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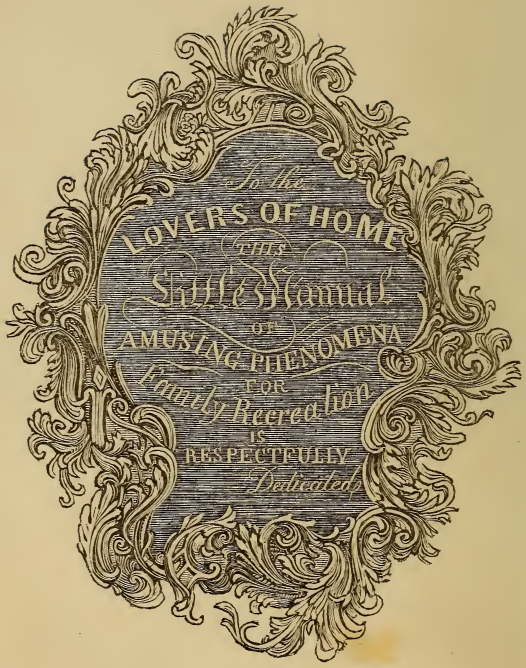
To the
LOVERS OF HOME
THIS
Little Manual
OF
AMUSING PHENOMENA
FOR
Family Recreation
IS
RESPECTFULLY
Dedicated

REVISED AND IMPROVED.

PHILADELPHIA: H. PERKINS, 134 CHESTNUT STREET.
MDCCCXXXVIII.

ENTERED, according to Act of Congress, in the year 1838, by HENRY PERKINS, in the Clerk's office of the District Court for the Eastern District of Pennsylvania.

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To furnish the ingenious youth with the means of relieving the tediousness of a long winter's or a wet summer's evening, — to enable him to provide for a party of juvenile friends, instructive as well as recreative entertainment, without having recourse to any of the vulgar modes of killing time, — to qualify the hero of his little circle to divert and astonish his friends, and, at the same time, to improve himself, are the principal objects of the following little Work.

The boy whose wonder and curiosity have been excited by the experiments of the scientific lecturer,

or the illusions of the ventriloquist, will here find many of these mysteries unveiled, and plain directions for performing them, divested, as far as possible, of scientific or technical language. Many of the descriptions are strictly original, and now, for the first time, appear in print; and especial care has been taken to introduce only such Experiments as are adapted for performance at the parlour or drawing-room table, or fire-side, and such as are practicable without expensive chemical or mechanical apparatus, and require no implements beyond those which any ingenious youth may readily furnish from his own resources, or at a trifling expense.

Another object of these pages is to inform, without being dryly scientific, — by imparting interesting facts, to stimulate the young experimentalist to inquire into the laws that regulate them, — by aiding him to acquire dexterity of practice, to smooth the

road to the development of principles, — and, above all, to enable him to escape an imputation which every boy of spirit would consider the depth of disgrace, — that of being "No Conjuror!"

Transmutations.

Sight and Sound.

Light and Heat.

Gas and Steam.

Fire, Water, and Air.

Sleights and Subtleties.

Melange.


TRANSMUTATIONS.

TRANSMUTATIONS.

THE SPECTRAL LAMP.

Mix some common salt with spirit of wine in a platinum or metallic cup; set the cup upon a wire frame over a spirit-lamp, which should be inclosed on each side, or in a dark-lantern: when the cup becomes heated, and the spirit ignited, it will burn with a strong yellow flame; if, however, it should not be perfectly yellow, throw more salt into the cup. The lamp being thus prepared, all other lights should be extinguished, and the yellow lamp introduced, when an appalling change will be exhibited; all the objects in the room will be but of one colour, and the complexions of the several persons, whether old or young, fair or brunette, will be metamorphosed to a ghastly, death-like yellow; whilst the gayest dresses, as the brightest crimson, the choicest lilac, the most vivid blue or green — all will be changed into one monotony of yellow: each person will be inclined to laugh

at his neighbour, himself insensible of being one of the spectral company.

Their astonishment may be heightened by removing the yellow light to one end of the room, and restoring the usual or white light at the other; when one side of each person's dress will resume its original colour, while the other will remain yellow; one cheek may bear the bloom of health, and the other, the yellow of jaundice. Or if, when the yellow light only is burning, the white light be introduced within a wire sieve, the company and the objects in the apartment will appear yellow, mottled with white.

Red light may be produced by mixing with the spirit in the cup over the lamp, salt of strontian instead of common salt; and the effect of the white or yellow lights, if introduced through a sieve upon the red light, will be even more striking than the white upon the yellow light.

CURIOUS CHANGE OF COLOURS.

Let there be no other light than a taper in the room; then put on a pair of dark green spectacles, and having closed one eye, view the taper with the other. Suddenly remove the spectacles, and the taper will assume a bright red appearance; but, if the spectacles be instantly replaced, the eye will be unable to distinguish any thing for a second or two. The order of colours will, therefore, be as follows:—green, red, green, black.

THE PROTEAN LIGHT.

Soak a cotton wick in a strong solution of salt and water, dry it, place it in a spirit lamp, and, when lit, it will give a bright yellow light for a long time. If you look through a piece of blue

glass at the flame, it will loose all its yellow light, and you will only perceive feeble violet rays. If, before the blue glass, you place a pale yellow glass, the lamp will be absolutely invisible, though a candle may be distinctly seen through the same glasses.

THE CHAMELEON FLOWERS.

Trim a spirit-lamp, add a little salt to the wick, and light it. Set near it, a scarlet geranium, and the flower will appear yellow. Purple colours, in the same light, appear blue.

