energy, and nitrate of bismuth will be formed. Crystalize the solution by a gentle heat, and preserve the crystals, which possess great beauty, under a glass.

Distillation of Sea Water.

A most successful experiment on this subject was lately tried on board the Aguilar, lying in the London Docks. The apparatus consists of a fire-place in

front, having underneath a large oven. In the upper part is a tank, into which the sea-water is put; and well fitted over this are two coppers for boiling broth or meat. Between this tank and the oven below, the flame of fire is carried with great but equal strength to the flue behind; from which, however, but little smoke is discharged, the apparatus acting as an almost perfect fumivore. From the tank proceeds a bent tube, which conducts the steam into the refrigeratory, where it is condensed into a quadrangular box, which is hollow in the middle: this box is surrounded by another tank, into which cold salt water is poured, which, when heated, is let in by a pipe and cock to the tank below the cooking coppers, there to be converted into steam, and condensed as before mentioned. With this apparatus a piece of beef was roasted in the oven; about 3½ gallons of excellent soup made, where only two gallons of water had originally been put in; a leg of mutton boiled, with turnips, in a copper, into which not a drop of water had been poured; a quantity of pure fresh, almost tasteless, water produced, equal to a quart of beer measure, in the short space of five minutes.

Silver Tree.

The method of forming this beautiful precipitation of silver, was originally given by Lemery:—Dissolve one part of silver in dilute nitric acid; dilute the solution with twenty parts of distilled water, and add to it two parts of mercury. This process requires about forty days for the formation of the metallic tree. Homberg gives a shorter process. It consists in making an amalgam in the cold, of four parts of silver leaf and two of mercury. This amalgam is to be dissolved in a sufficient quantity of nitric acid, and the solution to be diluted with water equal to thirty-two times the weight of the metal employed. By introducing into this liquid a lump of soft amalgam of silver, the formation of the tree speedily

takes place. It may be formed, also, by putting a soft amalgam of silver into six parts of a solution of nitrate of silver, and four of a solution of nitrate of mercury.

Easy Method of extinguishing Fire.

A new mode of extinguishing fire in chimneys by throwing sulphur on the fire below, has been tried with great success, and recent experiments have fully confirmed the valuable result of the method, which is in fact perfectly consonant with the received theory of combustion; only, the person using it must take care not to throw on too large a quantity of sulphur, otherwise he might be exposed to inhale the noxious effluvia, which destroy animal life on the same principle that they extinguish fire.

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 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.

Beautiful Compound for Ornamental Medallions, &c.

Put into a crucible an ounce of copper, and an ounce of antimony; fuse them by a strong heat, and pour the alloy into a mould. The compound will be very hard and of a most beautiful violet hue; and admirably adapted for works of taste, as medallions, seals, &c.

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 silversmith's to be made into tea-spoons. Give one to a stranger to stir his tea, as soon as it is poured from the teapot; he will not be a little surprised to find it melt in his tea-cup.

Alloy for varnishing Figures.

Fuse half an ounce of tin with the same quantity of bismuth in a crucible; when melted, add half an ounce of mercury. When perfectly combined, take the mixture from the fire and cool it. This substance mixed with the white of an egg forms a beautiful varnish, for plaster figures, &c.

Sympathetic Ink.

(See also Endless Amusement, First Series, p. 22)

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 or the cobalt which comunicates 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.

With the above 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.

Another Sympathetic Ink.

Write with the nitro-muriate of gold, and brush the letters over with muriate of tin in a diluted state. The writing, before invisible, will now appear of an exquisitely beautiful purple colour.

To ascertain if Linen be bleached with Lime.

Every body knows the injury which is done to linen by bleaching it with lime. It is easy to detect linens which have been so bleached, in the following manner:—Cut off a piece of the new linen which you wish to examine, put it into a glass, and pour upon it several spoonfuls of good vinegar. If the linen contain lime, the acid will excite considerable effervescence, accompanied with a slight noise. Otherwise no effect is produced.

Brilliant Experiment with Platina.

Platina, (the heaviest of all elementary substances) when reduced into very small particles, produces, by simple contact with hydrogen gas, (the lightest of elementary substances,) an electrical or dynamic combination, which if brought into contact with hydrogen gas or with atmospheric air, instantly dissolves itself, yielding fire and water. To prove this important fact by a brilliant experiment, the hydrogen gas is made to pass from a reservoir, by a capillary tube, curved below, upon pure platina in powder, which is contained in a glass tunnel, hermetically sealed at the point, so that the gas mingles with the air before it touches the platina. The moment that the current of gas reaches the surface of the platina, the powder of that metal becomes red and burning, and this phenomenon continues as long as the stream of gas is directed upon it.

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.

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

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.

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 eva-

poration 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 crystalization, 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.

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.

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.

Dr. Wollaston's Ice Apparatus.

(See Frontispiece, Fig. 12.)

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, of the shape of figure 12. 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 forceps, 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 shew.

Easy method of Silvering Ivory.

Prepare a dilute 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 be-

come 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 Crystalization.

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-shaped 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 solidity, was decanted from the crystalized 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.

Method of Gilding Ivory, very easy.

Put the figure you intend to gild into a solution of sulphate of iron, and then a solution of nitro-muriate of gold. On withdrawing it from the latter, it will be covered with metallic gold.

Bronze for casting Busts, &c.

Melt in a clean crucible seven ounces of pure copper: when fused, throw into it three ounces of zinc, and two

ounces of tin. These metals will combine, forming bronze, an alloy which, from the exactness of the impression which it takes from a mould, has, in ancient and modern times, been generally used in the formation of busts, medals, and statues.

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.

To prepare Fulminating Silver.

Dissolve pure silver in nitric acid, 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.

A Metallic Tree, which may be removed from the Vessel in which it is formed.

Mix together equal parts of saturated solutions of silver and mercury in nitric acid, diluted with a little water; in this mixture suspend five or six drams of pure mercury contained in a piece of fine linen rag doubled. The metallic solutions will soon penetrate to the mercury inclosed in the cloth, and clusters of beautiful needle-shaped crystals will begin to be formed round it, and adhere to the nucleus of mercury. When the arbonization ceases to increase, the bag loaded with beautiful crystals may be taken out of the vessel where it was formed, by means of the thread by which it is suspended, and hung under a glass jar, where it may be preserved as long as may be thought proper.

Vivid Green coloured Fire under Water.

Put into an ale glass two ounces of water, and add first a piece or two of phosphorus, of about the size of a pea, and then thirty or forty grains of chlorate of potash. This being done, pour upon the mass, by means of a tube or funnel with a long neck reaching to the bottom of the glass, five or six drams (by measure) of sulphuric acid. As soon as the acid comes into contact with the materials, flashes of fire begin to dart from under the surface of the fluid. When this takes place

drop into the mixture a few lumps (not powder) of phosphuret of lime, equal in size to a large pea. This will instantly illuminate the bottom of the vessel, and cause a stream of fire, of an emerald green colour, to pass through the fluid. By a fresh addition of the same materials, the action may be kept up when it begins to subside.

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, or soda, and, upon stirring it, a fine green colour will be produced.

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 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 small crystal, or a drop of the solution of prussiate of potash be added, the water will become a dark brown colour.

To convert a 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.

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.

Freezing Mixtures.

Mix seven drams of snow, with four drams of diluted nitric acid. If the thermometer be at +32°, it will fall to—30°, being 62 degrees lower than the freezing point of water.

Another.

Mix four drams of snow, with five drams of muriate of lime: the thermometer will sink from +32° to—40°, being 72 degrees. This mixture will freeze mercury.

Another.

A mixture of five drams of sulphate of soda, and four drams of diluted sulphuric acid, will lower the temperature of the thermometer 47 degrees, that is from +50° to +3°.

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 of the size of a peppercorn; 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 procure Nitrous Oxide, or Laughing Gas.

Take two or three ounces of nitrate of ammonia in crystals, and put 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. This 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.

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.

New Dye.

A chemist of Copenhagen has discovered a means of producing a lively yellow colour for dying cloth. He

gathers the tops of the potatoes when ready to flower, presses the juice, mixes it with more or less water, and suffers the cloth to remain in it during twenty-four hours. He then dips it in spring water. The cloth may be either of wool, silk, cotton, or flax. By plunging the cloth thus tinged with yellow, into a vessel of blue, a brilliant and lasting green is obtained.

Instantaneous Light.

The contents of the fire-boxes usually sold in the chemists' shops, consist of matches dipped in a mixture of chlorate of potass (rubbed with a little mucilage of gum arabic and white sugar in a marble mortar), and a bottle of sulphuric acid. On the insertion of the match in the acid it is instantly lighted.

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.

Distillation of Coal.

It is one of the important results of chemical science, that the various products from the distillation of coal, amount to nearly six times the price of the original article. A chaldron of Newcastle coals, which costs in London £3, will produce

1½ chaldrons of coke, at 31*s*	1	18	9
12 gallons of tar, at 10*d*	0	10	0
18 gallons of ammonial liquor, at 6*d* ..	0	9	0
20,000 cubic feet of gas, at 15*s* per 1000 cubic feet.....	15	0	0
	£17	17	9

Experiments on 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 small 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 became 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 chloride 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 tubes opposite to that part whence the wind is to come.

To cause Fruit and Flowers to grow in the Winter.

Take up the trees on which the fruit grows by the roots, in the spring, just as they put forth their buds, taking care to preserve some of their own earth about the roots. Set them, standing upright, in a cellar till the middle of September, and put them into vessels with an addition of earth, then bring them into a stove, taking care to moisten the earth around them every morning with rain water, in a quart of which dissolve the size of a walnut of sal-ammoniac, and about the middle of March, the fruit will appear.

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.

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 where the style has passed. The person who receives the letter may easily render it legible by sprinking over it a little coloured dust, or some pounded charcoal well sifted.

Method of employing the above for tracing out all sorts of Figures.

Mix with the above composition some very fine lamp-black, and rub it gently over a piece of very fine thin paper; then wipe it carefully, so that when laid upon a sheet of white paper, and pressed down gently with the hand, no stain may remain upon the latter. Having laid over this black the print which you wish to copy, and placed the white paper below it, by employing a style, you may transfer all the outlines of the print to the latter paper. Flowers also may be painted by those ignorant of drawing, by tracing the outlines in the above manner, and laying the proper colours very lightly on.

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 pencilling will assume a beautiful metallic brilliance.

Crystalization 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 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 crystalization 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.

Combination of Fire and Water.

Place a piece of camphor, or a few fragments, in any convenient situation, such as the bottom of a glass, and lay a piece of coiled or pressed up platina wire, heated, upon it; the Platina will glow brilliantly as long as any camphor remains, and frequently light up into a flame.

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 Dr. 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 liquor 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.

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 18s. or 20s. 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.

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.

To produce Heat and Flame by throwing a Solid into a Liquid.

Take a few grains of oxymuriate of potash, and one or two very small pieces of phosphorus, and throw them into a cup or saucer containing a little sulphuric acid, and the phosphorus will instantly burst into a flame.

To produce Heat and Flame by dropping a Solid on Water or Ice.

Procure some potassium, and let a very small piece of it fall into a basin of cold water, or upon a piece of

ice, and it will immediately burst into flame, and burn with great brilliancy.

To exhibit the Expansion of Iron by Heat.

Take a small rod of iron, of such a length when cold, as to be included between two points, and of such a diameter as barely to allow it to pass through an iron ring. When strongly heated, it will have become sensibly longer, and will be incapable of passing through the ring. The degree of expansion is not the same in the different metals. The following is the order of their expansibility:—Zinc, lead, tin, copper, bismuth, iron, steel, antimony, platinum.

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.

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.

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.

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.

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.

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 Mr. Braconnot, 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 all 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.

Rosin Bubbles, a curious Experiment.

We can recommend to the attention of our readers the following simple and curious experiment: we have not tried it ourselves, but have no doubt of its success. It is an extract of a letter from Mr. Morey, of Oxford, New Hampshire, to Dr. Silliman, the editor of the American *Journal of Science and Arts.* If the end of a copper tube, or of a tobacco-pipe be dipped in melted rosin, at a temperature a little above that of boiling water, taken out and held nearly in a vertical position, and blown through, bubbles will be formed of all possible sizes, from that of a hen's egg down to sizes which can hardly be discerned by the naked eye; and from their silvery lustre, and reflection of the different rays of light, they have a pleasing appearance. Some, that have been formed these eight

months, are as perfect as when first made. They generally assume the form of a string of beads, many of them perfectly regular, and connected by a very fine fibre; but the production is never twice alike. If expanded by hydrogen gas, they would probably occupy the upper part of the room. The *formation* of these bubbles is ascribed to the common cause, viz. the distention of a viscous fluid by one that is aëriform; and their *permanency*, to the sudden congelation of the rosin, thus imprisoning the air by a thin film of solid matter, and preventing its escape."

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 rotary 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.

Incombustible Cloth.

M. Gay Lussac has proposed a means of rendering the various tissues of cloths, stuffs, &c. incombustible; and the means he recommends appear superior to those which as yet have been proposed. That the combustibility of these substances is diminished by their having been immersed in solution of certain salts, as of alum, muriate of soda, &c. has been long known. M. Gay Lussac considered that those salts should possess this property most eminently which entered most readily into fusion, being enabled by that means to cover perfectly the fibre of the substances, and preserve them from the contact of the air. Guided by this thought, he substituted phosphate of ammonia and borate of soda for alum, &c. and he found that muslins thus treated could be placed in contact with ignited bodies without danger. They were carbonized, but would not inflame.

Method of producing Light by Friction, even under Water.

Rub two pieces of fine lump sugar together in the dark; the effect is produced, but in a much greater degree, by two pieces of silex or quartz: but that which affords the strongest light of any thing is a white quartz from the Land's End, considerable quantities of which are brought to Bristol, and enter into the composition of china ware. By means of two pieces of such quartz, pretty forcibly rubbed together, you may distinguish the time of the night by a watch: but what is more surprising, the same effect is produced equally strong on rubbing the pieces of quartz together under water.

Recipe for destroying Flies.

To one pint of milk add a quarter of a pound of raw sugar, and two ounces of ground pepper, simmer the

same together eight or ten minutes, and place it about in shallow vessels; the flies attack it greedily, and in a few moments are suffocated. By this method, kitchens, &c. may be kept clear of flies all summer, without the danger attending poison.

Spiders the best Barometer.

The manner in which the spiders carry on their operations, comformably to the impending changes of the atmosphere, is simply this:—If the weather is likely to become rainy, windy, or in other respects disagreeable, they fix the terminating filaments, on which the whole web is suspended, unusually short; and in this state they await the influence of a temperature which is remarkably variable. On the contrary, if the terminating filaments are made uncommonly long, we may, in proportion to their length, conclude that the weather will be serene, and continue so at least for ten or twelve days. But if the spiders be totally indolent, rain generally succeeds; though, on the other hand, their activity during rain is the most certain proof that it will be only of short duration, and followed with fair and very constant weather. According to further observations, the spiders regularly make some alterations in their webs or nets every twenty-four hours; if these changes take place between the hours of six and seven in the evening, they indicate a clear and pleasant night.

Preserving Power of the Pyroligneous Acid.

In the *Edinburgh Philosophical Journal*, some curious experiments relative to the antiseptic power of pyroligneous acid are detailed by Mr. Ramsey. The following are some of the principal results: A number of haddocks were cleaned, split, and slightly sprinkled with salt, for six hours; then being drained, they were dipped for about three seconds in pyroligneous acid, and

hung in the shade for eight days. On being broiled, they were of an uncommonly fine flavour, deliciously white, and equal to the highly-esteemed Finnan haddock. Herrings were cured in the same way as the haddocks. After being dried in the shade for two months, they were equal in quality and flavour to the best red herrings. The fish retained the shining and fresh appearance they had when taken from the sea. A piece of fresh beef was dipped for one minute in pyroligneous acid of specific gravity 1012, in July, 1819. On March 4, 1820, it was as free from taint as when first immersed. No salt was used in this experiment. A piece of beef was dipped at the same time in pure vinegar, of specific gravity 1009. It was perfectly free from taint on the 18th of November. This experiment indicates antiseptic powers in pure vinegar; some haddocks were cured with it, which remained free from taint, but when cooked had an insipid taste. When beef is partially salted, and then steeped for a short time in the pyroligneous acid after being drained and cooked, it has the same flavour as Hamburgh beef. Mr. Ramsey has no doubt, that with proper modifications, the use of the acid may be extended to the preservation of every species of animal food. The *Journal of Science and the Arts* states, that the experiments relating to the haddocks had been repeated with entire success in London, by Mr. Stodart.

Metallic Vegetation.

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

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 inth e garden, and next day the caterpillars had universally taken to them for shelter. In this way thousands were destroyed every morning.

To Bronze Plaster Figures.

The figure is to be first painted dark green, then lay it over with isinglass-size, until no part of its surface becomes dry, then with a brush, technically termed 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 very little 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 in a dry place, free from smoke, and in two days the figure is fit to receive the bronze, which is an almost impalpable powder, to be had at the colour shops, and is to be dabbed on with a piece of cotton wool. Having touched over the whole figure, let it stand a day, then with a soft, dry brush, rub off all the loose powder, particularly from the more prominent parts; it will then resemble the metal intended, and resist all injury from weather.

To arrange three Sticks that shall support each other in the Air.

Take a stick A, B, (Fig. 12) and rest the end A on the table, holding the other raised up, so that the stick shall be inclined to a very acute angle. Place above it

the second stick, with the end C resting on the table; and then dispose the third stick E, F, in such a manner, that while the end E rests on the table, it shall pass below the stick A, B, towards the upper end B, and rest on the stick C, D. These three sticks, by this arrangement, will be so connected with each other, that the ends D, B, and F, will necessarily remain suspended, each supporting the other.

To make the end of a Candle pierce a Board.

Load a musket with powder, and instead of a ball, put in the end of a candle; if you then fire it against a board, not very thick, the latter will be pierced by the candle end, as if by a ball. The rapid motion with which the candle-end is impelled, does not allow it time to be flattened, and therefore it acts as a hard body

Method of rendering Glass less brittle.

Let the glass vessel be put into a vessel of cold water, and let this water be heated boiling hot, and then allowed to cool slowly of itself, without taking out the glass. Glasses treated in this way may, while cold, be suddenly filled with boiling hot water, without any risk of their cracking. If the glasses are to be exposed to a higher temperature than that of boiling water, boil them in oil.

Animated Fire.

When small pieces of camphor are placed in a basin of pure water, a very peculiar motion commences, some of the pieces turn as if on an axis, others go steadily round the vessel, some seem to be pursuing others, and thus they continue forming a very curious and pleasing appearance; but if a single drop of sulphuric acid be

put into the water, the motion of the camphor instantly stops. If a piece of camphor be lighted, and then carefully placed on the water, it burns with a bright flame, moving about with great rapidity, as if in search of something, but is instantly stopped by a drop of sulphuric acid.

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.

Counterfeit Money.

The specific gravity of metals forms the chief characteristic of their value, when hardness is combined with that quality. Take an unsuspected piece of money

of the same denomination as the doubtful one, and having fastened each with thread, or a horse hair, to a pair of small scales, drop the two pieces in a vessel full of water; and if both are of the same quality, they will stand at a balance; if not so, the lightest is made of the basest metal. The comparison of silver, with lead, however, would be at variance with this otherwise unerring test; but then the sound, the feel, and indeed the smell of lead, are so entirely different from silver, as to confirm the gooness of our test, when so combined with those other sensible qualities.