TO CHANGE THE COLOURS OF FLOWERS.

Hold over a lighted match, a purple columbine, or a blue larkspur, and it will change first to pink, and then to black. The yellow of other flowers, held as above, will continue unchanged. Thus, the purple tint will instantly disappear from a heart's-ease, but the yellow will remain; and the yellow of a wall-flower will continue the same, though the brown streak will be discharged. If a scarlet, crimson, or maroon dahlia be tried, the colour will change to yellow; a fact known to gardeners, who by this mode, variegate their growing dahlias.

CHANGES OF THE POPPY.

Some flowers which are red, become blue by merely bruising them. Thus, if the petals of the common corn-poppy be rubbed upon white paper, they will stain it purple, which may be made green by washing it over with a strong solution of potash in water. Put poppy petals into very dilute muriatic acid, and the infusion will be of a florid red colour; by adding a little chalk, it will become the colour of port wine; and this tint, by the addition of potash, may be changed to green or yellow.

TO CHANGE THE COLOUR OF A ROSE.

Hold a red rose over the blue flame of a common match, and the colour will be discharged wherever the fume touches the leaves of the flower, so as to render it beautifully variegated, or entirely white. If it be then dipped into water, the redness, after a time, will be restored.

LIGHT CHANGING WHITE INTO BLACK.

Write upon linen with permanent ink, (which is a strong solution of nitrate of silver,) and the characters will be scarcely visible; remove the linen into a dark room, and they will not change; but expose them to a strong light, and they will be indelibly black.

THE VISIBLY GROWING ACORN.

Cut a circular piece of card to fit the top of a hyacinth glass, so as to rest upon the ledge, and exclude the air. Pierce a hole through the centre of the card, and pass through it a strong thread, having a small piece of wood tied to one end, which, resting transversely on the card, prevents its being drawn through. To the other end of the thread attach an acorn; and, having half filled the glass with water, suspend the acorn at a short distance from the surface.

The glass must be kept in a warm room; and, in a few days, the steam which has generated in the glass will hang from the acorn in a large drop. Shortly afterwards, the acorn will burst, the root will protrude and thrust itself

into the water; and, in a few days more, a stem will shoot out at the other end, and, rising upwards, will press against the card, in which an orifice must be made to allow it to pass through, From this stem, small leaves will soon be observed to sprout; and, in the course of a few weeks, you will have a handsome oak plant, several inches in height.

CHANGES IN SAP GREEN.

Sap green is the inspissated juice of the buckthorn berries: if a little carbonate of soda be dropped into it, the colour will be changed from green to yellow; it may be reddened by acids, and its green colour restored by chalk.

TO REVIVE APPARENTLY DEAD PLANTS.

Make a strong dilution of camphor in spirit of wine, which add to soft water, in the proportion of a dram to a pint. If withered, or apparently dead plants be put into this liquid, and allowed to remain therein from two to three hours, they will revive.

SINGULAR EFFECT OF TEARS.

If tears are dropped on a dry piece of paper, stained with the juice of the petals of mallows or violets, they will change the paper to a permanently green colour.

BEAUTIES OF CRYSTALLIZATION.

Dissolve alum in hot water until no more can be dissolved in it; place in it a smooth glass rod and a stick of the same size; next day, the stick will be found covered with crystals, but the glass rod will be free from them: in this case, the crystals cling to the rough surface of the stick, but have no hold upon the

smooth surface of the glass rod. But, if the rod be roughened with a file at certain intervals, and then placed in the alum and water, the crystals will adhere to the rough surfaces, and leave the smooth bright and clear.

Tie some threads of lamp-cotton irregularly around a copper wire or glass rod; place it in a hot solution of blue vitriol, strong as above, and the threads will be covered with beautiful blue crystals, while the glass rod will be bare.

Bore a hole through a piece of coke, and suspend it by a string from a stick, placed across a hot solution of alum; it will float; but, as it becomes loaded with crystals, it will sink in the solution according to the length of the string. Gas-coke has mostly a smooth, shining, and almost metallic surface, which the crystals will avoid, while they will cling only to the most irregular and porous parts.

If powdered tumeric be added to the hot solution of alum, the crystals will be of a bright yellow; litmus will cause them to be of a bright red; logwood will yield purple; and common writing ink, black; and the more muddy the solution, the finer will be the crystals.

To keep coloured alumn crystals from breaking, or losing their colour, place them under a glass shade with a saucer of water; this will preserve the atmosphere moist, and prevent the crystals getting too dry.

If crystals be formed on wire, they will be liable to break off, from the expansion and contraction of the wire by changes of temperature.

TO CRYSTALLIZE CAMPHOR.

Dissolve camphor in spirit of wine, moderately heated, until the spirit will not dissolve any more; pour some of the solution into a cold glass, and the camphor will instantly crystallize in beautiful tree-like forms, such as we see in the show-glasses of camphor in druggists' windows.

CRYSTALLIZED TIN.

Mix half an ounce of nitric acid, six drams of muriatic acid, and two ounces of water; pour the mixture upon a piece of tin plate previously made hot, and, after washing it in the mixture, it will bear a beautiful crystalline surface, in feathery forms. This is the celebrated *moirée metallique*, and, when varnished, is made into ornamental boxes, &c. The figures will vary according to the degree of heat previously given to the metal.

CRYSTALS IN HARD WATER.

Hold in a wine-glass of hard water, a crystal of oxalic acid, and white threads will instantly descend through the liquid, suspended from the crystal.

VARIETIES OF CRYSTALS.

Make distinct solutions of common salt, nitre, and alum; set them in three saucers in any warm place, and let part of the water dry away or evaporate; then remove them to a warm room. The particles of the salts in each saucer will begin to attract each other, and form crystals, but not all of the same figure: the common salt will yield crystals with six square and equal faces, or sides; the nitre, six-sided crystals; and the alum, eight-sided crystals; and if these crystals be dissolved over and over again, they will always appear in the same forms.

HEAT FROM CRYSTALLIZATION.

Make a strong solution of Epsom salts in hot water, and while warm, bottle it, cork it closely, and it will remain liquid: draw out the cork, when the salts will immediately crystallize, and in the process, the remaining liquid and the bottle will become very warm.

SPLENDID SUBLIMATION.

Put into a flask a small portion of iodine; hold the flask over the flame of a spirit-lamp, and, from the state of rich ruby crystals, the iodine, on being heated, will become a ruby-coloured transparent gas; but, in cooling, will resume its crystalline form.

ARTIFICIAL ICE.

Mix four ounces of nitrate of ammonia, and four ounces of subcarbonate of soda, with four ounces of water, in a tin vessel, and in three hours the mixture will produce ten ounces of ice.

MAGIC INKS.

Dissolve oxide of cobalt in acetic acid, to which add a little nitre; write with this solution, hold the writing to the fire, and it will be of a pale rose colour, which will disappear on cooling.

Dissolve equal parts of sulphate of copper and muriate of ammonia in water; write with the solution, and it will give a yellow colour when heated, which will disappear when cold.

Dissolve nitrate of bismuth in water; write with the solution, and the characters will be invisible when dry, but will become legible on immersion in water.

Dissolve, in water, muriate of cobalt, which is of a bluish-green colour, and the solution will be pink; write with it, and the characters will be scarcely visible; but, if gently heated, they will appear in brilliant green, which will disappear as the paper cools.

CHAMELEON LIQUIDS.

Put a small portion of the compound called mineral chameleon into several glasses, pour upon each water at different temperatures, and the contents of each glass will exhibit a different shade of colour. A very hot solution will be of a beautiful green colour; a cold one, a deep purple.

Make a colourless solution of sulphate of copper; add to it a little ammonia, equally colourless, and the mixture will be of an intense blue colour; add to it a little sulphuric acid, and the blue colour will disappear; pour in a little solution of caustic ammonia, and the blue colour will be restored. Thus, may the liquor be thrice changed at pleasure.

THE MAGIC DYES.

Dissolve indigo in diluted sulphuric acid, and add to it an equal quantity of solution of carbonate of potass. If a piece of white cloth be dipped in the mixture, it will be changed to blue; yellow cloth, in the same mixture, may be changed to green; red to purple, and blue litmus paper to red.

Nearly fill a wine-glass with the juice of beet-root, which is of a deep red colour; add a little lime water, and the mixture will be colourless; dip into it a piece of white cloth, dry it rapidly, and in a few hours, the cloth will become red.

WINE CHANGED INTO WATER.

Mix a little solution of subacetate of lead with port wine; filter the mixture through blotting paper, and a colourless liquid will pass through; to this add a small quantity of dry salt of tartar, when a spirit will rise, which may be inflamed on the surface of the water.

TWO COLOURLESS TRANSPARENT LIQUIDS BECOME BLACK AND OPAQUE.

Have in one vessel some sulphuric acid, and in another an infusion of nut-galls; they are both colourless and transparent; mix them, and they will become black and opaque.

TWO COLOURLESS FLUIDS MAKE A COLOURED ONE.

Put into a wine-glass of water, a few drops of prussiate of potash; and into a second glass of water, a little weak solution of sulphate of iron in water: pour the colourless mixtures together into a tumbler, and they will be immediately changed to a bright deep blue colour.

Or, mix the solution of prussiate of potash with that of nitrate of bismuth, and a yellow will be the product.

Or, mix the solution of prussiate of potash with that of sulphate of copper, and the mixture will be of a reddish brown colour.

CHANGE OF COLOUR BY COLOURLESS FLUIDS.

Three different colours may be produced from the same infusion, merely by the addition of three colourless fluids. Slice a little red cabbage, pour boiling water upon it, and when cold, decant the clear infusion, which divide into three wine-glasses: to one, add a small quantity of solution of alum in water; to the second, a little solution of potash in water; and to the third, a few

drops of muriatic acid. The liquor in the first glass will assume a purple colour, the second, a bright green, and the third a rich crimson.

Put a dram of powdered nitrate of cobalt into a phial containing an ounce of the solution of caustic potass; cork the phial, and the liquid will assume a blue colour, next a lilac, afterwards a peach colour, and lastly a light red.

TO CHANGE A BLUE LIQUID TO WHITE.

Dissolve a small lump of indigo in sulphuric acid, by the aid of moderate heat, and you will obtain an intense blue colour: add a drop of this to half a pint of water, so as to dilute the blue; then pour some of it into strong chloride of lime, and the blue will be bleached with almost magical velocity.

VERITABLE "BLACK" TEA.

Make a cup of strong green tea; dissolve a little green copperas in water, which add to the tea, and its colour will be black.

RESTORATION OF COLOUR BY WATER.

Water being a colourless fluid, ought, one would imagine, when mixed with other substances of no decided colour, to produce a colourless compound. Nevertheless, it is to water only that blue vitriol, or sulphate of copper, owes its vivid blueness; as will be plainly evinced by the following simple experiment. Heat a few crystals of the vitriol in a fire shovel, pulverize them, and the powder will be of a dull and dirty white appearance. Pour a little water upon this, when a slight hissing noise will be heard, and at the same moment, the blue colour will instantly re-appear.