Curious Method of forming Pictures.

Cover white paper, or leather, with a solution of nitrate of silver, and place it behind a painting on glass, which is exposed to the rays of the sun. The rays that come through will blacken the paper; the shades will be more or less deep, in proportion to the quantities of light transmitted through the different parts of the glass. Where the glass is transparent, and all the light comes through, the paper will be quite black; where the glass is quite opaque, and does not transmit any light, the paper will be quite white; and there will be degrees of intensity of the shadow, of every variety between these. The picture is not sensibly affected by the light of candles or lamps; but day-light destroys it very soon, causing all the paper to become black.

The Fiery Flash.

Pour iron filings upon the flame of a candle, from a sheet of paper, about eight or ten inches above it: as they descend in the flame, they will enter into a very vivid scintillating combustion.

To make a Pyramid move upon a Table, without artificial means.

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

To make a Peg that will exactly fit three different kinds of Holes.

Make one of the holes circular, the other square, and the third oval; a 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 fit it as exactly as any of the former.

Art of Gilding Writings, Drawings, &c. on Paper and Parchment.

Letters written on vellum or paper are gilded in three ways; in the first, a little size is mixed with the ink, and the letters are written as usual; when they are dry, a slight degree of stickiness is produced by breathing upon them, upon which the gold leaf is immediately applied; and by a little pressure may be made to adhere with sufficient firmness. In the second method, some white lead or chalk is ground up with strong size, and

the letters are made with this by means of a brush; when the mixture is almost dry, the gold leaf may be laid on, and afterwards burnished. The last method is to mix up some gold powder with size, and to form the letters of this by means of a brush. It is supposed that this latter method was that used by the monks in illuminating their missals, &c.

To roast Coffee in an improved manner.

Take about half a pound of coffee, and put it into a Florence flask, in the mouth of which insert a cork with a slit cut in its side to allow the escape of the vapour, then expose the flask to the heat of a chaffing-dish of coals; support the flask in a horizontal position by its neck, and gradually turn it round till the coffee is roasted.

To cause one Hand to feel cold, and the other hot, when immersed in the same Liquid.

Procure three basins, and put water of the temperature of thirty-three degrees into one basin, of fifty degrees into another, and of a hundred degrees into the third; then plunge one hand into the water of thirty-three degrees, and the other into that of a hundred degrees; and when they have both remained a few seconds, withdraw them, and plunge both hands into the water of fifty degrees; the one which was before in warm water will now feel cold, and the one that was in the cold water will feel warm.

To silver the Backs of Looking Glasses.

Take a sheet of tin-foil, and spread it upon a table, then rub mercury upon it with a hare's foot till the two metals incorporate. Lay the plate of glass upon it, and load it with weights, which will have the effect of press-

ing out the excess of mercury that was applied to the tin-foil. In a few hours the tin-foil will adhere to the glass and convert it into a mirror. About two ounces of mercury are sufficient for covering three square feet of glass.

To gild the Edges of Writing-paper, or Leaves of Books.

Screw a quantity of the pages strongly into a press, after being cut as smooth as possible. Size them with isinglass-glue, mixed up with spirits of wine, and then apply the gold leaves when the size arrives at a proper degree of dryness.

M. Rieusseo's Chronograph.

This chronograph has 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, this 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 metalic 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 rotary 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 pres-

sure 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 Ferrara, 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 canvas; 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 pannels. 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 pannels, 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 pannel, and

again drawn from this, so that the painting itself remains fixed upon the pannel without sustaining the smallest injury.

Glass from Straw.

Wheat straw, without any addition, may be melted into colourless glass with the blow-pipe. Barley-straw melts into a glass of a topaz yellow colour.

To hold a Stick upright on the Tip of the Finger, without its being able to fall.

Affix two knives to the extremity of the stick, in such a manner that one of them may incline to one side, the second on the other: if this extremity be placed on the tip of the finger, the stick will keep itself upright, without falling; and if it be made to incline, it will raise itself again, and recover its former situation.

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 a 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.

Method of Moulding Tortoise-shell or Horn.

Put six pints of water into a kettle; add to it an ounce of olive or other oil; make the water boil; then put in the tortoise-shell or horn, and it will become soft. Take it out, and put it into a mould under a press, and it will take the figure you want. This must be done quickly; for if it cools ever so little, the process will fail. It will not require much pressure.

The Magic Cask.

To construct a cask into which if three different kinds of liquor be poured, they shall be drawn off at pleasure by the same cock, without being mixed:—The cask must be divided into three partitions, A, B, C, (see frontispiece, fig. 11) intended to contain the three different liquors, such as red wine, white wine, and water; which may be introduced each into its proper partition, by the same bung, in the following manner: in constructing the cask, a funnel D, with three pipes E, F, G, each conveyed into its partition, must be fitted with the bung; and within this funnel must be placed another, H, pierced with three holes, which may be made to correspond with the apertures of each pipe. If each hole, in the interior funnel H, be made to correspond, in succession, by turning it with the aperture of the pipe to which it belongs, the liquor poured into the funnel H, will pass into that pipe. In this manner each partition may be filled with the liquor intended for it, without their being able to mix; because, when one pipe is open, the other two are shut. But to draw off each liquor also, without confusion, at the bottom of the cask, there must be three other pipes K, L, M, each corresponding to a partition, and a kind of cock I, N, pierced with three holes, each corresponding to its pipe, that by turning the stopper of the cock I, until one of these holes is brought opposite to its pipe, the liquor of the partition, to which that pipe belongs, will issue alone through it.

Rice Glue.

An elegant cement may be made from rice-flour, which is at present used for that purpose in China and Japan. It is only necessary to mix the rice-flour intimately with cold water, and gently simmer it over the fire, when it readily forms a delicate and durable cement, not only answering all the purposes of common paste, but admirably adapted for joining together paper, card, &c. in forming the various beautiful and tasteful ornaments which afford so much employment and amusement to the ladies. When made of the consistence of plastic clay, models, busts, basso-relievos, &c. may be formed; and the articles, when dry, are susceptible of a high polish, and are very durable.

Cement.

The following is a very excellent cement for the use of turners and artisans in general:—Sixteen parts of whiting are to be finely powdered and heated to redness, to drive off all the water. When cold, it is to be mixed with sixteen parts of black resin, and one part of bees-wax; the latter having been previously melted together, and the whole stirred till of an uniform consistence.

To give Plaster Figures the appearance of Marble.

Put into four pounds of clear water, one ounce of pure card-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' times, stir the compost, and

dip it a second time, and this generally suffices. Cover it carefully from the dust for a week; then with soft muslin rag, or cotton wool, rub the figure gently, when a most brilliant gloss will be produced.

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.

Artificial Roses.

The most beautiful artificial roses are formed of the thin pellicle which lies between the shell and the white of eggs. This very delicate substance is so thin and pliable, that it represents admirably the velvet of the rosa centifolia.

Comparative Nutritive Properties of Food.

A very interesting report on this subject was lately presented to the French Minister of the Interior, by Messrs. Percy and Vanquelin, two members of the In-

stitute. The result of their experiments is as follows: in bread, every hundred pounds weight are found to contain eighty pounds of nutritious matter; butchers' meat, averaging the various sorts, contains only thirty-five pounds in one hundred; French beans, (in the grain) ninety-two in one hundred, broad beans, eighty-nine; peas, ninety-three; lentiles, (a kind of half pea, but little known in England) ninety-four pounds in one hundred; greens and turnips, which are the most aqueous of all vegetables used for domestic purposes, furnish only eight pounds of solid nutritious substance in one hundred; carrots, fourteen pounds: and what is very remarkable, as being in opposition to the hitherto acknowledged theory, one hundred pounds of potatoes only yield twenty-five pounds of substance, valuable as nutrition. One pound of good bread is equal to two pounds and a half or three pounds of the best potatoes; and seventy-five pounds of bread, and thirty pounds of meat, are equal to three hundred pounds of potatoes; or to go more into detail, three quarters of a pound of bread and five ounces of meat are equal to three pounds of potatoes; one pound of potatoes is equal to four pounds of cabbage and three of turnips; but one pound of rice, broad beans, or French beans, (in grain) is equal to three pounds of potatoes.

A Method by which to enlarge or diminish the Size of a Picture.

Divide the sides of the original with a pair of compasses into any number of equal parts, and rule lines across with a black lead-pencil from side to side, and from top to bottom. Then, having your paper of the size intended, divide it into the same number of squares, either larger or smaller, as you would enlarge or contract it. Then placing the original before you, draw square by square the several parts, observing to make the part of the figure you are drawing fall in the same part of the square in the copy as it does in the original.

To prevent mistakes number the squares both of the original and the copy. To avoid the necessity of ruling across the original, which in some cases may injure it, take an open frame, with threads stretched across, placing the picture in the middle, and taking care to number the extremity of each square.

Preservation of Flowers for Distillation.

Rub three pounds of rose-leaves for two or three minutes with a pound of common salt. The flowers being bruised by the friction of the salt, form a paste which is to be put into an earthen jar, or a water-tight barrel. The same process is to be repeated until the vessel is filled, so that the roses may be equally salted. The vessel is then to be shut up and kept in a cool place until wanted. For distillation, this aromatic paste is, at any season, to be put into the body of the still with twice its weight of water; and when heat is applied, the oil, or essential water, is to be obtained in the common way. Both the oil and the water are in this way produced in greater quantity, than by using the leaves without the salt: besides, the preserved paste will keep its flavour and strength unimpaired for several years. Other flowers capable of affording essential oils may also be treated in the above way, with economy and advantage.

Botanical Illustration.

The ash-tree will be found worthy the attention of those who are fond of the curiosities of nature. The pod of the fruit is in shape like a bird's tongue, having only one cell that contains a seed of the same shape. By opening the pod carefully with a pen-knife, the umbilical cord will be found running from the stalk to the upper end of the fruit, where it enters to convey the nourishment to the germ, in which (on opening from the reverse end) will be found the future tree, so formed, both in

trunk and leaves, as not even to require the assistance of magnifiers to see the perfect plant. We are not aware of any other kernel that affords so distinct a resemblance of its parent.

To make artificial Coral for Grottoes.

To two drams of fine vermillion 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.

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.

To preserve the Colour of Red Cabbage as a Test.

Digest the leaves of the cabbage in warm alcohol; when all the colouring matter is extracted, distil off a portion of the alcohol, and evaporate the remainder by a very gentle heat to the consistence of a syrup. This extract, if kept in closely stopped phials, will remain unimpaired for years. When used, a small portion of water should be added to it, in which it is readily soluble, when the addition of the acid or the alkali will produce its peculiar effect. When this test is employed to discover small quantities of carbonic acid, it should be

made slightly green by a diluted alkali. Test papers may also be prepared with the alcoholic tincture of the cabbage, which, when rendered green by immersion in a diluted alkaline solution, may be used in the same cases in which litmus papers are commonly employed.

Singular Experiment with the Snuff of a Candle.

When a candle is burnt so low as to leave a tolerably large wick, blow it out; a dense smoke will arise; if another candle be applied to the utmost verge of this smoke, a very strange phenomenon will take place: the flame of the lighted candle will be carried to the one just blown out, as if it were borne on a cloud; or, more properly speaking, like a flash of lightning, proceeding at a slow rate. The experiment may be performed by blowing oot the candle as often as it is lighted.

To lift a Flint-glass Bottle with a Straw.

Take a straw which is not broken or bruised, bend one end of it into a sharp angle, and put it into the bottle, so that the bent part of it may rest against its side, and you may take the other end in your hand, and lift up the bottle by it, without breaking the straw; and this will be more readily accomplished, as the angular part of the straw approaches to that which comes out of the bottle.

To beautify the Complexion.

Take a few nut-galls, bruise them to a very fine powder, and strew it nicely upon a towel; then put a little ground copperas into a basin of water, which will soon dissolve and leave the water perfectly transparent. It would be unfair to trick a fair friend; but after any person has washed in this water, and wiped with the towel

on which the galls were strewed, the hands and face will immediately become black; and will not resume their natural appearance for a few days.

The method by which Watch-glasses are formed.

The art of making watch-glasses depends upon the employment of caloric, as a power which expands glass unequally. A glass globe is blown of sufficient size to permit five glasses being cut from it. When the globe is cold, a red-hot tobacco-pipe, or iron-wire, is run round the model of the watch-glass drawn upon it; the crack follows the point of the heated wire or pipe, until the circle is described, and the watch-glass drops out of its place. The other four are done in the same way. This contrivance is admirable, considering that it arose from what is generally supposed to be a bad property of glass, viz. fracture by heat too suddenly applied.

How Two Men may be born on the same Day, die at the same Moment, and yet one may have lived a Day, or even two Days more than the other.

It is well known, that if a ship sail round the world, going from east to west, those on board, when they return, will count a day less than the inhabitants of the country. The cause of this is, that the vessel, following the course of the sun, has the days longer, and in the whole number of the days reckoned, during the voyage, there is necessarily one revolution of the sun less. On the other hand, if the ship proceed round the world from west to east, as it goes to meet the sun, the days are shorter, and during the whole circumnavigation, the people on board necessarily count one revolution of the sun more. Suppose that one of twins embark on board a vessel which sails round the world from east to west, and that the other remain at home. When the

ship returns, the inhabitants will reckon Thursday, while those on board the vessel will reckon only Wednesday; and the twin who embarked will have a day less in his life. Consequently, if they should die the same day, one of them would count a day older than the other, though they were both born at the same hour. Let us next suppose that, while the one circumnavigates the globe from east to west, the other goes round from west to east, and that on the same day they return to port, where the inhabitants reckon Thursday, for example: in this case, the former will count Wednesday, and the latter Friday, so that there will be two days difference in their ages. If the latter returned on a Wednesday and the former on a Friday, the former would count the day of his arrival Thursday: next day would be Thursday to the inhabitants, and the day after would be Thursday to those who arrived in the second vessel; which, notwithstanding the popular proverb, would give three Thursdays in one week.

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.

Manufacture of Mosaic at Rome.

It is well known that mosaic-work consists of variously shaped pieces of coloured glass enamel; and that when these pieces are cemented together, they form those regular and beautiful figures which constitute tessellated pavements. These pavements, the work of the ancient Romans, have frequently been dug up in England and other countries. The principal manufactory of mosaic pictures in the present day, is at Rome,

and belongs to his Holiness the Pope. The building in which the establishment is situated is large, and contains a collection of enamels drawn into the form of sticks. These are arranged, according to their colours, in an extensive suit of rooms. The number of shades of colour is 17,000. The enamel, consisting of glass mixed with metallic colouring matter, is heated for eight days in a glass-house, each colour in a separate pot. The melted enamel is taken out with an iron spoon, and poured on polished marble placed horizontally; and another flat marble-slab is laid upon the surface, so that the enamel cools into the form of a round cake, of the thickness of three-tenths of an inch. In order to divide the cake into smaller pieces, it is placed on a sharp steel anvil, called tagliulo, which has the edge uppermost; and the stroke of an edged-hammer is given on the upper surface of the cake, which is thus divided into long prisms, whose bases are three-tenths of an inch square; these prisms are again divided across their length by the tagliulo and hammer into pieces of the length of eight-tenths of an inch, to be used in the mosaic pictures. Sometimes the cakes are made thicker and the pieces larger. For smaller pictures, the enamel, whilst fused, is drawn into quadrangular sticks, and these are divided across by the tagliulo and hammer, or by a file; sometimes also, these pieces are divided by a saw without teeth, consisting of a copper blade and emery; and the pieces are sometimes polished on a horizontal wheel of lead with emery. Gilded mosaic is formed by applying the gold leaf on the hot surface of a brown enamel, immediately after the enamel is taken from the furnace; the whole is put into the furnace again for a short time, and when it is taken out, the gold is firmly fixed on the surface. In the gilded enamel, used in mosaic at Rome, there is a thin coat of transparent glass over the gold.

Substitute for a Copying Machine.

Write with common writing ink in which lump sugar has been dissolved, in the proportion 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...	0,318....	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. Lançon 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 blow-pipe, 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.

Comparative Merit of British Singing Birds.

The following table, formed by the Honourable Daines Barrington, is designed to exhibit the comparative merit

of British singing birds; in which 20 is supposed to be the point of absolute perfection.

	Mellowness of tone.	Sprightly Notes.	Plaintive Notes.	Compass.	Execution.
Nightingale	19	14	19	19	19
Sky-lark	4	19	4	18	18
Wood-lark	18	4	17	12	8
Tit-lark	12	12	12	12	12
Linnet	12	16	12	16	18
Goldfinch	4	19	4	12	12
Chaffinch	4	12	4	8	8
Greenfinch	4	4	4	4	6
Hedge-sparrow	6	0	6	4	4
Aberdavine, or Siskin	2	4	0	4	4
Red-poll	0	4	0	4	4
Thrush	4	4	4	4	4
Blackbird	4	4	0	2	2
Robin	6	16	12	12	12
Wren	0	12	0	4	4
Reed-sparrow	0	4	0	2	2
Black-cap, or Norfolk mock Nightingale	14	12	12	14	14

Of the wonderful Attenuation of which some Matters are susceptible.

An ounce of gold is a cube of 5½ lines on each side; so that one of its faces will cover about 27 square lines. This cube, a gold-beater reduces into leaves, which altogether would cover 146 square feet. But 27 square lines are contained 111,980 times in 146 square feet, consequently the thickness of this gold leaf is the 111,980th part of 5½ lines, or the 21,534th part of a line.—A cylindrical ingot of silver, weighing 45 marcs, about 22 inches in length, and 15 in breadth, is covered with six

ounces of gold reduced to gold leaf. The thickness of the gold in this state, called gilding, is about the 15th part of a line. But only an ounce of gold may be employed; and in this case the thickness of the gilding will be only the 90th part of a line.—This ingot thus gilt is made to pass through several holes in succession, each smaller than the other, till it is reduced to a wire of the thickness of a hair. M. Reaumur took a wire of gilt silver, drawn out in this manner, and having weighed half a gross of it, with the greatest nicety, measured its length, which he found to be 202 feet, whence he learned the gross was 404 feet in length, the ounce 2232, the mare 23,856, and the mares 1,163,520 or 96 leagues of 2000 toises each.—As the ductility of gold is far greater than that of silver, a much longer wire might be made with an ingot of gold of the same weight. Muschenbroek says, that an artist of Augsbourg made a gold wire, weighing only a grain, which was 500 feet in length. A wire of this size, capable of encompassing the earth would have weighed only about 50 pounds.---But we can shew that the work of an insect surpasses the above. A single thread of silk, 360 feet in length weighs a grain, 24 grains 1440 toises, and 36 grains a league of 2160 toises; an ounce of this thread will extend 16 leagues, and a pound 128: in short, a thread of this kind capable of encompassing the earth, would weigh no more than 35 pounds. We shall here add, that the thread of a spider's webb, which is much finer and lighter than the thread of the silk-worm, of the same length as above, would weigh only one pound!---A grain of musk is capable of perfuming, for several years, a room 12 feet in every direction, without sustaining any sensible dimunition of its volume or weight. But a space such as the above contains 1728 cubic feet each of which contains 1728 cubic inches, and each of these 1728 cubic lines; so that the number of cubic lines is the third power of 1728.---It is probable, that every one of these cubic lines contains some of the odorous particles; the air of the chamber may in the course of several years be renewed 1000 times; and the grain of musk, without sensible alteration, may furnish new odorous particles. In calculating the tenuity of each of these, the imagination is lost.