Under the microscope, the beauty of this experiment will be increased, for the instant that a drop of water is placed in contact

with the vitriol, the powder may be seen to shoot into blue prisms. If a crystal of prussiate of potash be similarly heated, its yellow colour will vanish, but re-appear on being dropped into water.

THE MAGIC WRITING.

Dissolve a small portion of green-copperas in water, and soak in it sheets of writing paper, so as to allow them to be taken out whole, and then dried; then, cover the paper with very finely powdered galls, and write on it with a pen dipped in water; when dry, brush off the galls, and the writing will appear.

TWO LIQUIDS MAKE A SOLID.

Dissolve muriate of lime in water until it will dissolve no more; make also a similar solution of carbonate of potash; both will be transparent fluids; but if equal quantities of each be mixed and stirred together, they will become a solid mass.

TWO SOLIDS MAKE A LIQUID.

Rub together in a mortar, equal quantities of the crystals of Glauber's salts and nitrate of ammonia, and the two salts will slowly become a liquid.

A SOLID OPAQUE MASS MADE A TRANSPARENT LIQUID.

Take the solid mixture of the solutions of muriate of lime and carbonate of potash, pour upon it a very little nitric acid, and the solid opaque mass will be changed to a transparent liquid.

TWO COLD LIQUIDS MAKE A HOT ONE.

Mix four drams of sulphuric acid, (oil of vitrol,) with one dram of cold water, suddenly, in a cup, and the mixture will be nearly half as hot again as boiling water.

QUADRUPLE TRANSMUTATION.

Dissolve a small piece of nickel in nitric acid, and it will appear of a fine grass-green colour; add to it a little ammonia, and a blue precipitate will be formed; this will change to a purple-red in a few hours, and the addition of any acid will convert it to an apple-green.

QUINTUPLE TRANSMUTATION.

Heat potassium over the flame of a spirit-lamp, and the colour will change from white to a bright azure, thence to a bright blue, green, and olive.

COMBINATION OF COLOURS.

Cut out a disc or circle of pasteboard, and cover it with paper half green and half black: cause the disc to be rapidly turned round, (like the shafts of a toy wind-mill,) and the colours will combine and produce white.

UNION OF TWO METALS WITHOUT HEAT.

Cut a circular piece of gold-leaf, called "dentist's gold," about half an inch in diameter; drop upon it a globule of mercury, about the size of a small pea, and if they be left for a short time, the gold will lose its solidity and yellow colour, and the mercury its liquid form, making a soft mass, of the colour of mercury.

MAGIC BREATH.

Half fill a glass tumbler with lime-water; breathe into it frequently, at the same time stirring it with a piece of glass. The fluid, which before was perfectly transparent, will presently become quite white, and, if allowed to remain at rest, real chalk will be deposited.

TWO BITTERS MAKE A SWEET.

It has been discovered, that a mixture of nitrate of silver with hypo-sulphate of soda, both of which are remarkably bitter, will produce the sweetest known substance.

VISIBLE AND INVISIBLE.

Write with French chalk on a looking-glass; wipe it with a handkerchief, and the lines will disappear; breathe on it, and they will re-appear. This alteration will take place for a great number of times, and after the lapse of a considerable period.


SIGHT & SOUND.

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ARTIFICIAL MIRAGE.

THE mirage is an optical phenomenon, produced by the refractive power of the atmosphere. The appearance presented is that of the double image of an object in the air; one of the images being in the natural position, and the other inverted, so as to resemble a natural object and its image in the water. The mirage is commonly vertical, or upright, that is, presenting the appearance, above described, of one object over another, like a ship above its shadow in the water. Sometimes, however, the image is horizontal, or upon the water, and at other times, it is seen on the right or left hand of the real object, or on both sides.

All the effects of the mirage may be represented artificially to the eye. For this purpose, provide a glass tumbler two-thirds full of water, and pour spirit of wine upon it; or pour into a tumbler some syrup, and fill it up with water: as the water and

spirit, or the syrup and water incorporate, they will produce a refractive power; then, by looking through the mixed or intermediate liquids at any object held behind the tumblers, its inverted image may be seen. The same effect, Dr. Walloston has shown, may be produced, by looking along the side of a red-hot poker at a word or object ten or twelve feet distant. At a distance less than three-eighths of an inch from the line of the poker, an inverted image was seen; and within and without that, an erect image.

The above phenomena may likewise be illustrated, by holding a heated iron above a tumbler of water, until the whole becomes changed; then withdraw the iron, and, through the water, the phenomena of the mirage may be seen in the finest manner.

Or, look directly above the flame of a candle, or over the glass of a lighted lamp, and a tremulous motion may be observed; because the warm air rises, and its refracting power being less than that of the colder air, the currents are rendered visible by the distortion of objects viewed through them. The same effect is observable over chimney pots, and slated roofs which have been heated by the sun.

MOTION OF THE EYE.

On entering a room, we imagine that we see the whole side of it at once, as the cornice, the pattern of the paper-hanging, pictures, chairs, &c., but we are deceived; for each object is rapidly, but singly presented to the eye, by its constant motion. If the eye were steady, vision would be lost. For example, fix the eye on one point, and you will find the whole scene become more and more obscure, till it vanishes. Then, if you change the direction of the eye ever so little, at once the whole scene will be again perfect before you.

SINGLE VISION WITH TWO EYES.

As we have two eyes, and a separate image of every external object is formed in each, it may be asked, why do we not see double? The answer is, it is a matter of habit. Habit alone teaches us, that the sensations of sight correspond to any thing external, and shows to what they correspond. Thus, place a wafer on a table before you; direct your eyes to it, that is, bring its image on both retinæ to those parts which habit has ascertained to be the most sensible, and best situated for seeing distinctly, and you will see only the *single wafer*. But, while looking at the wafer, squeeze the upper part of one eye downwards, by pressing on the eyelid with the finger, and thereby forcibly throw the image on another part of the retina of that eye, and double vision will be immediately produced; that is, *two wafers* will be distinctly seen, which will appear to recede from each other as the pressure is stronger, and approach, and finally blend into one, as it is relieved. The same effect may be produced without pressure, by directing the eyes to a point nearer to, or farther from them, than the wafer; the optic axes, in this case, being both directed away from the object seen.

TWO OBJECTS SEEN AS ONE.

On a sheet of black paper, or other dark ground, place two white wafers, having their centres three inches distant. Vertically above the paper, and to the *left*, look with the *right* eye, at twelve inches from it, and so that, when looking down on it, the line joining the two eyes shall be parallel to that joining the centre of the wafers. In this situation, close the left eye, and look full with the right perpendicularly at the wafer below it, when this wafer only will be seen, the other being completely invisible. But, if it be removed ever so little from its place, either to the right or left,

above or below, it will become immediately visible, and start, as it were, into existence. The distances here set down may, perhaps, vary slightly in different eyes.

Upon this curious effect, Sir John Herschel observes: "It will cease to be thought singular, that this fact of the absolute invisibility of objects in a certain point of the field of view of each eye, should be one of which not one person in ten thousand is apprised, when we learn, that it is not extremely uncommon to find persons who have for some time been totally blind with one eye, without being aware of the fact."

ONLY ONE OBJECT CAN BE SEEN AT A TIME.

Look at the pattern of the paper-hanging of a room, a picture, or almost any other object in it; then, without altering your position, call to mind the magnificent dome of St. Paul's Cathedral; the pattern of the paper-hanging, or the subject of the picture, though actually impressed on the retina of the eye, will be momentarily lost sight of by the mind; and, during the instant, the recollected image of the dome rising from the dingy roofs of London, will be distinctly seen, but in indistinct colouring and outline. When the object of the recollection is answered, the dome will quickly disappear, and the paper-hanging pattern, or the picture, again resume the ascendancy.

STRAIGHT OBJECTS SEEN CROOKED.

Look through a series of vertical bars, as those of a palisade, or of a Venetian window-blind, at the wheel of a carriage passing along the street, and the spokes of the wheel, instead of appearing straight, as they naturally would do, if no bars intervened, seem to

be of a curved form. The velocity of the wheel must not be so great as to prevent the eye from following the spokes as they revolve.

Again, when the disk of the wheel, instead of being marked by a number of radiant lines, has only one radius marked upon it, it presents the appearance, when rolled behind the bars, of a number of radii, each having the curvature corresponding to its situation, their number being the same as that of the bars through which you look at the wheel. It is, therefore, evident that the several portions of one and the same line, seen through the intervals of the bars, form on the retina of the eye so many different radii.

OPTICAL ILLUSION.

Shut one eye, direct the other to any fixed point, as the head of a pin, and you will indistinctly see all other objects. Suppose one of these to be a strip of white paper, or a pen lying upon a table covered with a green cloth: either of them will disappear altogether, as if taken off the table; for the impression of the green cloth will entirely extend itself over that part of the retina which the image of the pen occupied. The vanished pen will, however, shortly re-appear, and again vanish; and the same effect will take place when both eyes are open, though not so readily as with one eye.

PIN-HOLE FOCUS.

Make a pin-hole in a card, which hold between a candle and a piece of white paper, in a dark room, when an exact representation of the flame, but inverted, will be seen depicted upon the paper, and be enlarged as the paper is drawn from the hole; and if, in a

dark room, a white screen or sheet of paper be extended at a few feet from a small round hole, an exact picture of all external objects, of their natural colours and forms, will be seen traced on the screen; moving objects being represented in motion, and stationary ones at rest.

OPTICAL DECEPTIONS.

Prick a hole in a card with a needle; place the same needle near the eye, in a line with the card-hole, look by daylight at the end of the needle, and it will appear to be behind the card, and reversed.

Prick a hole with a pin in a black card, place it very near the eye, look through it at any small object, and it will appear larger as it is nearer the eye; while, if we observe it without the card, it will appear sensibly of the same magnitude at all parts of the room.

ACCURACY OF SIGHT.

Rule a short line upon a slate, and upon another slate rule another line, one-eleventh longer than the first: a person possessing what is called "a true eye," may perceive the difference in length, even though fifty or sixty seconds elapse between looking at the first and the second lines. If they differ only one-twentieth, then an interval of thirty-five seconds may elapse without destroying the judgment; but, if it be longer, the estimate will be incorrect. When the difference between the lines amounts only to one-fiftieth, an interval of three seconds between the examination of each, is the longest that can be allowed without interfering with the correctness of the comparison.

VISUAL DECEPTION.

Let a room be only lit by the feeble gleam of a fire, almost extinguished, and the eye will see with difficulty the objects in the apartment, from the small degree of light with which they happen to be illuminated. The more exertion is made to ascertain what these objects are, as by fixing the eye more steadily upon them, the greater will be the difficulty in accomplishing it. The eye will be painfully agitated, the object will swell and contract, and partly disappear, but will again become visible when the eye has recovered from its delirium.

HAND-WRITING UPON THE WALL.

Cut the word or words to be shown, out of a thick card or pasteboard, place it before a lighted lamp, and the writing will be distinctly seen upon the wall of the apartment.

IMITATIVE HALOES.