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 describe a Vertical Dial on a Pane of Glass, which will shew the Hours without a Style, by means of the solar Rays.

Detach a pane of glass from the window frame on the outside, and describe upon it a vertical dial according to the declination of the window and the height of the pole above the horizon: taking as the height of the style the thickness of the window frame. Then fix the pane of glass against the frame in the inside; giving to the meridian line a situation perpendicular to the horizon, as it ought to have in vertical dials. Then cement to the window frame on the outside, opposite to the dial, a piece of strong paper, not oiled, in order that the surface of the dial may be more obscure. And to know the hours without the shadow of a style, make a small hole in the paper with a pin, opposite to the bottom of the style, which is marked out. As this represents the extremity of the style, the rays of the sun passing through it form on the glass a luminous point, which, as the rest of the dial is obscure, indicate the hours very agreeably.

The Mechanical Tumbler.

Make a figure resembling a man, of any substance exceedingly light, such as the pith of the elder tree, which is soft, and can be easily cut into any form. Then pro-

vide for it an hemispherical base of some very heavy substance, such as the half of a leaden bullet, made very smooth on the convex part. Cement the figure to the plane part of the hemisphere; and in whatever position it is placed, when left to itself it will rise upright. In this manner were constructed those small figures called Prussians, sold at Paris. They were formed into battalions, and being made to fall down by drawing a rod over them, they immediately started up again as soon as it was removed.

The Unsinkable Dress.

Between the cloth and lining of a jacket, without arms, place small pieces of cork, an inch and a half square, and about half or three-quarters of an inch in thickness. They must be arranged very near to each other, that as little space as possible may be lost; but yet not so close as to affect in any great degree the flexibility of the jacket, which must be quilted to prevent the corks moving from their places. The jacket must be made to button round the body, by means of strong buttons, well sewed on; and to prevent its slipping off, should be furnished with a kind of girdle, to pass between the legs and fasten before. By means of such a jacket, which will occasion as little embarrassment as a common dress, people may throw themselves into the water with the greatest safety; for if it be properly made, the water will not rise over the shoulders. The wearers need make no effort to support themselves; they may read or write, and even load a pistol and fire it.

Tracing Desk.

Let a frame be made sufficiently large for a square of crown glass to 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 di-

vided to serve for paper, pencils, &c. To the top of the frame, fix two stays, by which the frame may be raised or depressed, as occasion may require. The frame is to be used thus:---lay the subject you intend to copy on the glass, and fasten a sheet of fine white paper upon it, with some wafers or paste. 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 line, which you may copy accurately, and finish as 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 a black lead pencil: after which, fill up the shades in the manner it appears without the desk.

To etch Designs on Glass.

Cover the glass all over with a thin coat of bees-wax, and trace the design with an etching needle; then spread the whole over as uniformly as possible with fluor spar (Derbyshire spar) to the depth of an eighth of an inch, and when this is done, pour sulphuric acid, diluted with three times its weight of water, upon the spar. After the acid has remained upon it three or four hours, it is to be poured off, and the glass washed with oil of turpentine; the etching will then appear, and the parts that were covered with the wax will have remained untouched.

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.

Simple Method of Preserving Fruit.

The following simple method of effecting this desirable object has been successfully practised. The fruit, being picked clean, and not too ripe, is to be put into common bottles, which must be filled quite full. These bottles, having corks stuck lightly in them, are to be placed upright in a pan of water, which is to be heated gradually to 160° or 170° Fahrenheit, or until the water feels hot to the finger, but not so hot as to scald. This degree of heat is to be kept up for half an hour, and then the bottles being taken out, one by one, they are to be filled up to within one inch of the cork, with boiling water, the cork fitted very close and tight, and the bottle laid on its side, that the cork may be kept moist. To prevent fermentation and mould, the bottles are to be turned once or twice a week for the first month or two, and once or twice a month afterwards. Fruit treated in this way will keep two years or more. Care must be taken that it be not cracked by the heat.

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.

A Lantern, to give Light under Water.

The lantern must be made of leather, which will resist the waves better than any other substance, and must be furnished with two tubes, having a communication with the air above. One of these tubes is to admit fresh air for maintaining the combustion of the candle; and the other to serve as a chimney, by affording a passage to the smoke; both must rise above the surface of the water. The tube, which serves to admit fresh air, must communicate with the lantern at the bottom, and that which serves as a chimney, must be connected with it at the top. Any number of holes may be made in the leather, of which the lantern is constructed, into which glasses are fitted; by these means, the light will be diffused on all sides. In the last place, the lantern must be suspended from a piece of cork, that it may rise and fall with the waves.

To Paint the Glasses for a Magic Lantern.

(See also Endless Amusement, First Series, p. 65.)

The glasses for a magic lantern are painted in oil, with carmine, lake, Prussian blue, and other transparent colours; they are laid on as thinly and clearly as possible, and in their use require no other direction than such as are familiar to all persons acquainted with drawing. Should change or motion be required, two glasses must be employed; on the front glass should be painted the correct design that is first to be exhibited,

with blank spaces left upon it, for the arms, legs, or head, in which the alteration is to take place: on the back glass, which should slide in a groove, must be delineated those parts only, with outlines or dots, which may be necessary to prevent the appearance of both at the same time. For instance, if a figure be wished to appear on a column, pyramid, or tomb, either of these should be painted on the front glass, with sufficient room left for the display of the statue: this is to be depicted on the back glass, and the space on which it is to be shewn, must also be darkened as directed, before it is permitted to appear. The same rules are observable in all other devices, with which experience will soon become acquainted.

The Magic Telescope.

(See Endless Amusement, First Series, p. 129.)

To construct a magic telescope, by means of which we pretend to see through opaque bodies, provide a tube of ivory, wider towards the end where the object glass is placed; but the ivory must be of sufficient thinness to admit the light through the inside. The narrow end is furnished with an eye glass, which serves to shew more distinctly the inside of it. The other end also is furnished with a glass, which has the appearance only of an object glass, the posterior surface of it being opaque, so as to serve for the base or bottom of a sort of compass or magnetic needle, which turns on a pivot fixed in its centre. When the telescope rests on the end containing the object glass, this needle assumes a horizontal position, and points towards the north, or towards a magnetic needle in the neighbourhood. It is necessary also to have a real telescope, similar in appearance to the other, to shew instead of it, which may be done by dexterously substituting the one for the other. When you wish to employ the magic telescope, place it with the object glass downwards upon the thing you intend to examine, and if there be a magnet or piece of magnetized iron below it, the needle will turn to that side.

Tricks to be done by the Magic Telescope.

Several figures being given, which a person has arranged close to each other in a box, to tell through the lid what number they form. If you intend to employ the ten cyphers, take ten small squares, of an inch and a half on each side, and on the upper face of each make a groove, but let these grooves be in different directions; that is to say, the first intended for the number 1 must proceed directly from the top to the bottom; the second must deviate to the right, so as to form an angle equal to a tenth part of the circumference; the third an angle of two-tenths; and so of the rest, which will give ten different positions. Then introduce into these grooves small bars of steel well magnetized, taking care to turn their north poles to the proper direction; cover these grooves and the face of the squares with strong paper, in order to conceal the bars. You must also provide a narrow box, capable of containing in its breadth one of these squares, and of such a length that they can all be arranged in it. Then desire a person in your absence to take several of these squares, and arrange them in the box in any manner, at pleasure, so as to form any number whatever, and to shut the box; after which you are to tell the number which has been formed. Deposit your pretended telescope on the place of the first square that is on the left; if the figure below it be 1, the needle will turn in such a manner that the north pole will be before you. If the figure be 4, it will turn to the fourth division of the circle, which is equally divided into ten parts; and so of the rest. It will thence be easy to discover and tell the figure in each place. A word written in secret, with given characters, may be discovered in the same manner; also an anagram, formed of a proposed word, as *Roma*, which gives *amor*, *mora*, *orma*, *maro*, *&c.*; or a question which has been selected from several persons and put into the box. In short, this trick may be varied in a great many ways, exceedingly amusing. The box of metals, for instance, is a variation of the same trick:—You put six plates of different metals in a box, and bid a person take any one of them,

and put it into another box, and shut it; you may then easily tell which one he has taken. These plates are of such a form, that they can occupy in the small box but one position: each of them, that of iron excepted, contains in its thickness a magnetic bar, arranged in situations which are known, and these situations are discovered by means of the pretended magic telescope; consequently the nature of the metal must be known. No magnetic bar is placed in the plate of iron, because this would be useless; but one side of the plate may be magnetized, or if it be not, the indeterminate direction of the needle will announce that it is iron.

Simple Microscope.

The most powerful single microscopes are very small globules of glass, which any curious person may make for himself, by melting the ends of fine threads of glass in the flame of a candle, or by taking a little fine powdered glass on the point of a very small needle, and melting it into a globule in that way. It was with such microscopes as these that Lewenhoeck made all his wonderful discoveries, most of which are deposited in the British Museum.

Curious Optical Deception.

Provide a sufficient number of small equilateral 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 in the same manner, 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.

Artificial Rainbow.

(See also Endless Amusement, First Series, p. 62.)

The very easiest method of performing this experiment, is to fill a transparent cylindric glass bottle with water, and place it on a table in an upright position; place a lighted candle at the same height, and at the distance from it of ten or twelve feet, and then walk in a transversal direction between the light and the bottle, keeping your eye at the same elevation. When you have reached a certain point, you will see bundles of coloured rays issuing from one of the sides of the bottle, in the following order:—violet, blue, yellow, red; and if you continue to walk transversely, you will see a second series, in a contrary order, namely, red, yellow,

blue and violet, proceeding from the other side of the bottle. To imitate the phenomenon completely, seven similar bottles might be arranged in such a manner, that the eye being placed at a proper point, one of the seven colours should be seen in each; and seven others might be arranged at some distance, so as to exhibit the same colours in an inverted order.

Another.

Turn your back to the sun, when at a moderate elevation, and with a syringe, scatter the water into the air as high as possible, in a direction somewhat oblique to the horizon.

Portable Camera Obscura.

The camera obscura is a most amusing optical toy. Fig. 6 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.

Extraordinary Effects of Burning Mirrors.

(See also Endless Amusement, First Series, p. 32.)

We cannot omit to mention some mirrors celebrated on account of their size, and the effects they produced; one of them was the work of Settala, a canon of Milan: it was parabolic, and inflamed wood at the distance of fifteen or sixteen paces. Villette, an artist and optician of Lyons, constructed three, about the year 1670, one of which was purchased by Tavernier, and presented to the King of Persia; the second was purchased by the King of Denmark, and the third by the King of France.

The one last mentioned was thirty inches in diameter, and of about three feet focus. The rays of the sun were collected by it into the space of about half-a-guinea. It immediately set fire to the greenest wood: it fused silver and copper in a few seconds; and in one minute, more or less, vitrified brick, flint, and other vitrifiable substances. A mirror, superior even to these, was constructed by Baron Von Ichivnhausen, about 1687: it consisted of a metal plate, twice as thick as the blade of a common knife; it was five feet three inches in breadth, and its focal distance was three feet six inches: it produced the following effects:—wood, exposed to its focus, immediately took fire, which the most violent wind could not extinguish. Water, contained in an earthen vessel, was instantly thrown into a state of ebullition; so that eggs were boiled in a moment, and soon after, the whole water was evaporated. Copper and silver passed into fusion in a few minutes, and slate was transformed into a kind of black glass, which, when laid hold of with a pair of pincers, could be drawn out into filaments. Brick was fused into a kind of yellow glass; pumice stone and fragments of crucibles, which had withstood the most violent furnaces, were also vitrified, &c. But metal is not the only substance of which burning mirrors are made; they may be constructed of wood and leaf gold; nothing is necessary but to turn a piece of exceedingly dry and very hard wood into the form of the segment of a concave sphere; to cover it in a uniform manner with a mixture of pitch and wax, and then apply bits of gold leaf, about three or four inches in breadth. Instead of gold leaf, small plane mirrors might be adapted to the concavity, and the effect would be little inferior to that of a mirror made entirely of metal. Father Zahn mentions a mirror made of paste-board, covered on the inside with straw cemented to it, which was so powerful as to fuse all metals.

To construct a Lantern, by which a Book can be read at a great distance, at Night.

Construct a lantern of a cylindric form, like a small cask placed lengthwise, so that its axis shall be horizontal; in one end of it fix a spherical mirror, the focus of which falls about the middle of the length of the cylinder; place a taper or lamp in this focus, and the light will be reflected through the open end, so strong that very small print may be read by it at a great distance, looked at through a telescope. Those who see this light at a distance, will imagine they see a large fire.

To tell the Hour of the Day by the Left-hand.

Extend the left-hand in a horizontal position, so that the inside of it shall be turned towards the sky; then take a bit of straw or wood, and place it at right angles, at the joint, between the thumb and the fore finger: it must be equal in length to the distance from that joint to the end of the fore finger, and must be held upright, as represented (in fig. 10) at A; this piece of stick or straw supplies the place of a style. Turn the bottom of the thumb towards the sun, the hand being extended, till the shadow of the muscle which is below the thumb terminates at the line of life, marked C. If the wrist or bottom of the hand be then turned towards the sun, the fingers being kept equally extended, the shadow of the bit of straw or stick will indicate the hour. When the shadow falls on the tip of the fore finger, it denotes five in the morning or seven in the evening; at the end of the middle finger, it denotes six in the morning and evening; at the end of the next finger, seven in the morning and five in the evening; at the end of the little finger, eight in the morning and four in the afternoon; at the nearest joint of the little finger, nine in the morning and three in the afternoon; at the next joint of the little finger, ten in the morning and two in the afternoon; at the root of the little finger, eleven in

the morning and one in the afternoon; in the last place, when the shadow falls on that line of the hand marked D, which is called the table line, it will indicate twelve o'clock at noon.

Beauty and Deformity.

(See Frontispiece, Fig. 6.)

Having drawn, in its just proportions, the figure you intend to disguise, draw a square round it as A,B,C,D, which divide into several other small squares. Then describe on the proposed plane a parallelogram E,B,F,G, and divide one of the two shorter sides, as E, G, into as many equal parts as D, C, one of the sides of the square A, B, C, D, which in this case are seven. Divide the other side B, F, into two equal parts, in the point H, and draw from it to the points of division of the opposite side E, G, as many straight lines, the two last of which will be H, E, and H, G. Having then assumed in the side B, F, the point I, above the point H, as the height of the eye above the plane of the picture, draw from I, to the point E, the straight line E,I, which will cut those lines proceeding from the point H, in the points 1, 2, 3, 4; 5, 6, 7. Through these points of intersection draw straight lines parallel to each other, and to the base E, G, of the triangle E,G,H, which will thus be divided into as many trapeziums as there are little squares in A, B, C, D. Hence, if the figure in the square A,B,C,D, be transferred to the triangle E, G, H, by making these parts of the outline contained in the different natural squares A, B, C, D, to pass through the corresponding trapeziums or perspective squares, the figure will be found to be distorted. But it may be seen exactly like its prototype, if it be viewed through a hole K, which ought to be small towards the eye, and wide towards the object, made in a small board L, placed perpendicularly in H, so that the height L, K, shall be equal to H, I, which must never be very great, in order that the figure may be more distorted in the picture.

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.

To fire a Pistol over your Shoulder, and hit a Mark, with as much Certainty as if you took aim at it in the usual Manner.

To perform this trick, place before you a plane mirror, so disposed, that you can see in it the object you propose to hit; then rest the barrel of the pistol on your shoulder and take aim, looking at the image of the pistol in the glass as if it were the pistol itself; that is, in such a manner, that the image of the object may be concealed by the barrel of the pistol:—it is evident you must hit the mark.

Wonderful Apparitions of various Objects.

(See Frontispiece, Fig. 5.)

A, B, C, is a thin partition of a room, down to the floor, with an aperture for a good convex lens turned outwards into the room, nearly in a horizontal direction, proper for viewing by the eye of a person standing upright from the floor or footstool. D, is a large concave mirror, supported at a proper angle, to reflect upwards through the glass in the partition B, images of objects at E, presented towards the mirror below. A strong light from a lamp, &c. being directed on the object E, and no where else; then to the eye of a spectator at F, in a darkened room, it is truly surprising to what effect the images are reflected up in the air at G.

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.

The Water Microscope.

Provide a plate of lead, one-third of a line in thickness, and make a round hole in it with a large pin; pare the edges of this hole, and put into it, with the point of a feather, a small drop of water: the anterior and posterior surfaces of the water will assume a convex spherical form, and thus you will have a microscope.

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.

Curious Phenomena in regard to Colours and Vision.

If you look steadily for some time at a luminous body, the sun for instance, when you direct your sight to other objects in a place very much illuminated, you will observe there a black spot; a little less light will make the spot appear blue, and a degree still less will make it become purple; in a place absolutely dark, this spot, which you have at the bottom of your eye, will become luminous. Or, if you look with attention at a bright red spot on a white ground, as a red wafer on a piece of white paper, you will see, after some time, a blue border round the wafer; if you then turn your eye from the wafer to the white paper, you will see a round spot of delicate green inclining to blue, which will continue longer, according to the time you have looked at the red object. If, instead of a red wafer, you look at a yellow one, on turning your eye to the paper you will observe a blue spot. A green wafer on a white ground, will produce in the eye a spot of pale purple colour, a blue one will produce a spot of a pale red. In the last place, if a black wafer on a white ground be viewed in the same manner, after looking at it some time with attention, you will observe a white border form itself around the wafer; and if you then turn your eye to the white ground, you will observe a spot of a brighter white than the ground, and well defined. When you look at a white spot on a black ground, the case will be reversed. In these experiments, red is opposed to green, and produces it, as green produces red; blue and yellow are also opposed, and produce each other; and the case is the same with black and white, which evidently indicates a constant effect depending on the organization of the eye.

The real Apparition.

(See Frontispiece, Fig. 3.)

Behind a partition A, B, place, somewhat inclined, a concave mirror E, F, which must be at least ten inches in diameter, and its distance equal to three-fourths from its centre. In the partition is cut a square or circular opening, of seven or eight inches in diameter, directly opposite to the mirror. Behind this a strong light is so disposed as to illuminate strongly an object placed at C, without shining on the mirror, or being seen at the opening. Beneath the aperture, and behind the screen, is placed any object at C, which is intended to be represented, a flower, figure, or picture, &c. but in an inverted position. Before the partition, and below the aperture, place a flower-pot D, or other pedestal suited to the object C, so as the top may be even with the bottom of the aperture, and that the eye placed at G, may see the flower in the same position as if it came out of the pot; the space between the mirror and the back part of the partition being painted black, to prevent any extraneous light being reflected on the mirror. Then a person, placed at G, will perceive the flower, or other object placed behind the partition, as if standing in the flower-pot or pedestal: but on putting forth his hand to pluck it, he will find he grasps at a phantom.

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.

Another 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.

Solar Microscope.

Make a round hole in the window-shutter, about three inches in diameter, and place in it 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 their 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.