Look at a candle, or any other luminous body, through a plate of glass, covered with vapour, or dust in a finely divided state, and it will be surrounded with a ring of colours, like a halo round the sun or moon. These rings increase with the size of the particles which produce them; and their brilliancy and number depend on the uniform size of these particles.

Or, haloes may be imitated by crystallizing various salts upon thin plates of glass, and looking through the plate at a candle or the sun. For example, spread a few drops of a strong solution of alum over a plate of glass so as to crystallize quickly, and cover it with a crust scarcely visible to the eye. Then place

the eye close behind the smooth side of the glass plate, look through it at a candle, and you will perceive three fine haloes at different distances, encircling the flame.

TO READ A COIN IN THE DARK.

By the following simple method, the legend or inscription upon a coin may be read in absolute darkness. Polish the surface of any silver coin as highly as possible; touch the raised parts with aqua-fortis, so as to make them rough, taking care that the parts not raised retain their polish. Place the coin thus prepared upon red-hot iron, remove it into a dark room, and the figure and inscription will become more luminous than the rest, and may be distinctly seen and read by the spectator. If the lower parts of the coin be roughened with the acid, and the raised parts be polished, the effect will be reversed, and the figure and inscription will appear dark, or black upon a light or white ground.

This experiment will be more surprising if made with an old coin, from which the figure and inscription have been obliterated; for, when the coin is placed upon the red-hot iron, the figure and inscription may be distinctly read upon a surface which had hitherto appeared blank.

This experiment may be made with small coins upon a heated poker, a flat iron, or a salamander. The effect will be more perfect if the red-hot iron be concealed from the eye of the spectator: this may be done by placing upon the iron a piece of blackened tin, with a hole cut out, the size of the coin to be heated.

TO MAKE A PRISM.

Provide two small pieces of window-glass and a lump of wax; Soften and mould the wax, stick the two pieces of glass upon it, so that they meet, as in the cut, where *w* is the wax, *g* and *g*

the glasses stuck to it, (Fig. 1.) The end view (Fig. 2) will show the angle, *a*, at which the pieces of glass meet; into which angle put a drop of water.

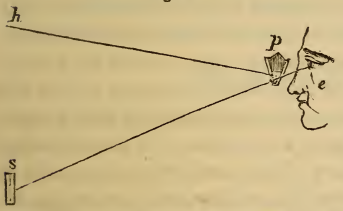
Fig. 1.

Fig. 2.

To use the instrument thus made, make a small hole, or a narrow horizontal slit, so that you can see the sky through it, when you stand at some distance from it in the room. Or a piece of pasteboard placed in the upper part of the window-sash, with a slit cut in it, will serve the purpose of the hole in the shutter. The slit should be about one-tenth of an inch wide, and an inch or two long, with even edges. Then hold the prism in your hand, place it close to your eye, and look through the drop of water, when you will see a beautiful train of colours, called a spectrum; at one end red, at the other violet, and in the middle yellowish green.

The annexed figure will better explain the direction in which to look: here, *e*, is the eye of the spectator, *p*, is the prism, *h*, the hole in the shutter or pasteboard, *s*, the spectrum. By a little practice, you will soon become accustomed to look in the right direction, and will see the colours very bright and distinct.

Fig. 3.



By means of this simple contrivance, white light may be analysed and proved to consist of coloured rays, and several of its properties be beautifully illustrated.

OPTICAL AUGMENTATION.

Take a glass rummer that is narrow at bottom and wide at top,

into which put a half-sovereign, and fill the glass three-fourths with water; place on it a piece of paper, and then a plate, and turn the glass upside down quickly, that the water may not escape: by looking sideways at the glass, you will perceive a sovereign at the bottom, and higher up the half-sovereign, floating near the surface. Fill the glass with water, and the large piece only will be visible.

GOLD FISH IN A GLASS GLOBE.

A single gold fish in a globe vase, is often mistaken for two fishes, because it is seen as well by the light bent through the upper surface of the water, as by straight rays passing through the side of the vase.

COLOURS PRODUCED BY THE UNEQUAL ACTION OF LIGHT UPON THE EYES.

If we hold a slip of white paper vertically, about a foot from the eye, and direct both eyes to an object at some distance beyond it, so as to see the slip of paper double, then, when a candle is brought near the right eye, so as to act strongly upon it, while the left eye is protected from its light, the left-hand slip of paper will be of a tolerably bright *green* colour, while the right-hand slip of paper, seen by the left eye, will be of a red colour. If the one image overlaps the other, the colour of the overlapping parts will be white, arising from a mixture of the complementary red and green. When equal candles are held equally near to each eye, each of the images of the slip of paper is white. If, when the paper is seen red and green by holding the candle to the right eye, we quickly take it to the left eye, we shall find that the left image of the slip of paper gradually changes from *green* to *red*, and the right one from *red* to *green*, both of them having the same tint during the time that the change is going on.

OPTICAL DECEPTION.

Look steadily at a carpet having figures of one colour, green, for example, upon a ground of another colour, suppose red, and you will sometimes see the whole of the green pattern as if the red one were obliterated; and at other times, you will see the whole of the red pattern, as if the green one were obliterated. The former effect takes place when the eye is steadily fixed on the green part, and the latter, when it is steadily fixed on the red portion.

COLOURED SHADOWS.

Provide two lighted candles, and place them upon a table before a whitewashed or light papered wall: hold before one of the candles a piece of coloured glass, taking care to remove to a greater distance the candle before which the coloured glass is not placed, in order to equalize the darkness of the two shadows. If you use a piece of green glass, one of the shadows will be green, and the other a fine red; if you use blue glass, one of the shadows will be blue, and the other a pale yellow.