An Optical Game.

Present to any one a ring, or place it at some distance, and in such a manner that the plane of it shall be turned towards the person'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.

To tell the Number thought of by a Person.

(See also Endless Amusement, First Series, p. 46.)

Desire the person, who has thought of a number, to triple it, and to take the exact half of that triple, if it be even; or the greater half, if it be odd. Then desire him to triple that half, and ask him how many times it will contain nine; for the number thought of will contain the double of that number of nines, and one more, if it be odd. Thus if 5 has been the number thought of, its triple will be fifteen, which cannot be divided by 2 without a remainder. The greater half of 15 is 8; and if this be multiplied by 3, we shall have 24, which contains 9 twice: the number thought of will be 4 + 1, that is to say 5.

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 shew that a Candle burns with more brilliancy and much longer in Oxygen Gas than in Atmospherical Air.

Procure two short candlesticks, of tin, and put a piece of candle of the same size in each. When the candles are lighted and burning with equal brightness, put one of them in a jar of oxygen gas, and the other in a jar of equal size, containing atmospherical air; and the one in the oxygen gas will not only far surpass the other in brilliancy, but will burn more than double the time.

To shew that a Candle just put out may be lighted again in Oxygen Gas.

Take a jar, six or eight inches deep, and fill it with oxygen gas, then turn its mouth upwards, and let a candle down in it (by means of a piece of wire) which has just been put out, and still retains part of the wick red-hot; it will immediately be lighted with a slight explosion. The candle may even be put out again, and re-kindled by the same jar of gas.

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 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 a 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.

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 of the same kind as employed in last experiment, 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.

To produce Heat by adding Water to another Liquid.

Put a small quantity of sulphuric acid into a glass or tea-cup, then add to it about one fourth of its bulk of cold water, and upon stirring it, the temperature will immediately rise to 250 or 300 degrees of Fahrenheits' thermometer. In mixing sulphuric acid with water, great care should be taken not to do it too suddenly, as the glass or vessel containing it may break, and the acid be thrown about.

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.

To render the Skin and Flesh Fire-proof.

Take juice of marshmallow, white of egg, flea-cane seed, and lime; powder and mix them with juice of radish, and the white of egg; mix all thoroughly, and with this composition anoint your body or hand, and allow it to dry, afterwards anoint again, and you may then boldly take up hot-iron without hurt. Spirits of sulphur, sal ammonia, essence of rosemary, and onion juice is another excellent receipt. Half an ounce of camphor dissolved in two ounces of aqua-vitæ; add one ounce of quicksilver, one ounce of liquid storax, which

is the droppings of myrrh, and hinders the camphor from firing. Take also two ounces of hematatis, which is a red stone to be had at the druggists, which, being put to the above composition, anoint well your feet with it, and you may walk over a red-hot iron bar without the least inconvenience. Diluted sulphuric, nitric, or muriatic acid, or a saturated solution of burnt alum being repeatedly rubbed on the skin, will render it less sensible to the action of caloric. Hard soap, or a soap paste rubbed over the tongue, will preserve it from being burnt by a hot iron rapidly passed over it. Moisture too, skilfully employed, will do much, in preserving the flesh from danger. A wet finger may be safely dipped into a pan of boiling sugar, and even without being wet, if instantly withdrawn and plunged in water, a thin crust of sugar may be thus obtained without danger.

To construct and Inflate a small Balloon.

It is an interesting and amusing experiment to inflate a small balloon made of gold-beaters' skin (using a little gum-arabic to close up 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 find the least Number of Weights that will weigh from One Pound to Forty.

This problem may be resolved by means of the geometrical progression 1, 3, 9, 27, 81, &c. the property

of which is such, that the last number is twice the sum of all the rest, and one more; so that the number of pounds being forty, which is also the sum of 1, 3, 9, 27, these four weights will answer the purpose required. Suppose it be required, for example, to weigh eleven pounds by those weights, you must put into one scale the one pound weight, and into the other the three and nine pound weights, which, in this case, will weigh eleven pounds, in consequence of the one pound weight being in the other scale; and therefore, if you put any substance into the first scale, along with the one pound weight, and it stand at equilibrio with the 3 and 9 in the other scale, you may conclude it weighs eleven pounds. In like manner, to find a fourteen pound weight, put into one of the scales, the one, three, and nine pound weights, and into the other that of twenty-seven pounds, and it will evidently outweigh the other three by fourteen pounds; and so on of any other weight.

A Person striking a Figure out of the sum of Two given Numbers, to tell him what that Figure was.

Arbitrarily command those numbers only, as are divisible by 9, such as 36, 63, 117, 126, 162, &c. Then let a person choose any of these two numbers; and, after adding them together in his mind, strike out from the sum any one of the figures he pleases. After he has done this, desire him to tell you the sum of the remaining figures; and it follows that the number you are obliged to add to this amount, n order to make it 9, or 18, is the one he struck out. Suppose, for example, he choose the numbers 126, and 252, whose sum is 378. Then, if he strike out 7 from this amount, the remaining figures, 3 and 8, will make 11; to which 7 must be added, to make 18. If he strike out the 3, the sum of the remaining figures, 7 and 8, will be 15; to which, 3 must be added, to make 18; and so, in like manner, for the 8

To tell Two or more Numbers which a Person has thought of.

When each of the numbers thought of does not exceed 9, they may be found in the following manner:—Having made the person add 1 to the double of the first number thought of, desire him to multiply the whole by 5, and to add to the product the second number. If there be a third, make him double this first sum, and add 1 to it; then desire him to multiply the new sum by 5, and to add to it the third number. If there be a fourth, you must proceed in the same manner, desiring him to double the preceding sum; to add 1 to it, to multiply by 5, and then to add the fourth number, and so on. Then ask the number arising from the addition of the last number thought of, and if there were two numbers, subtract 5 from it; if three, 55, if four 555, and so on, for the remainder will be composed of figures of which the first on the left will be the first number thought of, the next the second, and so of the rest. Suppose the numbers thought of to be 3, 4, 6; by adding 1 to 6, the double of the first, we have 7, which being multiplied by 5, gives 35; if 4, the second number thought of, be then added, we shall have 39, which doubled gives 78, and if we add 1, and multiply 79 by 5, the result will be 395. Lastly, if we add 6, the third number thought of, the sum will be 401, and if 55 be deducted from it, we shall have for remainder 346; the figures of which, 3, 4, 6, indicate in order the three numbers thought of.

To use the Sun-dial by Night as a Moon-dial.

If any one wishes, out of curiosity or necessity, to learn what o'clock it is by the moon, he may calculate it by the shadow which the moon casts upon the sun-dial; only it is necessary to know the moon's age, which may be found in the almanack. If the new moon happens in the morning, this day is taken into the account; but if it happens after noon, the following day

is counted the first. The moon's age is to be multiplied by 4 and divided by 5. The quotient must either be added to the hours which the shadow indicates on the sun-dial, and the sum gives the time sought; or the hour shewn by the moon upon the dial is subtracted from the quotient, and the remainder gives the hour sought. The first is to be done when the shadow falls on an hour of the afternoon, and the latter when it falls upon an hour of the forenoon. The following examples will illustrate this:—1st. Suppose a countryman returns home in the evening, the moon being ten days old, and finds that the shade cast by the moon on the sun-dial is at half-past two; or that the shadow cast by the moon falls on the place at which the shadow cast by the sun stands at half-past two. The question is, what o'clock was it when the peasant came home? The answer is calculated as follows:—The moon's age, 10 days $+ 4 = 40 \frac{40}{5} = 8$: 8, therefore is the time when the moon was in the meridian, and $8 + 2\frac{1}{2} = 10\frac{1}{2}$, or half-past ten, the hour sought. 2nd. Suppose the moon to have been 18 days old, and the shadow cast by it on the sun-dial to have marked 11. This time is subtracted from the hour when the moon was in the meridian; thus:—moon's age, 18 days $+ 4 = 72$; $\frac{72}{5} = 14\frac{2}{5}$, or 2 hours 24 minutes past midnight, at which time the moon was in the meridian on that day, and from which the hour marked by the shadow must be deducted. The shadow shews here 11 o'clock in the forenoon, or one hour before noon, which deducted from 2 hours 24 minutes, gives 1 hour 24 minutes; $2\frac{2}{5} - 1 = 1\frac{2}{5}$, or 24 minutes past 1 o'clock.

Curious Arithmetical Question.

In what manner can counters be disposed in the eight external cells of a square, so that there may be always 9 in each row, and yet the whole number shall vary from 20 to 32? Inspect the four following figures; the first of which represents the original disposition of

the counters in the cells of the square; the second that of the same counters when 4 are taken away; the third the manner in which they must be disposed when these 4 are brought back with 4 others; and the fourth, with the addition of 4 more. There are always 9 in each external row; and yet, in the first case, the whole number is 24, in the second it is 20, in the third 28, and in the fourth 32.

1

3	3	3
3		3
3	3	3

2

4	1	4
1		1
4	1	4

3

2	5	2
5		5
2	5	2

4

1	7	1
7		7
1	7	1

Of odd Magic Squares.

There are several rules for the construction of these squares, but the simplest and most convenient is that which follows:

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

Suppose an odd square, the root of which is 5, and that it is required to fill it up with the first 25 of the natural numbers. In this case, begin by placing 1 in the middle cell of the horizontal band at the top; then proceed from left to right, ascending diagonally, and when you go beyond the square, transport the next number 2 to the lowest cell of that vertical band to which it belongs; set 3 in the next cell, ascending diagonally from left to

right, and as 4 would go beyond the square, transport it to the most distant cell of the horizontal band to which it belongs: set 5 in the next cell, ascending diagonally from left to right, and as the following cell, where 6 would fall, is already occupied by 1, place 6 immediately below 5; place 7 and 8 in the two next cells, ascending diagonally, as seen in the figure; and then, in consequence of the first rule of transposition, set 9 at the bottom of the last vertical band; then 10, in consequence of the second, in the last cell on the left of the second horizontal band; then 11 below it, according to the third rule: after which, continue to fill up the diagonal with the numbers 12, 13, 14, 15, and as you can ascend no farther, place the following number 16 below 15; if you then proceed in the same manner, the remaining cells of the square may be filled up without any difficulty, as seen in the above figure. The following are the squares of 3 and 7 filled up by the same method.

8	1	6
3	5	7
4	9	2

30	39	48	1	10	19	28
38	47	7	9	18	27	29
46	6	8	17	26	35	37
5	14	16	25	34	36	45
13	15	24	33	42	44	4
21	23	32	41	43	3	12
22	31	40	49	2	11	20

Another kind of Magic Square in Compartments.

Another property, of which most magic squares are susceptible is, that they are not magic when entire, but that, when divided into those squares into which they

can be resolved, these portions of the original square are themselves magic. A square of 8 cells on a side, for example, formed of four squares, each having 4 for its root, being proposed, it is required that not only the square of 64 shall be disposed magically, but each of those of 16, and that the latter even, however arranged, shall still compose a magic square. This is the simplest method of all for constructing squares that are evenly even, as will appear from what follows:

1	63	62	4	9	55	54	12
60	6	7	57	52	14	15	49
8	58	59	5	16	50	51	13
61	3	2	64	53	11	10	56
17	47	46	20	25	39	38	28
44	22	23	41	36	30	31	33
24	42	43	21	32	34	35	29
45	19	18	48	37	27	26	40

To construct a square of 64, in this manner, take the first 8 numbers of the natural progression, from 1 to 64, and the 8 last and arrange them magically in a square of 16 cells; do the same thing with the 8 terms which follow, the first 8 and the 8 which precede the last 8, and by these means you will have a second magic square; form a similar square of the 8 following numbers with their corresponding ones, and another with the 16 terms: the result will be four squares of 16 cells, the numbers in which will be equal when added together, either in bands or diagonally; for they will every where be 130. It is therefore evident, that if these squares be arranged side by side, in any order whatever, the square

resulting from them will be magic, and the sum in every direction will be 260.

Easy Method of finding the Circumference of a Circle.

When moderate exactness only is required, we may employ the proportion of Archimedes, who has demonstrated that the diameter to the circumference, is nearly as 1 to 3$\frac{1}{7}$, or as 7 to 22. If we therefore make this proportion as 7 is to 22, so is the given diameter to a fourth term; or if we triple the diameter and add to it a seventh, we shall have the circumference very nearly. The circumference of a circle, the diameter of which is equal to 100 feet, will be found therefore to be 314 feet 3 inch 5$\frac{1}{7}$ lines: the error in this case is about 1 inch 6 lines. If we desire to approach still nearer to the truth, we must employ the proportion of Metius, which is that of 113 to 355; we must therefore say as 113 to 355, so is the given diameter to the required circumference. The same diameter as before being supposed, we shall find the circumference to be 314 feet 1 inch 10$\frac{1}{113}$ lines; the difference between which and the real circumference is less than a line. If still greater exactness be required, we have only to employ the proportion of 10,000,000,000 to 31,415,926,535; he error in this case, if the circumference were a great circle, such as the equator of the earth, would be, at most, half a line. To find the diameter, the circumference being given, the inverse proportion must be employed. We must, therefore, say as 22 is to 7, or as 355 to 113, or as 314,159 is to 100,000, or as 31,415,926,535 to 10,000,000,000, so is the given circumference to a fourth term, which will be the diameter required.

The Diameter of a Circle being given, to find the Area.

Archimedes has demonstrated, that a circle is equal to the rectangle of half a radius by the circumference. Find therefore, the circumference by the preceding article, and multiply it by half the radius, or the fourth part of the diameter: the product will be the area of the circle, and the more exact, the nearer to truth the circumference has been found. By employing the proportion of Archimedes, the error, in a circle of 100 feet diameter, will be about $3\frac{1}{7}$ square feet. That of Metius would give an error less than 25 square inches, or about a sixth of a square foot. As the circle in question would contain about 7,854 square feet, the error, at most, would be only one 47,124th part of the whole area. But the area of a circle may be found, without determining the circumference; for it follows, from the proportion of Archimedes, that the square of the diameter is to the area, as 14 to 11; from that of Metius, that it is as 452 to 355; from the proportion of 100,000 to 314,159, that it is as 100,000 to 78,539, or with still greater exactness as 1,000,000 to 785,398. The area of the circle therefore will be found by making this proportion, as 14 is to 11, or as 452 to 355, or as 1,000,000 is to 785,398, so is the square of the given diameter, to a fourth proportional, which, if the last proportion has been employed, will be very near the truth.

A Person having made Choice of several Numbers, to tell what Number will exactly divide the Sum of those which he has chosen.

Provide a small bag, divided into two parts; into one of which put several tickets, numbered 6, 9, 15, 36, 63, 120, 213, 309, &c. and in the other part put as many different tickets marked with the number 3 only. Draw a handful of tickets from the first part, and, after shewing them to the company, put them into the bag again; and

having opened it a second time, desire any one to take out as many tickets as he thinks proper. When he has done this, open privately the other part of the bag, and tell him to take out of it one ticket only. You may then pronounce, that this ticket shall contain the number by which the amount of the other numbers is divisible; for, as each of these numbers are some multiple of 3, their sum must evidently be divisible by that number. This recreation may be diversified, by marking the tickets in one part of the bag with any figures that are divisible by 9, and those in the other part of the bag with the number 9 only, the properties of both 9 and 3 being the same.

By knowing the last Figure of the Product of any 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, 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 part, 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 is the fourth in the series, and that the remaining figures are 87.

Three things being privately distributed to three Persons, to guess that which each has got.

Let the three things, for instance, be a ring, a guinea, and a shilling, and let them be known privately to yourself by the vowels *a*, *e*, *i*; of such *a* signifies one, *e*, two, *i*, three. Then take 24 counters, and give the first person 1, which signifies *a*, the second 2, which represents *e*, and the third 3, which stands for *i*; then, leaving the other counters upon the table, retire into another room, and bid him who has the ring take as many counters from the table as you gave him; he that has the guinea, twice as many, and he that has the shilling, twice as many. This being done, consider to whom you gave one counter, to whom two, and to whom three; and as there were but twenty-four counters at first, there must necessarily remain either 1, 2, 3, 5, 6, or 7, on the table. If these numbers remain, as they ought, the question may be resolved by retaining in your memory the six following words:—

Salve, certa, anima, semita, vita, quies.
1. 2. 3. 5. 6. 7.

As, for instance, suppose the number that remained was 5; then the word belonging to it is semita; and as the vowels in the first two syllables of this word are *e* and *i*, it shews, according to the former directions, that he to whom you gave two counters has the ring, he to whom you gave three counters the gold, and the other person, of course, the silver; it being the second vowel which represents 2, and the third which represents 3.

If a hundred Stones are placed in a straight line, at the distance of a yard from each other, how many yards must the Person walk who undertakes to pick them up, one by one, and to put them into a basket a yard distance from the first Stone?

It is evident that, to pick up the first stone, and put it into a basket, the person must walk two yards, one

in going and another in returning; that for the second he must walk four yards, and so on, increasing by two, as far as the hundredth, which will oblige him to walk two hundred yards, one hundred in going, and one hundred in returning. It will be perceived also, that these numbers form an arithmetical progression, in which the number of terms is one hundred, the first term two, and the last two hundred. The sum total, therefore, will be the product of two hundred and two, by fifty, or 10,100 yards, which amount to more than five miles and a half.

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.

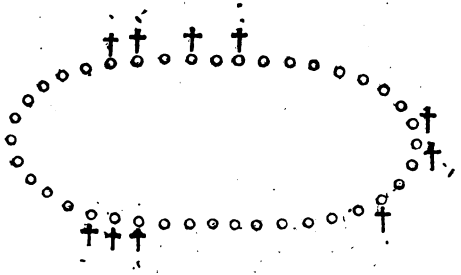
To find the Points cast on Two Dice.

For this trick, cast both the dice, and observe how many points appear at the top, then let a person take one of them up (it is of no consequence which) and see what number is at the bottom, and add all together; then let him cast the dice again, and add the points cast to the former sum: let the dice stand, being seven with

you, and add the points which appear at the top of the dice, and you will find so many were thrown in the whole.

Predestination Illustrated.

Forty persons are condemned to die, but a pardon is received for ten of the number which are to be determined by lot. It is desired to preserve the ten persons with an appearance of equity, it being predetermined which they shall be. How is it to be accomplished? Thus, counting from 12 to 12. Arrange 40 cyphers in a circular form, thus:



then, beginning at the first, mark every 12th one with a cross; continue in this manner, taking care to pass over those already crossed, still proceeding circularly, till the required number of places has been marked; if you then count the places of the marked cyphers, those on which the lot falls will be the 7th, 8th, 10th, 12th, 21st, 22nd, 24th, 34th, 35th, and 36th.

New Mode of Multiplication.

The following new method of multiplication, it is said, was discovered by a midshipman, while doing penance at the mast head.

Old method.	New method.
3546	3546
5432	5432
7092	15201212
10638	373126
14184	2934
17730	36
19261872	19261872

The first line of the new method is produced by beginning in the unit's place, as usual: each upper figure is multiplied by that immediately under it, and the whole product is set down without carrying. Thus: $2\times6=12$, $3\times4=12$, $4\times5=20$, and $5\times3=15$. For the second line multiply second figure at bottom with first at top: $3\times6=18$; and second at top with first at bottom, $4\times2=8$; and these products, $18+8=26$, which is written one place farther to the left. Then third at bottom with second at top: $4\times4=16$; and third at top with second at bottom, $5\times3=15$; and the products, $16+15=31$, which is set down. Then fourth figure at bottom with third at top: $5\times5=25$; and fourth at top with third at bottom, $3\times4=12$; and their products, $25+12=37$, which is set down, and the second line is completed. For the third line take third figure at bottom with first at top: $4\times6=24$; and third at top with first at bottom, $5\times2=10$; and $24+10=34$, which is set down. Then fourth at bottom with second at top: $5\times4=20$; and fourth at top with second at bottom, $3\times3=9$; and $20+9=29$, which is set down, and completes the third line. The fourth line is completed by multiplying fourth figure at bottom with first at top: $5\times6=30$; and fourth at top with first at bottom, $3\times2=6$; and the $30\times6=36$, which is placed as above; and these added together give the true pro-

duct, as if multiplied in the common way. It may be necessary to add, that when the products in the first line, or the sums of the products in the succeeding ones, do not amount to two figures, it is necessary to place a 0 before the single figure: thus, multiplying 312 by 231 the operation will stand:

312			312
231			231
60302	and not		632
1107			117
7			7
72072			2502

Another Example—To Multiply 345 *by* 678.

The first operation exhibits the common method at full length, by forming the several products in nine lines, instead of three, the usual number, and it will be readily found that the sum of the rows within the several braces is the same as each product formed in the common way.

Old method.			By the new method.		
345			345	8×5=40	First row.
678			678	7×4=28	
				6×3=18	
40		5	182840	8×4=32	
32.	= 8×	4.	4567.	7×5=35	
24..		3..	54..		
35.		5		67	Second row.
28..	= 7.×	4.	233910		
21...		3..		7×3=21	
3...		5		6×4=24	
24...	=6..×	4.			
18....		3..		45	
233910	=678×	345		8×3=24	Third row.
				6×5=30	
				54	

The dots may be considered as so many cyphers.

Then, as in the common method, each figure in the multiplier is multiplied by each figure of the multiplicand; and their several products, exhibited as under, at full length, will be found to be the same, and to have the same situation, *i. e.* with regard to the place of units and tens, &c. as in the common method; hence the new method is right.

New method at full length.

345
678

40=8×5
28..=4.×7
18....=3..×6..
32.=4.×8
35.=7.×5
21..=7.×3..
24...=6..×4.
24..=3..×8
30..=6..×5

The following example proves that it may be applied to cases where the multiplicand and multiplier do not consist of the same number of figures.

671586
345

201453230
2683464
33593

231697170

which agrees with the common method.

Worked thus:

5×6=30; 4×8=32; 6715×3=20145.
4×6=24; 8×5=40; 24+40=64.
3×8=24; 6715×4=26860; 24+26860=26884
3×6=18; 6715×5=33575; 18+33575=33593.

To place Figures, so as to give the same Product, whether Up, Down, or Angularly.

8	3	4
1	5	9
6	7	2

Rule for constructing the Magic Squares.

(See Endless Amusement, First Series, p. 57.)

Every odd number, if divided by 2, appears composed of two parts, the one exceeding the other 1. Divide the odd number given by 2; write the greater half in the top corner on the right hand; increase it by the given number, continually writing each number so increased diagonally downwards till you arrive at the opposite corner. Let the number that falls in the middle square be increased by 1, continually downwards, writing it diagonally until you arrive at the right hand, bottom corner; then, returning, diminish it by 1, continually upwards, writing the numbers so diminished diagonally until you arrive at the left hand, top corner. Place the square of the given number above the middle term, and diminish it upwards by 1, continually writing it diagonally towards the left as before. Place the square of the given number, diminished by the given number 1 on the right hand, increase it by 1, continually writing it diagonally towards the right. Place the given number on the left-hand side of the middle number, and the number 1 immediately under the middle number, diminish the former and increase the latter continually by 1, writing the former diagonally upwards towards the left, and the latter downwards towards the right; thus you will have three lines of figures running diagonally from left to right. Finally, if you continually increase each number of those two lines aforesaid to the left (by the number required) writing them diagonally downwards, and di-

minish it diagonally upwards (by the number required) until every square be full, the operation is complete.

EXEMPLIFICATION OF THE RULE.

22	47	16	41	10	35	4
5	23	48	27	42	11	29
30	6	24	49	18	36	12
13	31	7	25	43	19	37
38	14	32	1	26	44	20
21	39	8	33	2	27	45
46	15	40	9	34	3	28

Let 7 be the given number, then the greater part of 7 is 4; because 4+3=7, and 4 exceeds 7 by 1. Write 4 in the top compartment at the right hand, increasing it by 7, and continually writing it diagonally downwards, the numbers in that row will be 4, 11, 18, 25, 32, 39, 46; amongst which, the middle number is 25; diminishing it continually by 1 upwards, and increasing it downwards, and writing it diagonally from left to right, the row will contain the numbers 22, 23, 24, 25, 26, 27, 28. The square of 7, the given number, is 49; write it over the middle number 25, and diminishing it continually by writing the numbers so diminished upwards towards the left, we have in that half of the row 47, 48, 49, and 49—6 (which is the given number 1) is 43, which, placing on the right-hand side of the middle number, and continually increasing by 1, writing it diagonally downwards, we have in the other half of the row 43, 44, 45; placing the number 1 under 25, and the number 7 at its right, and continually increasing the former and diminishing the latter, by writing the former diagonally downwards towards the right, and the other diagonally upwards towards the left, we shall have in this row 5, 6, 7, 1, 2, 3.

Finally, continually increasing the numbers 23, 6, 24, 7, 25, 1, 26, 2, 27, by 7, and writing the numbers so increased diagonally, with the number from which they were increased, we shall have in the succeeding rows 30, 31, 32, 33, 34—, 13, 14, 8, 9—38, 39, 40—21, 15—and 46: in like manner diminishing the numbers 23, 48, 24, 49, 25, 43, 26, 44, 27, by 7, writing them diagonally upwards, have in the succeeding rows 16, 17, 18, 19, 20—41, 42, 36, 37—10, 11, 12—35, 29—and 4.

N. B.—All the rows are supposed to be read from left to right.

To dispose of the Figures up to One Hundred so as to produce 505, when cast upwards or crossways, in Twenty differents Ways.

10	92	93	7	5	96	4	98	99	1
11	19	18	84	85	86	87	13	12	90
71	29	28	77	76	75	24	23	22	80
70	62	63	37	36	35	34	68	69	31
41	52	53	44	46	45	47	58	59	60
51	42	43	54	56	55	57	48	49	50
40	32	33	67	65	66	64	38	39	61
30	79	78	27	26	25	74	73	72	21
81	89	88	14	15	16	17	83	82	20
100	9	8	94	95	6	97	3	2	91

These ten columns, when added cross-ways, make each 505.

These ten columns make each, when added up, 505.

The effect of Galvanism on 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.

1. 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.

2. 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 connexion between the two metals. The animal, therefore, is quiet, until a communication 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.

3. 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 the 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.

4. Or 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.

5. 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 tasteless 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 Battery.

(Refer to Frontispiece, Fig. 22.)

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 or cement. The plates being placed to the fire, the trough is to be well warmed, and placed horizontally on a level table, with its bottom downwards, very hot ce-

ment 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 over-hang the inner surface about a quarter of an inch. The trough being about three quarters or 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.

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 Fahrenheit.

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.

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 on 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.

Violet coloured Gas.

Put three or four grains of iodine into a small test tube, and seal the other end of the tube hermetically. If the tube be gently warmed, by holding it over a candle, the iodine becomes converted into a beautiful violet-coloured gas, or vapour, which condenses again into minute brilliant metalic crystals, of a blueish-black colour, when the tube is suffered to grow cold; and this experiment may be repeated with the same tube for any number of times.

Lamp without Flame.

If a heated wire of platinum be introduced into any inflammable or explosive mixture, it will become ignited, and continue so till the gas is consumed; but inflammation will, in most cases, only take place when the wire becomes white hot. This experiment is easily made by pouring a small quantity of ether into the bottom of a beer glass, and holding a piece of heated platinum wire a little above its surface; the wire becomes red hot, but does not inflame the vapour of the ether till it acquires an intense white heat.

Musical Flame.

A current of hydrogen may be inflamed when issuing from a small aperture, and if a tube of eighteen or twenty inches in length be held over the flame, a peculiar musical tone is produced. This effect is not peculiar to hydrogen, but is produced by a variety of other flames, and is referable to the succession of explosions produced by the combustion of the gas in the tube. Reference to fig. 14, will explain the arrangement of the apparatus.

Gas for Steam.

Sir Humphrey Davy has discovered that the application of a certain gas, fifteen times heavier than the atmosphere, to the mechanism of a steam-engine, will produce a power fully equal to that which now results from the application of steam. The great obstacle which stands in the way of a general and immediate introduction into use of this gas, is the difficulty of confining it. The task of constructing convenient vessels, sufficiently strong for that purpose, Sir Humphrey proposes as a problem, the solution of which must be attended with inestimable benefit to this country.

Singular effect of Platina, in contact with Hydrogen Gas.

M. Dobereiner, professor of chemistry in the University of Jena, gives an account of a discovery of the greatest importance. By a series of entirely new experiments, he has ascertained that platina, the heaviest of all elementary substances, when reduced into very fine particles, produces, by simple contact with hydrogen gas, (the lightest of elementary substances,) an electrical or dynamic combination, which, if brought into contact with hydrogen gas or with atmospheric air, instantly dissolves itself, yielding fire and water. To prove this important fact by a brilliant experiment, M. Dobereiner makes hydrogen pass from a reservoir, by a capillary tube, curved below, upon pure platina in powder, which is contained in a glass tunnel, hermetically sealed at the point, so that the gas mingles with the atmospheric air before it touches the platina. The moment that the current of gas reaches the surface of the platina, the powder of that metal becomes red and burning, and this phenomenon continues as long as the stream of gas is directed upon it.

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.

Another.

If gold-leaf be heated to about 100° and immersed in a jar of chlorine gas, combustion, with a beautiful green flame, will take place.

Another.

Put some filings of earsenic into a platinum spoon, heat them to about 80°, and immerse them in a jar of chlorine gas. Combustion will take place, attended by beautiful scintillations, and a greenish flame.

Another.

Hang upon a hooked wire a leaf of Dutch metal, and immerse it in a jar of chlorine gas; a very beautiful combustion will take place.

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, fig. 16, 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.

Hydraulic Orrery.

A very curious piece of mechanism under this name has lately been exhibited, highly deserving of scientific notice; not so much for its astronomical display, as for its developement of great effects produced by very small mechanic force; a very small syphon, in the first instance, setting the whole machine in motion, whilst new forces are generated by that motion, to an extent that may render the principle one of high importance in the useful arts. As an orrery, it shews, by a very ingenious adjustment, the exact motion of the moon through her nodes, and the relative motions of Jupiter's moons in a diminishing ratio of force and motion, on a very simple principle, but which seems capable of more extensive application.

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, raised the piston again; and thus, without the aid of the crew, the ship was cleared of water in four hours time.

Method of constructing an Hydraulic Machine where a Bird drinks up all the Water, that spouts up through a Pipe, and falls into a Basin.

(Refer to Frontispiece, Fig. 8.)

Let A, B, C, be a vessel, divided into two parts by a horizontal partition E, F; and let the upper cavity be divided into two parts also, by a vertical partition G, H. A communication is formed between the upper cavity B, F, and the lower one E, C, by a tube L, M, which proceeds from the lower partition, and descends almost to the bottom D, C: a similar communication is formed between the lower cavity E, C, and the upper one A, G, by the tube I, K, which, rising from the horizontal partition E, F, proceeds nearly to the top of A, B: a third tube, terminating at the upper extremity of a very small aperture, descends nearly to the partition E, F, and passes through the centre of a basin R, S, intended to receive the water which issues from it. Near the edge of this basin is a bird, with its bill immersed in it; and through the body of the bird passes a bent syphon Q, P, the aperture of which P is much lower than the aperture Q. Such is the construction of this machine, the use of which is as follows:—Fill the two upper cavities with water through two holes, made for the purpose, in the sides of the vessel, and which must be afterwards shut. The water in the cavity A, G must not rise above the orifice K of the pipe K, I. If the cock adapted to the pipe L, M, be then opened, the water of the upper cavity H, F, will flow into the lower cavity, where it will compress the air, and make it pass through the pipe K, I, into the cavity A, G; in this cavity it will compress the air which is above it, and the air, pressing upon it, will force it to spout up through the pipe N, O, from whence it will fall down into the basin. But at the same time that the water flows from

the cavity B, G into the lower one, the air will become rarefied in the upper part of that cavity: hence, as the weight of the atmosphere will act on the water, already poured into the basin through the orifice O of the ascending pipe N, O, the water will flow through the bent pipe Q, S, P, into the same cavity B, G, and this motion, when once established, will continue as long as there is any water in the cavity A, G.

A Fountain, to play by the Pressure of the Air.

To produce a fountain in vacuo, it is merely necessary to exhaust a glass receiver by means of an 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. 17.

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 fig. 23. 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.

Gallileo's Experiment.

This distinguished philosopher constructed the apparatus (fig. 15) by which he was enabled to resist the action of ten strong coach-horses. The two hemispheres A and B are made to fit air-tight, and a stop-cock C being applied to the lower hemisphere, the air may be readily withdrawn by the action of an air-pump. When a vacuum is produced, the stop-cock should be turned, and they will be held together with a force proportioned to the area of the hemispheres.

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. 19 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 which makes the difference in their descent.

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.

The Air Pump.

Having had occasion to speak of the air-pump, it may be advisable to describe the way in which it is usually constructed. Fig. 20 represents the cheapest form, and in its action it exactly resembles the common sucking-pump—with this difference, that the valves are made of moistened bladder instead of leather.

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 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, covered on both sides with strong smooth leather: 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 to fill it by. The car, or boat, is made of wicker work, 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 inclosing the fœtus in the womb. With this they may be made eighteen inches in diameter. Fig. 1 represents the present improved form of the hydrogen gas balloon; and fig. 2 that of the parachute employed by M. Garnerin.

Atmospheric Engine.

A curious apparatus, tending to illustrate some of the largest steam-engines, may be constructed by reference to the diagram fig. 9. The tube *a*, furnished with a bulb *b*, is first heated with a spirit lamp, and as soon as the air is expelled by the formation of steam, the piston-rod *c* may be introduced. On withdrawing the flame the steam will rapidly condense, and the pressure of the air above the piston being unbalanced by any resistance beneath it, will immediately be driven to the bottom of the tube. Should the piston be but three inches in diameter, it will be driven down with a force equal to about one hundred pounds.

The Hydro-pneumatic Apparatus.

Consists of a japanned iron or copper vessel, of different shape and size according to the particular purposes for which it is intended, and containing a shelf perforated with holes through which the gas may pass into inverted vessels properly placed for its reception. Fig. 13, letter A represents the hydropneumatic trough: B, B, inverted glasses for the reception of gas; C, a wrought-iron tube placed in a pan of charcoal for the evolution of gases requiring a red heat; and D, a retort heated by the spirit-lamp E.

Pressure of the Atmosphere.

The great force with which the air that surround us presses upon the earth's surface may be shewn by a very simple experiment. Take a glass tube, fig. 18, and after tying a wet bladder over one of the ends, expose it to the action of the air-pump. The pressure of the superincumbent atmosphere will speedily crush the bladder with a very loud report.

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.

To exhibit the Effect of the Magnetic Fluid by by means of a Balance.

Suspend a magnet in one of the scales of a delicate balance, and counterpoise it by putting weights into the other scale; when thus adjusted, hold a piece of iron under the magnet, and the scale to which it is attached

will instantly descend. If a piece of iron be suspended from the scale instead of the magnet, and the magnet then held under the iron, the scale to which it is attached will descend in the same manner as the magnet did before.

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 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.

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 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 upon) does not change your piece for another, and thus defeat the accomplishment of your purpose.

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.

Another Way.

Inclose a small needle in a glass ball, then move it over a magnetic bar, and the needle will be found to stand perpendicular to the bar, when it is over either of the poles of the magnet.

To shew the effect of the Magnetic 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 each other still nearer.

To ascertain the course of the Magnetic Fluid from one Pole of the Magnet to the other.

Place a pane of glass, covered with writing, over a magnetic bar, and strew a few steel filings on the paper: on striking the glass gently the filings will dispose themselves in such a manner as to represent the exact course of the magnetic fluid.

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 pin, 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 would 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.

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. 28.

The Electrifying Cane.

Charge a glass rod, by holding it in a perpendicular position, the head touching either of the conductors of an electrical machine, so that the sliding wire may be against the head; when it is charged, it may be used as a cane (only remember it is glass), with being entirely discharged, for the space of a whole day: if you meet a friend whom you wish to surprise, offer your hand, as if you only intended to shake hands with him, hold your cane so that the sliding wire may fall to the head, and touch his leg with it, your friend will be surprised by an electrical shock. If the cane should not contain the charge long enough, take the head off, let the sliding wire fall out, and clean the inside of the small tube with a piece of cotton or leather tied to one end of the wire.

Electric Eel.

An electric eel *(gymnotus electricus)* was lately brought to Paris from America, and, in trying upon it the experiments of M. Humboldt, a very singular occurrence took place. Several naturalists had already subjected themselves to electric shocks, more or less violent, by touching the fish, which is of the size of a large eel, when Dr. Janin de Saint Jusk seized it with both his hands, and was rewarded with a succession of shocks more severe than Volta's pile would have given. Indeed, he was exposed to real danger, in consequence of

finding it impossible to loose his hold of the animal, notwithstanding its every motion agitated his whole frame to an excessive degree. An involuntary contraction forced him to grasp it with supernatural strength, and the more he grasped, the more dreadful did the electrical shocks become. They extorted from him the most agonizing cries, which alarmed all present, who were even afraid for his life, as it is probable, had he continued long in the situation, that death must have ensued. Happily it occurred to him, to replunge the eel into its tube, and scarcely were his hands wetted, when the contact of the water (acting as a conductor) enabled him to let his enemy slip.

The Electrical Star.

Introduce the blunt end of a wire, furnished with projecting points, into the hole of the prime conductor; turn the machine, and the flames of electricity will fly from each point resembling a star. If it is turned round upon its centre, the flames will appear as one continued circle of fire.

The Electrical Coin.

Let a person, standing upon the insulated stool, take a piece of money between his teeth; and if a person, standing upon the ground, touch it, the spark will be so painful to the person who holds the money, that he seldom fails to let it drop, provided his lips do not touch it at the same time.

The Leyden Phial.

The Leyden phial (see fig. 25.) 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 Chime.

If three bells (fig. 26.) be attached to the prime conductor, and a communication made with the ground, they will continue to ring as long as the machine is turned.

Electrical Machine.

The best electrical machine for experimental purposes is represented at fig. 29. 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 two 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 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 col-

lects 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 communicated 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.

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, for a representation of which refer to fig. 4, 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, A, passing through a tube of ivory, B, 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.

Thunder House.

This interesting piece of electrical apparatus is shewn at fig. 21. A is a rod intended to represent a thunder cloud, and furnished with a ball at B. On charging the Leyden jar C, a small brick is readily driven from the building, by the shock which follows the discharge. If the ball be withdrawn, the advantage of a pointed lightning rod will then become apparent, as the brick will not be driven out by the explosion, but quietly pass down to the ground.