COLOURS OF SCRATCHES.

An extremely fine scratch on a well-polished surface, may be regarded as having a concave, cylindrical, or, at least, a curved surface, capable of reflecting light in all directions; this is evident, for it is visible in all directions. Hence, a single scratch or furrow in a surface, may produce colours by the interference of the rays reflected from its opposite edges. Examine a spider's thread in the sunshine, and it will gleam with vivid colours. These may arise from a similar cause, or from the thread itself, as spun by the animal, consisting of several threads agglutinated together, and thus presenting, not a cylindrical, but a furrowed surface.

OCULAR SPECTRA.

One of the most curious affections of the eye is that, in virtue of which it sees what are called *ocular spectra*, or accidental colours. If we place a red wafer on a sheet of white paper, and, closing one eye, keep the other directed for some time to the centre of the wafer, then, if we turn the same eye to another part of the paper, we shall see a green wafer, the colour of which will continue to grow fainter and fainter, as we continue to look at it.

By using differently coloured wafers, we obtain the following results:

WAFER.	SPECIMEN.
Black	White.
White	Black.
Red	Bluish Green.
Orange	Blue.
Yellow	Indigo.
Green	Violet, with a little Red.
Blue	Orange Red.
Indigo	Orange Yellow.
Violet	Bluish Green.

BEAUTIFUL COLOURS OF MOTHER-OF-PEARL.

This substance, obtained from the shell of the pearl oyster, is much admired for the fine play of its colours. To observe them accurately, select a plate of regularly formed mother-of-pearl, with its surface nearly parallel, and grind this surface upon a hone, or upon a plate of glass, with the powder of slate, till the image of the candle, reflected from the surfaces, is of a dull reddish white colour, when it will glow with all the colours of the rainbow. The

colours of mother-of-pearl may be communicated to soft black wax; and to clean surfaces of lead and tin by hard pressure, or the blow of a hammer. Or, dissolve gum arabic, or isinglass, in water, and allow it to harden upon a surface of mother-of-pearl, when it will take a perfect impression from it, and exhibit all the colours in the finest manner. Or, place the isinglass between two finely-polished surfaces of mother-of-pearl, and you may obtain a film of artificial mother-of-pearl, which, when seen by the light of a candle, or by an aperture in the window, will shine with the brightest hues.

WHITE LETTERS SEEN FURTHER THAN BLACK.

Paint the same letters of the same size precisely on two boards, the one white on a black ground, and the other a black on a white ground; the white letters will appear larger, and be read at a greater distance than the black.

ARTIFICIAL RAINBOW.

Observe the various colours which are reflected from the glass drops usually suspended from a lustre or chandelier, and you will witness a mimic rainbow. A rainbow may also be made by a garden engine, if the water be thrown high in the air, and the spectator stand between it and the sun.

FRINGE ABOUT A CANDLE.

Provide two small pieces of plate glass, moisten two of their sides with water, and put them together; then look through them at a candle, and you will perceive the flame surrounded with beautifully coloured fringes: these are the effect of moisture, intermixed with portions of air, and exhibiting an appearance similar to dew.

THE DOUBLE-COLOURED REFLECTION.

Provide a circular piece of coloured glass, and pierce its centre by means of a common awl, well moistened with oil of turpentine: encircle the glass with the fingers and thumb, hold it in the sunshine or the strong light of a lamp, and the following beautiful effects will be produced. If the glass be red, the luminous spot in the centre will be reflected green; if the glass be green, the spot will be red; if blue, orange; and if yellow, indigo.

LUMINOUS CROSS.

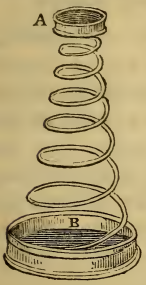
Place a lighted candle before a looking-glass, and there will appear a luminous cross radiating from the flame of the candle. This is produced by the direction of the friction by which the glass is polished; the scratches placed in a horizontal direction, exhibiting the perpendicular part of the cross, and the vertical scratches the horizontal part.

RINGS OF COLOURS ROUND A CANDLE.

Look at a candle through a plate of glass, upon which you have gently breathed, or over which are scattered particles of dust, or any fine powder, and you will perceive the flame surrounded with beautiful rings of colours. By using the seed of the lycopodium, or by placing a drop of blood diluted with water between two pieces of glass, the rings of colour will be still more finely exhibited. Round the luminous body there will be seen a light area, terminating in a reddish dark margin; this will be succeeded by a ring of bluish-green, and then by a red ring; these two last colours succeeding each other several times when the particles are of uniform diameter, as are the seeds of the lycopodium, each of which is but the 850th part of an inch in diameter.

SIMPLE AND CHEAP OPERA-GLASS.

In this new instrument, no tubes are necessary, as in the ordinary opera-glass; their place being supplied by a slender elastic conical spring of wire, into the upper extremity of which is inserted the eye-glass; the object-glass being fixed to the other extremity, as shown in the engraving. The two glasses must, of course, be kept parallel to each other when in use; which is very easily effected.



In using this opera-glass, rest the finger and thumb of one hand on the rim of the object-glass, B, whilst, with the thumb and finger of the other hand you hold the rim of the eye-glass, A. The spring tube may then be drawn out or shut up to very minute distances. Thus, the ordinary sliding tubes are superseded; nor is any external covering necessary, as the hand in grasping the instrument serves the purpose. If, however, a covering be preferred, a piece of silk may be sewn to the spirals of the spring.

This kind of opera-glass may be made very cheaply; it may be shut into a small space for the pocket, merely by pressing the object-glass and eye-glass together.