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.

Electric Magnetic Experiment.

A truly singular experiment has been repeated in the Academy of Sciences, with complete success, for the

purpose of demonstrating the influence of galvanic or rather voltaic electricity, on the magnetic needle. If the wire, made to communicate with the two poles of the pile of volta, is held over the needle at a small distance, and in a situation parallel to its direction, the needle instantly quits the magnetic meridian, where it is supposed to have remained in equilibrium and at rest. This deviation may extend to 45. If you place the wire below the needle, a similar deviation is observed, but in a contrary direction, that is from north to east, if the first has been from north to west, and *vice versa*.

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

Take a dry glass tumbler, and hold it over a brass wire fixed in the prime conductor of an electrical machine: the tumbler will soon become electrified; and if, in this state, it be inverted over a number of pith balls placed on a table, they will all leap and dance about in the tumbler for a considerable time; first receiving electricity from the sides of the tumbler, and then imparting it to the table.

Voltaic Pile.

The voltaic pile was invented towards the close of 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, fig. 24, 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.

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.

To kill an Animal by means of Electricity.

Affix the chain which communicates with the outside of the battery, to one of the animal's feet; and then with the discharging rod, form a communication between the animal's skull and one of the rods that communicates with the inside; the animal (even an ox) will be struck dead.

Diving Bell.

The mode of constructing a diving bell may readily be shewn.—Fig. 7, represents one of the most improved form; and it has been selected from the facility with which an apparatus of this description may be constructed on a small scale. If a tall vessel of water be

employed, the bell A may be lowered, and combustion supported as long as oxygen gas is driven down by the forcing pump B.

Descent in a Diving Bell, cure for Deafness.

From observations which have recently been made it has been suggested, that in cases of deafness, where the disorder is occasioned by the eustrachian tube being stopped up, the patient might be cured by descending in a diving bell. Dr. Hamel, who descended in one at Howth, in the vicinity of Dublin, informs us that he suffered, during his re-ascent, a violent sensation of pain within his ear, in consequence of the expansion of air in the exterior cavities; yet, as the air escaped much, easier than it entered, owing to the nearly conical form of that duct, he felt at almost every foot of his ascent an air bubble, that passed from his ear into his mouth, and each time afforded him considerable relief. The orifice which connects the eustrachian tube with the mouth, forms a kind of valve; it is therefore exceedingly difficult to admit a passage here to the atmospheric air; but within a diving bell this is effected merely by swallowing the saliva; and occasionally a violent report is heard nearly like that of a pistol, which is immediately succeeded by a cessation of the pain.

New method of Congealing Water.

Mr. T. Grothus 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 totally in less than a minute, and the water remained, convert-

ed into ice. I made this experiment in an apartment the temperature of which was 16° R."

Shortening Ropes by wetting them.

If we suspend perpendicularly a rope ten or twelve feet long, and affix to its lower extremity a heavy weight to stretch it as much as possible; the rope, when wetted, will be shortened; and if its length be such only as to allow the weight to touch the ground, the weight will be raised from the ground when the rope is wetted with water.

To cause a Stone to be in perpetual Motion.

Put very small filings of iron into aqua-fortis, and let them remain there until the water take off the iron requisite, which it will do in seven or eight hours. Then take the water and put it into a phial an inch wide, with a large mouth, and put in a stone of lapis calaminaries, and stop it up close; the stone will then keep in perpetual motion.

Barometical Automaton.

The principles on which this small, curious barometer is constructed, have been explained at p. 133; for, since the pressure of the finger on the water, which contains the small figures, makes it descend, and as it rises again when the pressure is removed, it may be imagined that the weight of the atmosphere must produce the same effect. Hence, if the small figure be equipoised in such a manner as to remain suspended during variable weather, it will sink to the bottom when the weather is fine, because the weight of the atmosphere is then more considerable. The contrary will be the case when it threatens rain, and when the mercury in the barometer falls; for the weight of the atmosphere, which

rests on the orifice of the bottle, being lessened, the small figure must of course rise.

A 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 it. 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.

New Compound of Iodine.

Heat an ounce of iodine, with a little water, on a sand-bath, and add to it, by degrees, about two ounces of potash, when the two salts above mentioned will be formed. In order to saturate the excess of alkali, pour in, by degrees, a tincture composed of one ounce of iodine

to six ounces of alcohol, specific gravity 837. When the re-action of the tincture on the potash is finished, pour the hot liquor on a filter, and the liquid which passes through will, as it cools, deposit yellow crystals, of the substance; they should be carefully washed in cold water, to remove all the iodate and hydriodate of potash. Another method is, to take the alcoholic solution of the two salts, prepared as above, and distil it; and when the fluid which comes over ceases to be coloured, to change the receiver; the colourless liquor then obtained, upon cooling, deposits very pure crystals, of the subtance in question. If the distillation be suspended from time to time, and the retort allowed to cool, beautiful crystals of the substance form in it. If strong alcohol be used in the above operations, and but little water, then, upon adding water to the filtered liquor, the substance is precipitated in abundance. This substance is solid, of a lemon yellow colour, tastes like nitric ether, and has an odour like that of saffron. Its form is a compressed hexahedron *(esaedro schiacciato)*. It is insoluble in water, alkalies, or acids, but soluble in alcohol and ether. It fuses and sublimes by a gentle heat, but at a higher temperature becomes discoloured, is decomposed, and evolves vapours of iodine, leaving behind a mere trace of carbon.

Vegetation in Atmospheres of different Densities.

The following experiments have been made by professor Dobereiner, of Jena:—Two glass vessels were procured, each of the capacity of 320 cubic inches, two portions of barley were sown in portions of the same earth, and moistened in the same degree, and then placed one in each vessel. The air was now exhausted in one, till reduced to the pressure of fourteen inches of mercury, and condensed in the other, until the pressure equalled fifty-six inches. Germination took place in both, nearly at the same time, and the leaflets appeared of the same green tint; but at the end of fifteen days the following differences existed:—The shoots in the rare-

fied air were six inches in length, and from nine to ten inches in the condensed air. The first were expanded and soft; the last rolled round the stem and solid. The first were wet on their surface, and especially towards the extremities; the last were nearly dry.

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.

The Mercurial Mallet.

To construct the water mallet, provide a long glass flask, pretty strong, and terminating in a neck that can be hermetically sealed; fill one-fourth or one-fifth of it with water; exhaust the air from it by means of an air pump, and then close the mouth of the flask hermetically. When the flask is taken out, if you fuse the neck of it gently at an enameller's lamp, in order to shut it more securely, the instrument will be completed: and when the water in it is shaken, it strikes it with a noise, like that occasioned by a blow of a mallet. If mercury be inclosed in the flask, instead of water, it will make a much greater noise, or smarter blow; you will be astonished that it does not break the flask. If the mercury be well purified, it will be luminous; so that when made to run from one end to the other, a beautiful stream of light will be seen in the dark.

To boil Water by the application of a Cold Fluid.

The following apparently paradoxical experiment, illustrates the influence of diminished pressure in facilitating ebullition. Insert a stop-cock securely into the neck of a Florence flask, containing a little water, and heat it over a lamp till the water boils, and the steam freely escapes by the open stop-cock; then suddenly remove the lamp and close the cock. The water will soon cease to boil; but if plunged into a vessel of cold water, ebullition instantly recommences, but ceases, if the flask be held near the fire: the vacuum, in this case, being produced by the condensation of steam.

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 seize the opportunity of conveying it secretly away. When you have possession of the handkerchief again, you slip away the curtain ring.

Atar (or Otto) of Roses.

This precious essence is easily obtained, provided the material is supplied in quantities sufficient for the purpose. One hundred weight of roses generally yield from two to three ounces of atar. The roses, with their calyxes, are to be immersed in double their weight of water, and to be distilled by a very gentle heat, from which will be obtained a strongly-scented rose wine. This to be cooled as quickly as possible, by the night air, and the globular particles found upon its surface are to be carefully gathered the next morning, which are more or less abundant, according to the quality of the roses.

It is said that a peculiar fragrant grass is employed abroad, along with the roses, besides other odorous vegetable substances; but although the quantity of essence is thereby increased, its quality is considered to be deteriorated. After the atar has been gathered, the rose-water that remains is powerfully scented. There is no necessity for distilling the roses immediately after they are gathered, as that may be inconvenient, particularly on account of the heat of the weather when the flower is produced. Rose leaves, as well as other flowers capable of affording fragrant essential oils, may be preserved for a long period, without losing any of their odour by being well rubbed and mixed into a paste with common salt. It is even said that the quantity of oil and water is greatly increased by the salting process, which is indeed very probable. The proportion of salt is one pound to three pounds of leaves. The flowers being bruised by the friction of the grains of salt forms a paste, which is to be preserved in an earthen jar form water-tight barrel; continuing the process uniformly until the barrel or jar is filled, which may be kept in a cool place for several years, without impairing its flavour or strength. This aromatic paste may be distilled at any season of the year, mixing it with about twice its weight of water before it is put into the still.

Method of Reading the Inscriptions on Coins and Medals in the Dark.

During the experiments on the revival of the inscriptions on coins by unequal oxidation, mentioned in the first number of the Edinburgh Journal of Science, Dr. Brewster had occasion to expose to a high degree of heat, a coin on which the inscription had been rendered black by oxidation. Upon taking the coin, while in a state of bright red heat, into a dark room, Dr. B. was surprised to observe that the letters of the inscription were more luminous than the rest of the coin, in consequence of their oxidated surface radiating the red light more copiously than the other parts. Though the effect

in this case was not sufficiently striking to make the inscription legible, it occurred to Dr. B. that if, by the action of an acid or any mechanical means, the general surface of the coin could be made rough or have its polished removed, while the raised points which constituted the inscription and the figures were polished, an effect opposite to that in the preceding experiment should be produced. He accordingly took a French shilling of Louis XV. and having roughened the depressed parts of the surface, and heightened the polish of the inscription, he placed it upon a red-hot mass of iron, and removed it into a dark room. When the shilling began to radiate light, the inscription *Benedictum Sit Nomen Dei* appeared in obscure letters, while the ground on which they stood shone with a brilliant light. By polishing the depressed parts of the surface and roughening the letters, Dr. B. obtained, as might have been expected, the opposite effect, the inscriptions being now legible, from it throwing off more light than the surrounding surface. In order to perform this experiment with most success, it is desirable to conceal from the observer's eye the mass of red hot iron on which the coin is placed.

Indelible Ink.

Dr. Maculloch recommends bistre as an indelible ink. Bistre consists chiefly of charcoal and hydrogen, and is analogous to the bitumens. It is most conveniently procured from destructive distillation of wood; and can be obtained gratis, and in any quantities, from the distillers of charcoal, from the gunpowder manufactories, and from the manufacturers of new vinegar. Thus obtained, it is a liquid resembling common tar in consistence. On being subjected to evaporation or distillation, it gives out an essential oil, and ultimately becomes a powder; in a hard state it is the bistre of the artists. It is soluble in the pure alkalies, both potash and soda. The combination with potash remains liquid, if not too far evaporated; that with soda gelatinizes. The process is very simple, consisting merely in boil-

ing the bistre in the alkaline solutions, taking care that they are fully saturated. In this state it becomes an indelible ink, and remains unchanged in a bottle, never changing its colour like common ink. It flows freely through the pen, and can be used to write as rapidly as ordinary ink. It is so incapable of change as to resist even oxymuriate acid gas; nor is it affected by exposure to damp. One of its chief defects is its colour, which is not black but brown. This solution of bistre is also well adapted for water-colour painting.

A method of taking Casts of Leaves and Foliage.

The leaf as soon as convenient after being gathered, is to be laid on fine-grained moist sand in a perfectly natural position, having that surface uppermost which is to forms the cast, and being banked up by the sand, in order that it may be perfectly supported. It is then, by means of a broad camel-hair brush, to be covered over with a thin coating of wax and Burgundy pitch, rendered fluid by heat. The leaf being now removed from the sand and dipped in cold water, the wax becomes hard, and at the same time sufficiently tough to allow the leaf to be ripped off without altering its form. This being done, the wax mould is placed on moist sand, and banked up as the leaf itself was, it is then covered with plaster of Paris made thin, care being taken that the plaster is accurately forced into all the interstices of the mould by means of a camel-hair brush. As soon as the plaster has set, the warmth thus produced softens the wax, which in consequence of the moisture of the plaster is prevented from adhering thereto, and with a little dexterity it may be rolled up, parting completely from the cast, without injuring it in the smallest degree. Casts thus obtained are very perfect, having a high relief, and are excellent models either for the draughtsman or for the moulder of architectural ornaments.

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 centre 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.

German Method of procuring Flowers.

Many foreigners procure flowers in the coldest seasons of the year. To effect this desideratum in Germany, they saw off such a branch as can be readily placed in an apartment, which they put in a running stream to dissolve the ice. It is afterwards carried into a warm room, and immersed in a saturated solution of lime.

The branch is then placed in vitriol and water, and in a few hours both leaves and flowers are seen to shoot forth.

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, if too thick. 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.

The Philosophical Phial

Is a small vessel of glass, which has been suddenly cooled, open at the upper end, and rounded at the bottom. It is made so thick at the bottom, that it will bear a smart blow against a hard body without breaking: but if a little pebble, or piece of flint, is let fall into it, it immediately cracks, and the bottom falls into pieces: but unless the pebble or flint is large and angular enough to scratch the surface of the glass, it will not break.

Blue Iris, a Test colour.

Professor Ormstead recommends the tincture of the petals of the garden iris, or blue lily, as superior to every other test liquor known. It is reddened as litmus

is, by blowing through it, or by a stream of carbonic acid gas. It is more convenient than violets, from the abundance of colouring matter contained in the petals: and it is said to be superior to red cabbage tincture, as well from its permanency as its delicacy. Of the former cause of superiority there may be doubts. This application of the petals of the blue iris has long been known to us; by rubbing them upon paper, we form a very convenient test either for acids or alkalies.

Imitation of Mother-of-Pearl.

The imitation of mother-of-pearl is produced by a preparation of sea-shells, reduced to powder, and formed into a paste. The Chinese are said to form their imitations of mother-of-pearl from rice glue, which is nothing more than rice ground to an impalpable powder, intimately mixed with cold water, and then gently boiled: a paste is thus produced which may be formed into moulds or figures.

Easy Mode of imitating Chalybeate Waters.

If a few pieces of silver coin be alternated with pieces of sheet iron, on placing the pile in water, it soon acquires a yellowish hue and chalybeate taste, and in twenty-four hours flocks of oxide of iron appear. Hence, by replenishing with water, a vessel in which such pile is placed, after each draught, we may have a sufficient substitute for a chalybeate spring. Clean copper-plates alternating with iron, would answer, or a clean copper-wire, entwined on an iron rod; but as the copper when oxidated yields an oxide, it is safer to employ silver.

Method of cleaning Playing Cards.

Nothing soils sooner than playing-cards, and they are an expensive article to replace, owing to the high duty

they pay. The following method will be found to remove every thing from them but a stain, and will give the dirtiest pack possible the appearance of being new. Rub the soiled card with a piece of flannel and some good fresh butter, until the butter shall have cleaned off all the dirt. So soon as the dirt is removed, wipe off the butter with a clean rag; and to restore the card to its former gloss, rub the surface sharply with a piece of flannel and some flour: cut the edges neatly with a pair of scissars, and the operation is completed.

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.

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*.

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 shall 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.

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 purposes of priestcraft and delusion.

The Invisible Girl.

This mystery is managed better in France than in this country. They have a communication by tin pipes, which end in a clear horn trumpet, inserted in an isolated glass chest or barrel, which is attached to the ceiling only by coloured ribbons, twined round a small gilt chain. In the inside of these pipes, at right angles, are placed small mirrors, which reflect and contract every object in the exhibition room, so that the responser can see as well as hear, all that occurs, even to objects held in the hands of the visitors, such as watches, money, &c.

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.

To wash Chintz so as to preserve its Gloss and Beauty.

Take two pounds of rice, and boil it in two gallons of water till soft; when done, pour the whole into a tub; let it stand till about the warmth you in general use for coloured linens; then put the chintz in, and use the rice instead of soap; wash it in this, till the dirt appears to be out; then boil the same quantity as above, but strain the rice from the water, and mix it in warm clear water. Wash it in this till quite clean; afterwards rinse it in the water the rice was boiled in, and this will answer the end of starch, and no dew will affect it, as it will be stiff as long as it is worn. If a gown, it must be taken to pieces; and when dried, be careful to hang it as smooth as possible; after it is dry, rub it with a sleek stone, but use no iron.

Musical Barometer.

A gentleman in Switzerland, invented some years ago sort of musical barometer, which has been called in the German *wetter harfe* (weather harp,) or *reisen harfe*, (giant harp,) which possesses the singular property of indicating changes of the weather by musical tones. This gentleman was in the habit of amusing himself by

shooting at a mark from his window; and that he might not be obliged to go after the mark at every shot, he fixed a piece of iron wire to it, so as to be able to draw it to him at pleasure. He frequently remarked that this wire gave musical tones, sounding exactly an octave, and he found that an iron wire extended in a direction parallel to the meridian, gave this tone every time the weather changed. A piece of brass wire gave no sound, nor did an iron wire extended east and west. In consequence of these observations, a musical barometer was constructed. In the year 1787, Captain Hans, of Basle, made one in the following manner:—Thirteen pieces of iron wire, each 320 feet long, were extended from his summer-house to the outer court, crossing a garden. They were placed about two inches apart, the largest were two lines in diameter, the smallest only one, and the others about one and a half: they were on the side of the house, and made an angle of twenty or thirty degrees with the horizon; they were stretched and kept tight by wheels for the purpose. Every time the weather changes, these wires make so much noise, that it is impossible to continue concerts in the parlour, and the sound resembles that of a tea-urn when boiling; sometimes that of an harmonicon, a distant bell, or an organ. In the opinion of the celebrated chemist, M. Dobereiner, this is an electro-magnetical phenomenon.

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 which 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 clean it from the powder, and give it a still brighter lustre. In case of white grounds, fine putty or whiting must be used.

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 vermillion 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 shorter or longer 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.

How to prepare Parchment for Painting.

Take about a yard and half of list, and roll it up very tight in a circular form; then take some finely powdered white pumice-stone, put the list in it, and rub it over the parchment. This plan, which is simple and very common, answers the best of any. If you wish it to take water colours without sinking, choose that which is not spongy and soft, and use alum-water with the colours when you mix them for use.

Easy method of taking Impressions from Medals, Coins, &c.

Boil a quantity of isinglass in rum, brandy, or other spirit, till it is in a sufficiently liquid state to pour upon the metal, &c. Any colour may be mixed with this composition; but it must be poured in a liquid state to the mixture; it is best to mix the colour with the spirit. A more correct way of taking impressions cannot possibly be used.

Mode of imitating Seed Pearls.

Cut silver lace into pieces of various lengths; put them into a small crucible, with pounded charcoal, one stratum above another; give it a heat sufficient to melt the silver, which will be found, on cooling, fused into round grains resembling pearls.

How to clean Old Pictures, painted in Oil Colours.

Clean the picture well with a sponge, dipped in warm beer; let it become very dry, and wash it with liquor of the finest gum-dragon, dissolved in fair water. Never use blue starch, which tarnishes and cuts out the colouring, or white of eggs, which casts a thick varnish over the pictures, and only mends bad ones by concealing the faults of the colouring.

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.

Painting in Milk.

Painting in milk may be used in place of distemper or oil painting, by means of a composition made with two pints of skimmed milk, eight ounces of slaked lime, six ounces of linseed or nut oil, five pounds of Spanish white, and two ounces of Burgundy pitch: the pitch is to be slowly melted in the oil, by a gentle heat; then add to it the mixture of milk and lime, being careful that it be previously heated, so as to prevent the too

sudden cooling of the pitch. A substitute for this resinous milk may be made by mixing 144 parts of very dry powdered skimmed-milk cheese, seven parts of slaked lime, 240 parts of Spanish white, and two parts of finely powdered charcoal, with eighty parts by weight of water.

A new Stain for Wood.

A beautiful new stain for wood, consists of a decoction of walnut or hiccory bark, with a small quantity of alum dissolved in it, to give permanency to the colour. Wood of a white colour receives from the application of this liquid a beautiful yellow tinge, which is not liable to fade. It is particularly adapted for furniture made of maple, particularly that kind of it called birds'-eye. The application of the walnut dye gives a lustre even to the darkest shades, while to the paler and fainter ones it adds a somewhat greenish hue, and to the whiter parts various tints of yellow. After applying this stain to cherry and apple wood, the wood should be slightly reddened with a tincture of some red dye whose colour is not liable to fade. A handsome dye is thus given, which becomes more beautiful as the wood grows darker by age.

To place a lighted Candle under Water, without extinguishing it, or a Handkerchief, without wetting it.

Take a glass, and fastening a small piece of wood across the mouth, stick upon it a piece of candle lighted, 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 a-light. In the same manner a handkerchief may be immersed without being wetted, if rolled very tightly together. The principal art consists in the nicety of 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.

Optical Experiment with Butterflies.

On a fine sunshiny day, when butterflies are about, (with a hat lightly put upon the head to screen the eyes from the sun) place one angle of a prism a little below the eyes, and move it up and down, until you see the prismatic colours. The butterflies within fifty yards or more, will be seen moving about, not in their insect form, but as a vibrating, tremulous flame of perpendicular fire, which, by the movement of the prism, will appear from two to four inches in length. This experiment is best made in a garden of flowers.

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.

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

This is performed on the same principle as the preceding. 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.

To take Three Balls off two Strings.

While the balls are examining, you double each string, and each appears to have two even ends; you twist the double end of each together, and putting on one of the balls which has a hole smaller than the others over the place that is joined, the strings remain firm, and can bear to be pulled. Each person that holds, thinks that he has the extremities of two strings, while in fact he has only the ends of one. By a jerk the middle ball comes off, followed by the rest; you then slip them into the hands of one of the persons who holds the strings; he of course lets go his hold, and you then take care to put the strings lengthways. This is a clever feat when performed adroitly, but it requires no slight degree of dexterity to conceal the deception. Formerly the feat was performed with three button moulds on two small whip cords of about two feet each, and with three rings upon two ribbons, but the balls and tapes are preferable.

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 find 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 slight of hand change it for the pieces, which must be instantaneously concealed.

To make a Sheep-pen which contains an Hundred Sheep, accommodate double the Number, by the addition of Two more Hurdles.

In the original pen, or that which holds the hundred sheep, the hurdles must be so disposed that there shall be but one at the top or bottom thereof. Then it is obvious, that if one hurdle more be placed at each end, the place enclosed must necessarily be double that of the first pen, and consequently it will hold twice the number of sheep.

Changes of the Kaleidoscope.

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,

amounting (according to our frail idea of the nature of things) to an eternity. 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.

The Noeturnal Reveilleur.

Against the wall of a room, near the ceiling, fix a wheel of 12 or 18 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 suspended 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 or cone 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. The size of the bells should be adapted to the somniferous disposition of the party intended to be roused; or if you please, a drum or tabor may be added, the stick to which may be fixed in the side of the room, by a swivel that goes through the middle of it, and one end of it being lifted up by the teeth placed upon the circumference of the wheel, the other end will alternately strike the drum.

The Horizontorium.

The horizontorium, on which the sketch (fig. 31) in the frontispiece is founded, is an ingenious recreation, which was introduced to the public about three years since, and is one of the most amusing optical deceptions ever witnessed. When viewed at any other but the correct point of sight, the designs appear a mere groupe of distorted objects, but when looked at correctly, has all the appearance of reality. As the effect depends entirely upon correctly placing the sight-piece, through which it is to be viewed, we have adopted a mode of describing it, which can be hardly be misunderstood.—A piece of paper, or card (which is better) must be cut out, of the precise shape and height of the piece A B C; an aperture for the eye, about the size of a pea (A) must be made, precisely on the spot shewn in the sight-piece. The shaded part of the sight-piece must be folded back at a right angle, so as to form a kind of foot to stand upon. The sight-piece must then be placed perpendicularly, exactly, over the place D: Then keeping the paper perfectly horizontal, and placing the eye close to the aperture A, there may be seen a perfect representation of a castle, surrounded by scenery. A very little experience will give the image or model very exactly; if not, the person who makes the trial may depend upon it that he has not placed the sight-piece correctly. The light ought to fall on the side of the figure opposite the shadow. If the representation of the sight-piece A B C is found to interfere with the picture, it may be covered with a small piece of paper. Especial care should be taken that the paper be perfectly smooth, as the slightest wrinkle will distort the figure materially. The eye must also be placed as close as possible to the sight-hole.

To purify Glass Vessels.

All sorts of glass vessels and other utensils may be purified from long retained smells of every kind, in the

easiest and most perfect manner by well rincing them with charcoal powder, after the grosser impurities have been scoured off with sand and potash.

Singular effect of Heat.

If a piece of tin-foil be wrapped in a piece of platinum-foil of the same size, and exposed on charcoal to the action of the blow-pipe, the union of the two metals is indicated by a rapid whistling, and by an intense brilliancy in the light which is emitted. If the globule thus melted is allowed to drop into a basin of water, it remains for some time red-hot at the bottom; and such is the intensity of the heat, that it melts and carries off the glaze of the basin from the part on which it happens to fall.

The Chick in Ovo.

Mr. David Ritchie says, he has heard of a mode of discovering the sex of the chick in ovo, differing from any which have been proposed by naturalists. The folliculus aeris, or air-cell, which is to furnish oxygen to the future chick, is situated at the larger end of the egg. It has not in all eggs the same position at the larger end; and in various districts of Scotland, it is believed that eggs bearing the air-cell only near the top of the larger end produce females. To ascertain this Mr. R. instituted a series of experiments. These experiments go very far to prove that the opinion which has been stated is correct, and so to determine what naturalists of Germany, France, and England, have endeavoured in vain to discover.

A curious Electro-Magnetic Experiment.

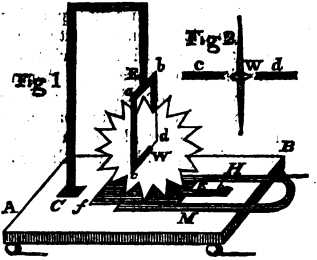


Fig. 1. A B is a rectangular piece of hard wood; C D E a piece of stout brass or copper wire; and *a b c d*, a rectangle of smaller copper wire (soldered at E;) on the lower side of which the wheel W of thin copper turns freely; *f g* is a small reseavoir of mercury sunk in the wood; and *g i* a narrow channel running into it. H M is a strong horse-shoe magnet.

Mercury being now poured into the reservoir *f g*, till the teeth of the wheel are slightly immersed in it, and the surface covered with weak dilute nitric acid, make the connexion with the battery at *i* and D; and the wheel W will immediately begin to rotate with astonishing velocity, far beyond the power of the eye to follow, and will thus produce the most pleasing effect.

The suspension of the wheel is shewn in fig 2; and it may be proper to add, that in order to ensure a complete contact, the two sockets and the ends of the spindle should be amalgamated, as also the tops of the points of the wheel.

If the contact be changed, or if the magnet be reversed, the motion of the wheel will be reversed also; but the best effect is produced when the wheel turns inwards.

A Fire and Water-proof Cement.

To half a pint of milk put an equal quantity of vinegar, in order to curdle it; then separate the curd from the whey, and mix the whey with the whites of four or five eggs, beating the whole together. When it is well mixed, add a little quick lime, through a sieve, until it has acquired the consistency of thick paste. With this cement broken vessels and cracks of all kinds may be mended. It dries quickly, and resists the action of fire and water.

RECREATIONS WITH CARDS.

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 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.

At the Game of Whist, what probability is there, that the Four Honours will not be in the Hands of any Two Partners?

De Moivre, 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 29 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	

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 them 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.

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 sake, may name the knave of hearts when it occurs.

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 be thus explained. In the pack of cards are 13 of each suit, the sum of all the spots of each suit, calling the knave 11, the queen 12, and the king 13, is seven times 13, or 91, which is a multiple of 13; consequently, the quadruple of this sum is a multiple 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.

Several Cards being presented in succession to several Persons, to guess that which each has thought of.

Shew as many cards to each person as there are persons to choose; that is to say three to each, if there are three persons. When the first has thought of one, lay aside the three cards in which he has made his choice. Present the same number to the second person, to think of one, and lay aside those three cards also. Having done the same with the third person, spread out the three first cards with their faces upwards, and place above them the next three cards, and above these the last three, that all the cards may thus be disposed in three heaps, each consisting of three cards. Then ask each person in which heap the card is which he thought of; that being known, it will be easy to tell these cards, for that of the first person will be the first in the heap to which it belongs; that of the second will be the second

of the next heap, and that of the third will be third of the last heap.

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.

A Person having drawn any number of Cards from a Pack, to guess the whole number of Spots that they contain.

Assume any number, (say 15, for example) greater than the number of the spots of the highest card, counting the knave 11, the queen 12, the king 13, and desire the person to add as many cards from the pack, to the first card he has chosen, as will make up 15, counting the spots of that card; let him do the same in regard to the second, third, fourth, &c.; and then desire him to tell how many cards remain in the pack. Then proceed as follows:—Multiply the above number 15, (or any

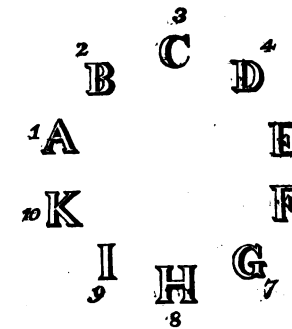
other that may be assumed) by the number of cards drawn from the pack, which we will suppose to be 3; to the product 45, add the number of these cards, which will give 48, subtract the 48 from 52, and take the remainder 4 from the cards left in the pack; the result will be the number of spots required. Let us suppose, for example, that the person has drawn from the pack a 7, a 10, and a knave, which is equal to 11; to make up the number of 15 with a 7, eight cards will be required; to make up the same number with a 10, will require five; and with the knave, which is equal to 11, four will be necessary. The sum of these three numbers, with the three cards, makes 20, consequently 32 cards remain in the pack. To find the sum of the numbers 7, 10, 11, multiply 15 by 3, which will give 45; and if the number of the cards drawn from the pack be added, the sum will be 48, which taken from 52, leaves 4. If 4 then be subtracted from 32, the remainder, 28, will be the sum of the spots contained on the three cards drawn from the pack.

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 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.

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 suit, 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 that 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 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; 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.

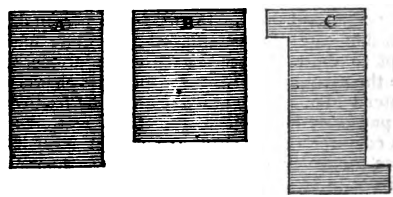
To alter a Card to another which has been secured in a locked-up Box.

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. *Note.*—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.

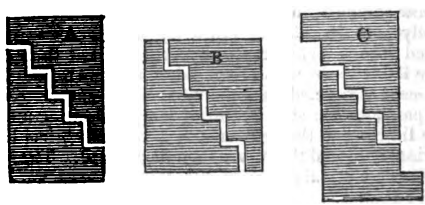
INGENIOUS PROBLEMS.

PROBLEM. I.

A parallelogram (A) may be cut into two pieces, which shall form the two other figures (B and C). It need scarcely be added, that whatever may be the dimensions of the piece A, the pieces B and C will bear the same proportion to it as they do in this figure.



SOLUTION.



PROBLEM II.

Five shillings or sixpences may be so placed over each other, as to be all visible and all be in contact.

SOLUTION.

The two shillings to the right and left are placed over the other two in such a way as just to touch the lower one; the fifth shilling may be then placed on its edge, which cannot be clearly exhibited in the cut, on the spot where the four touch, so as to be in contact with the whole.

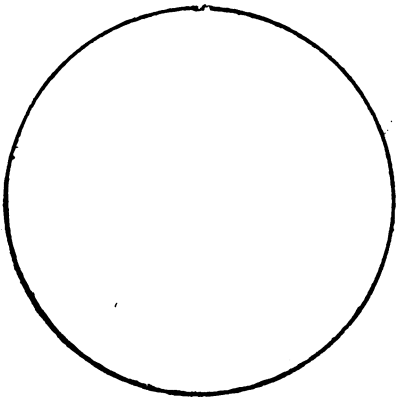
ANOTHER SOLUTION.

In the preceding figure, only one of the five shillings was placed edgewise. In this, as is clear from the sketch, three are ranged flat and two on edge.

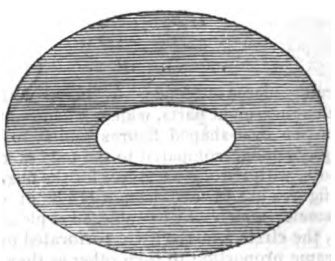
PROBLEM III.

A circular piece of paper, A, may, without any waste, be cut into eight parts, which, when put together, shall form two oval-shaped figures similar to B, which may be aptly enough compared to the tops of counting-house stools, with oblong apertures for the fingers. The annexed figures are formed from a circle of only two inches diameter, which may be enlarged at pleasure; but, of course, the circle and the two perforated ovals, will bear the same proportion to each other as they do in the

subjoined figures. This might be an useful and practical problem, as a person having a very choice piece of veneer wood, tortoise-shell, &c. of a circular form, might, without any waste, form out of it the tops of two oval tea-caddies, &c. leaving an open space in the centre, which might be inlaid with some other ornamental material, or silver name-piece.



B



SOLUTION.

Form two concentric circles (fig. 1) the outer double the diameter of the inner; divide them, as in the figure, and cut them into the eight pieces, 1, 2, 3, 4, 5, 6, 7, 8, which, when put together, will form two oval shaped figures resembling figure 2, the mode of forming which is too simple to require any further explanation.

Fig. 1.

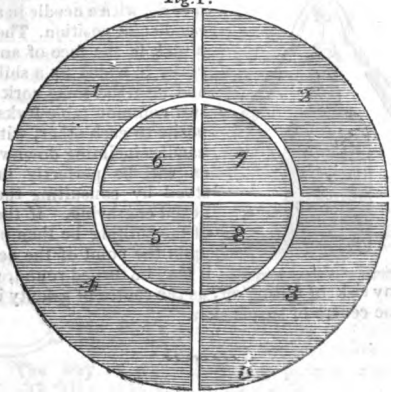
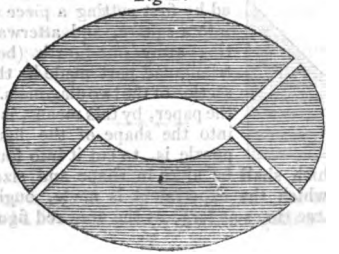


Fig. 2.



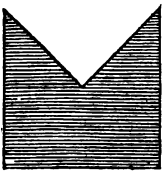
PROBLEM IV.

You are required to make a shilling turn upon its edge on the point of a needle.

SOLUTION.

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.

PROBLEM V.

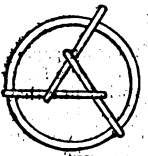


The figure in the margin is formed by first cutting a piece of paper into a square, and afterwards cutting away one-fourth (being the triangular part made by the intersection of the two diagonals.) When the paper, by this means, is brought into the shape of the figure, the puzzle is, to cut it into four parts, each of which shall be alike in shape and size. The paper on which the experiment is made, ought to be twice or three times as large as the annexed figure.

SOLUTION.

The figure must be divided, as in the margin; but, in cutting out the four pieces AA, BB, CC, DD, care must be taken not to cut through the external edge of the figure, or the pieces will not hang together. The scissors, or knife, must be brought as near as possible to the edge. It will be perceived that the pieces, though similar in shape, are not precisely so in size; but they are so nearly alike as to make the puzzle a very fair one.

PROBLEM VI.



The annexed figure explains a most ingenious device for forming flat roofs or floors, of pieces of timber, little more than half the length of such roof or floor. This plan is well known to architects; and is particularly mentioned in Plot's Natural History of Oxfordshire, from which we have taken this figure. The way in which a young person may be amused with this puzzle, is as follows:—Suppose a common basin to be six inches in diameter, it may be roofed over, as in the figure, with three slips of wood, &c., although these slips shall very little exceed half the diameter of the basin, say half an inch longer. In performing this puzzle, let the slips of wood be thin, like matches, or they will not lap over each other, so as to form a flat roof.

PROBLEM VII.

Two men, A and B, went to C, to purchase some spirits. A had a five gallon keg, B a three gallon keg, and

C had no other measure but an eight gallon keg. Now A and B want each four gallons of liquor, I wish to know if it be possible for C to measure the desired quantities to his two customers; and if it be possible, how he does it?

SOLUTION.

Fill the three gallon keg out of the eight; pour the three into the five; fill the three again out of the eight, and pour two of it out of the three into the five. This will fill the five, and leave one gallon in the three; empty the five into the eight, and the one out of the three into the five. Fill the three again, and then pour it to the one in the five. There will be four in the five, and four in the eight, each man's equal share.

PROBLEM VIII.

Let a piece of card, or stiff brown paper, (which is preferable) be cut into the form of the arch of a bridge, somewhat like that in the margin, but twice or three times the size. The other piece (which in the annexed figure is reared against the arch, and may be supposed to be a ladder) would be better of pasteboard. When the two parts are cut across and placed in an inclined position, as here represented, supporting each other, they may be raised from the table, both together, and replaced in their present position, without letting either piece fall, by means of a long pin, knitting needle, thin pencil, &c., inserted between the arch and the ladder. It is best done when there is a cloth on the table.

SOLUTION.

Let the top of the arch be gently moved aside by the pencil until the top of the ladder falls a little within it. The whole may then be raised.

PROBLEM IX.

Let a piece of apple, turnip, &c., be cut into the horse-shoe form; stick six pins where the dots appear, the puzzle then is by two cuts only, to divide the apple or turnip into six parts, each containing one pin.

SOLUTION.

Cut off the upper circular part, containing two of the pins, then, by changing the position of the piece, another cut will divide the horse-shoe into six portions, each containing one pin.

PROBLEM X.

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.

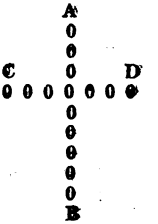
SOLUTION.

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.

PROBLEM XI.

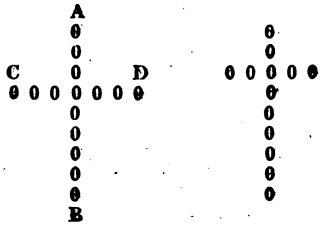
A lady had occasion to send a diamond cross to a jeweller, to be repaired. To provide against any imposition, she had the precaution to count the number of diamonds, which she did in the following manner:—She found the cross contained in length, from A to B, nine diamonds. Reckoning from B to C, or from 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?



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.



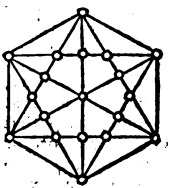
PROBLEM XII.

Tell me, illustrious Pythogoras, how many pupils frequent thy school? One half, replied the philosopher, study mathematics, one-fourth natural philosophy, one-seventh observe silence, and there are three females besides. The question here is, to find a number, the one-

half, one-fourth, and one-seventh, of which + 3, shall be equal to that number: it may easily be replied, that this number is twenty-eight.

PROBLEM XIII.

Place nineteen halfpence on a table (a round one is best) in such a manner as they will make nine rows, of five in each.



SOLUTION.

Make an hexagonal figure, as in the margin, and at every angle and point of intersection, place one half-penny or counter.

PROBLEM XIV.

How can you plant twelve trees in six rows, so as to have four in each row?

SOLUTION.

One tree to be planted at each angle and at each point where the lines intersect each other.

PROBLEM XV.

A gentleman passed the sixth part of his life in childhood, and the twelfth part in a state of youth; after a seventh part of his life and five years more were elapsed,

he had a son, who died when he had attained to half the age of his father; the latter survived him only four years. To resolve this problem, we must find a number, the one-sixth, one-twelfth, one-seventh, and one-half of which + 5 + 4, shall be equal to the number itself. This number is eighty-four.

PROBLEM XVI.

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."

PROBLEM XVII.

A man has a wolf, a goat, and a cabbage, to carry over a river, but, as he is obliged to transport them one by one, in what manner is this to be done, that the wolf may not be left with the goat, nor the goat with the cabbage?

SOLUTION.

He must first carry the goat, and then return for the wolf; when he carries over the wolf, he must take back

with him the goat, which he must leave, in order to carry over the cabbage; he may then return, and carry over the goat. By these means, the wolf will never be left with the goat, nor the goat with the cabbage, but when the boatman is present.

PROBLEM XVIII.

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.

PROBLEM XIX.

If from six you take nine, and from nine you take ten,
Ye wits, now the puzzle explain;
And if fifty from forty be taken, there then
Will just half a dozen remain.

SOLUTION.

From SIX take IX and S
—— IX — X — I
—— XL — L — X
} will remain.

PROBLEM XX.

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
	2d	2	2	3
	3d	3	3	1

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

PROBLEM XXI.

To place 4 poles in the ground, precisely at an equal distance from each other.

SOLUTION.

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.

PROBLEM XXII.

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.

PROBLEM XXIII.

Put down four nines, so that they will make one hundred.

SOLUTION.

$99\frac{9}{9}$.

PROBLEM XXIV.

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.

PROBLEM XXV.

Three jealous husbands, with their wives, having to cross a river at a ferry, find a boat without a boatman; but the boat is so small it can contain no more than two of them at once. How can these six persons cross the river, two and two, so that none of the women shall be

left in company with any of the men, unless her husband is present?

SOLUTION.

Two of the women must cross first, and one of them, rowing back the boat, carries over the third woman. One of the three women then returns with the boat, and remaining, suffers the two men, whose wives have crossed, to go over in the boat. One of the men then carries back his wife, and leaving her on the bank, rows over the third man. In the last place, the woman who had crossed enters the boat, and returning twice, carries over the other two women.

PROBLEM XXVI.

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

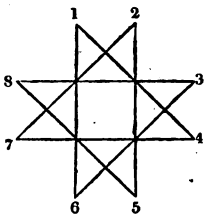
PROBLEM XXVII.

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.

PROBLEM XXVIII.



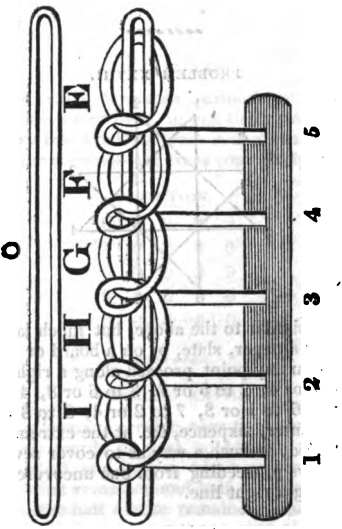
A figure similar to the above, but much larger, may be drawn on a paper, slate, or on a board or table with chalk. From any point proceed along a right line, as from 1 to 6 or 4, 2 to 5 or 7, 3 to 6 or 8, 4 to 7 or 1, 5 to 8 or 2, 6 to 1 or 3, 7 to 2 or 4, 8 to 3 or 5, and deposit a counter, sixpence, &c. at the extremity of the line so traced, in such a way as to cover seven of the points, always proceeding from one uncovered point to another along a right line.

SOLUTION.

The mode of accomplishing this is always to cover the point from which you last proceeded. To illustrate

this, suppose we begin from 1, and the two methods of performing it from that point:—1 to 6, 4 to 1, 7 to 4, 2 to 7, 5 to 2, 8 to 5, 3 to 8; thus seven of the points will be covered. If from 1, instead of proceeding in the first instance to 6, we choose to move to 4, the operation will then be, 1 to 4, 6 to 1, 3 to 6, 8 to 3, 5 to 8, 2 to 5, 7 to 2. On this principle, whatever point you proceed from, the problem will be solved.

PROBLEM XXIX.



The Puzzling Rings.—The inventor of this perplexing toy is unknown, but the invention is of considerable

antiqtüity: for Cardan, who began to write early in the sixteenth century, makes mention of the instrument called *Complicati Annulli*, or Puzzling Rings, and has left a very obscure description of the construction and the art of managing the toy. The annexed diagram will show the reader the construction of the rings and their necessary accompaniment, the staple. After this part is properly comprehended, the method of managing the instrument will soon be acquired, from the directions for working it which conclude this essay. The instrument may be thus described:—A thin plate of metal, 1, 5, has any number of holes drilled through it at equal distances; they are five in the figure, and are marked by the numbers 1, 2, 3, 4, 5. These holes, besides being at equal distances, are round, equal in diameter, and placed in a right line. To each of these holes a metal pin is properly adjusted; that is, it is furnished with a broad head, to prevent it from slipping through the hole; the upper part of the pin is considerably less in diameter than the perforation which it occupies. This circumstance is necessary, because the pin is to move with ease, not only up and down, but also in all directions. The top of this pin is bent into a loop, for the reception of a ring, which moves easily in the loop, but cannot be taken out of it. The diameter of these rings is less than the length of the pins, but greater than the distance of two adjacent holes. These parts are thus put together, and implicated one with another, viz. let its proper pin pass through the hole 1, and after the pin is so placed, let the upper end of it be so bent into a loop as to receive and retain the ring I. In like manner let the pin 2 H pass through the hole 2, and also through the ring I; after which, let the upper end of it be bent into a loop, as above described, for the reception of the ring H. In the same way, let the remaining holes, 3, 4, 5, be furnished with moveable pins, each of which passes through the ring attached to the preceding pin, and is afterwards bent into a loop, to receive and retain a ring; thus, pin 3 G passes through the ring H, and holds the ring G; in like manner the pin 4 F passes through the ring G, and holds the ring

F; and also the pin 5 E passes through the ring F, and is furnished with the ring E, as in the figure.

The figure marked O represents an essential part of the instrument; it is called the staple or needle. It should be made a little longer than the plate 1, 5, but not of a breadth which would prevent it from passing easily through the rings; and the hollow part of the staple should be of a dimension to permit two rings, with their respective loops, to pass easily at the same time through the cavity, when they are turned down with their edges.

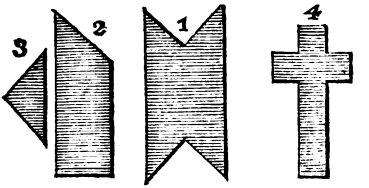
When the instrument is finished, pursuant to the preceding directions, the staple may be passed, with proper management, through all the rings from E to I, and when this is done, it may be again extricated by an inverse process. It is here intended that the staple should not only pass through the rings, but that it should also contain, in its oblong cavity, all the pins attached to the rings.

The method of performing the direct and inverse operations is as follows:—1st. Introduce the ring E through the staple O, by two motions, viz. E through O —O through E. This being done, the staple will pass through E, and include the pin 5 E within the cavity. 2d. Introduce F into O by these four motions; take E from the end of O—put F through O—O through F and E. 3d. Introduce G by eight motions, viz. 1st. Let E down by these two motions: take O from E—E from O; then take F from the end of O—introduce G through O—O through G and F; put E through O and O through E. By this last operation, the staple passes through the three first rings, E, F, G, and includes their respective pins, 5 E, 4 F, 3 G. In like manner, the ring H, with the three preceding, G, F, E, may be introduced with their pins into the staple, by sixteen motions; also the ring I may be introduced with all the preceding rings, by thirty-two motions, &c.

The converse of the preceding operation, or that by which the staple is again extricated from the rings, wants but little explanation, when the former process is understood. It is only necessary to remark on this

subject, that the first business is to take down the ring I, which is done thus:—Take down the three first, E, F, G, by inverting the operation by which the staple was introduced through them; then I may be taken down, and H will remain upon O. Introduce the staple again through E, F, G, and take down E, F; then H may be removed, and G will remain upon O. Again, introduce the staple through E, F, and take down E; then G may be removed. Lastly, put up E, and let down E, F, by which motion the staple will be freed from all the rings.

PROBLEM XXX.



Cut out of card or paper five pieces, similar in shape and size to the above; viz. one piece of fig. 1, one of fig. 2, and three pieces like fig. 3.—These five pieces may then be so joined as to form a cross, like that represented by fig, 4; but of course larger in size.

SOLUTION.

A simple inspection of the annexed cross will show how the five pieces must be arranged to form a cross.

PROBLEM XXXI.

The following magic tables should be copied on two separate pieces of card or paper.

A	B	C	D	E	F	G	H	I
51	70	26	63	55	29	48	22	59
24	34	71	18	73	11	3	58	5
42	7	35	54	19	38	57	13	32
15	79	53	27	46	20	12	67	50
60	25	17	45	1	47	39	40	14
78	52	62	81	28	74	66	76	77
6	16	44	9	64	56	21	4	41
69	61	80	36	10	2	75	31	68
33	43	8	72	37	65	30	49	23

1	2	3	4	5	6	7	8	9
1	10	19	28	37	46	55	64	73
2	11	20	29	38	47	56	65	74
3	12	21	30	39	48	57	66	75
4	13	22	31	40	49	58	67	76
5	14	23	32	41	50	59	68	77
6	15	24	33	42	51	60	69	78
7	16	25	34	43	52	61	70	79
8	17	26	35	44	53	62	71	80
9	18	27	36	45	54	63	72	81

SOLUTION.

The person, to whom the trick is intended to be shewn, is presented with a *duplicate* of the first table, and requested to choose any number in it, keeping that number secret. He is then to tell the person showing the trick, what letter stands over the column in which the chosen number is placed. The other table is then offered to him. The numbers in this table are placed in regular order; he will therefore readily discover the number he has chosen, (each table containing the same numbers in different orders) and is to point out the column in which that number is situated. Any person, understanding the trick, may now, without seeing the first table, tell which of the numbers in the column is the chosen one, by this simple rule: he is, as before stated, to know the letter standing over the column in

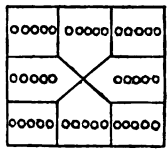
which the number is situated in the first table. Now, if that letter be E, the number will be the first in the column, pointed out in the second table, as containing the same number; if F, it will be the second, and so on, thus:

A	B	C	D	E	F	G	H	I
6th	7th	8th	9th	1st	2d	3d	4th	5th

EXAMPLE.

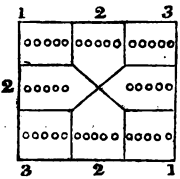
Suppose the number chosen be 17, the letter standing over that number in the first table being C, in whatever column the same number stands in the second table, it is sure to be the eighth in that column. Again, a person, having chosen a number, says the column in which it is placed is headed by the letter F, all the numbers in that column we know will stand second in whichever of the columns of the second table they may be placed; therefore, when we are told the number stands in the last column of the second table, we know that number to be 74.

PROBLEM XXXII.



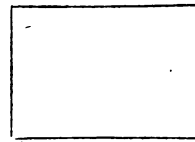
A figure similar to the above, but much larger, should be drawn on a slate or paper, &c. It will be observed, that there are five marks in each square; and that, counting as from one to three, they reckon fifteen each way. The puzzle is to take away eight of these marks, and substitute only four in such a way that they shall still reckon fifteen each way.

SOLUTION.



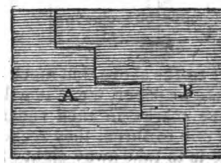
Take two marks from each of the four squares, indicated by the figure 2; and, in lieu of those eight abstracted, place one mark in each of the four squares, 1, 3—1, 3. They will then count fifteen each way, as they did before.

PROBLEM XXXIII.



A parallelogram, consisting of a square and half a square, must be formed of paper or card; and by one cut divided into two pieces, which, joined, form an exact square. In this ingenious problem there is no doubling up of the paper.

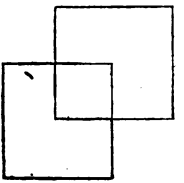
SOLUTION.



With a pair of compasses divide the longer side of the parallelogram into five parts, and the shorter side

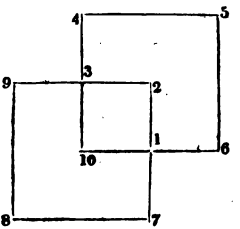
into four parts; then cut the whole in steps, as indicated in the foregoing figure: the two halves (A and B) may then be put together so as to form an exact square, by raising the part B one step.

PROBLEM XXXIV.



A figure similar to the above, consisting of two squares, intersecting each other, may be formed without removing the pen or pencil, crossing any line, or retracing any part.

SOLUTION.

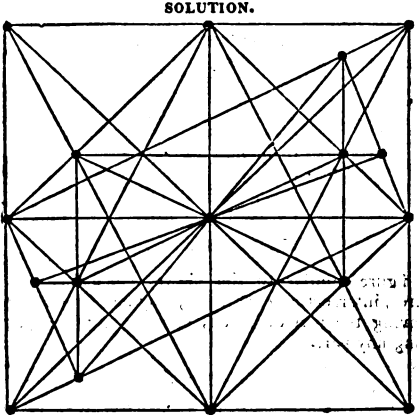


Draw a line from 1 to 2,—2 to 3,—3 to 4,—4 to 5,—5 to 6,—6 to 1,—1 to 7,—7 to 8,—8 to 9,—9 to 3,—3 to 10, and 10 to 1.

PROBLEM XXXV.

If I can plant, with seventeen trees,
Twice fourteen rows, in each row three,
A friend of mine I then shall please,
Who says he'll give them all to me.

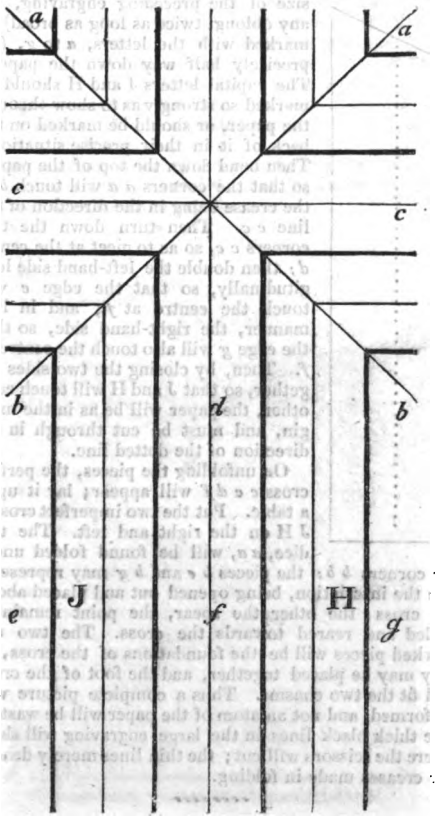
SOLUTION.

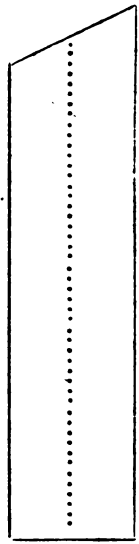


PROBLEM XXXVI.

An oblong piece of paper, (say about the size and shape of a common card) may be folded in such a manner, that, by one cut of the scissors, several pieces may be produced, bearing considerable resemblance to the following things:—The cross, upon which Christ suffered, which, from its perfect form, may be called the crucifix; two imperfect crosses, which may be considered the thieves' crosses; two pieces forming a pedestal for the principal cross; a piece for the scroll or inscription over it; the spear with which Christ was pierced; and two cubes, representing the dice with which the soldiers cast lots for his garments.

SOLUTION.

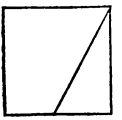




Let a piece of paper, of the form and size of the preceding engraving, (or any oblong, twice as long as broad) be marked with the letters, *a* to *g*, (*b b* precisely half way down the paper.) The capital letters J and H should be marked so strongly as to show through the paper, or should be marked on the back of it in their precise situations. Then bend down the top of the paper, so that the corners *a a* will touch *b b*, the crease being in the direction of the line *c c*. Then turn down the two corners *c c*, so as to meet at the centre *d*; then double the left-hand side longitudinally, so that the edge *e* will touch the centre at *f*; and in like manner, the right-hand side, so that the edge *g* will also touch the centre at *f*. Then, by closing the two sides together, so that J and H will touch each other, the paper will be as in the margin, and must be cut through in the direction of the dotted line.

On unfolding the pieces, the perfect cross *c c d f* will appear; lay it upon a table. Put the two imperfect crosses J H on the right and left. The two dice, *a a*, will be found folded under the corners *b b*; the pieces *b e* and *b g* may represent, one the inscription, being opened out and placed above the cross; the other the spear, the point remaining folded and reared towards the cross. The two unmarked pieces will be the foundations of the cross, as they may be placed together, and the foot of the cross will fit the two chasms. Thus a complete picture will be formed, and not an atom of the paper will be wasted. The thick black lines in the large engraving will show where the scissors will cut; the thin lines merely denote the creases made in folding.

PROBLEM XXXVII.



Given five squares, much larger than that in the margin, each divided into two parts, by a line from one angle bisecting the opposite side. Divide each of these five squares into two parts, by cutting along the diagonal line; there will then be ten pieces. Required so to arrange these ten pieces, that they shall form one square.

The solution to the above may be readily found by exercising a little ingenuity; but it would require a very complex figure to explain it.

FINIS.

Gye and Balne, Printers, 38, Gracechurch-Street.

ERRATA.

Page 56, line 3 from bottom, ...for Fig. 12, read Fig. 27.

Page 132, line 7 from top,.....for Fig. 8, read Fig. 30.

The Paragraph at the top of p. 52, should form the conclusion of the "Art of making Writing Ink," in p. 51.