MULTIPLYING THEATRES.

Place two pieces of looking-glass, one at each end, parallel to one another, and looking over, or by the edge of one of them, the images of any objects placed on the bottom of the box, will appear continued to a considerable distance.

Or, line each of the four sides of the box with looking-glass, and the bottom of the box will be multiplied to an astonishing extent,

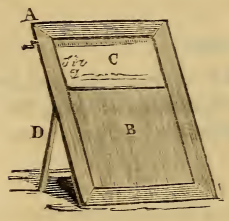
there being no other limitation to the number of images but what is owing to the continued loss of light from reflection. The top of the box may be almost covered with thin canvas, which will admit sufficient light to render the exhibition very distinct.

The above experiments may be made very entertaining, by placing on the bottom of the box some toy, as sentry soldiers, &c.; and, if these be put in motion, by wires attached to them, or passing through the bottom or side of the box, it will afford a still more entertaining spectacle. Or the bottom of the box may be covered with moss, shining pebbles, flowers, &c.; only, in all cases, the upright figures between the pieces of looking-glass should be slender, and not too numerous, else they will obstruct the reflected light.

In a box with six, eight, or more sides, lined with looking-glass, as above, the different objects in it will be multiplied to an almost indefinite extent.

APPARATUS FOR WRITING IN THE DARK.

In this ingenious contrivance, A is a frame of wood, into the back and front of which are inserted two thin boards, the front one, B, reaching about half the height of the frame, and the back one being movable, by sliding in grooves, for better fixing the paper to be written on, C, to a roller at top, with a handle and ratchet working into a spring.

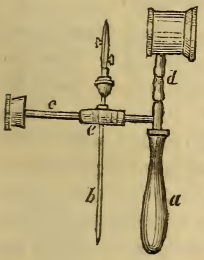


To use the apparatus, the paper is to be fixed on the roller, and a strip of lead, or other weight, suspended from the bottom of the paper, to keep it smooth: then, by resting the right hand on the edge of the board

B, and turning, with the left hand, the ratchet, the distance of the lines may be regulated by the number of clicks caused by the spring on the ratchet. D, is a foot to support the apparatus, which, however, should be light enough to be held in the hand as a slate.

PORTABLE MICROSCOPE.

This cheap and useful instrument consists of a handle of hard wood, *a*, which is screwed into a brass piece, *d*, having, at its top, a ring, with screws on back and front, into which are to be screwed two cells with lenses of different foci. There is also a projecting piece formed on the side of the brass piece, *d*, in which is a hole to receive the screwed end of a cylindrical rod of brass, *c*. Upon this rod, a springing slit socket, *e*, slides backwards and forwards, and is also capable of being turned round. This socket has affixed to it, on one side, a projecting part, with a screwed cavity in it, to receive a short screwed tube, with a small hole in its centre, made to fit the steel stem of the spring forceps; a corresponding hole being made at the bottom of the screwed cavity, where is lodged a piece of perforated cork; which, being pressed upon by the action of the screw, closes upon the steel stem of the forceps, and steadies them, and the objects held in them. The stem of the forceps being removed from its place in the short tube; the handles and lenses, and the rod, *c*, and the sliding socket upon it, being unscrewed from its place in the handle; they can all three be packed in a black paper case, which is only three and a half inches long, one inch broad, and half an inch thick.



This microscope possesses three different magnifying powers, namely, those of two lenses separately, and the two in combination.

Microscopes of a still simpler nature are small globules of glass, formed by smelting the ends of fine threads of glass in the flame of a candle ; and small globular microscopes of great magnifying power, made of hollow glass about the size of a small walnut, may be purchased very cheaply at the opticians'.

THE PHENAKISTICOPE, OR STOBOSCOPE.

This amusing instrument consists of a turning wheel, upon which figures are seen to walk, jump, pump water, &c. The disc or wheel should be of stout card-board, upon which should be painted, towards the edge, figures in eight or ten postures. Thus, if it is wished to represent a man bowing, the first position is a man standing upright; in the second, his body has a slight inclination ; in the third, still more; and so on, to the sixth position, where the body is most bent : the four following, represent the figure recovering its erect posture, so that the fifth and seventh, the fourth and eighth, the third and ninth, and second and tenth figures, have the same posture. Between each of the figures on the wheel, should be a slit, three-fourths of an inch long, and one-fourth of an inch wide, in a direction parallel with the radii of the wheel, and extending to an equal distance from the centre.

To work this instrument, place the figured side of the wheel before a looking-glass, and cause it to revolve upon its centre ; then look through the slits or apertures, and you may observe, in the glass, the figures bowing continually, and with a rapidity proportionate to the rate at which the wheel turns. The illusion depends on the circumstance, that the wheel between each aperture

is covered, while the figure goes further. That the deception may be complete, it is necessary that every part of the figures not bowing shall be at an equal distance from the centre of the wheel, and from the slits; also that the figures possess equal thickness and colour.

TO LOOK AT THE SUN WITHOUT INJURY.

Provide a wine-glass filled with plain water, which will keep off the heat so effectually, that the brightest sun may be viewed some time through it without any inconvenience. If a little black ink be added to the water, the image of the sun will appear through it, as white as snow; and when the ink is still more diluted, the sun will be of a purple hue.

BRILLIANT WATER MIRROR.

Nearly fill a glass tumbler with water, and hold it, with your back to the window, above the level of the eye, as in the engraving. Then look obliquely as in the direction E, *a*, *c*, and you will see the whole surface shining like burnished silver, with a strong metallic reflection; and any object, as a spoon, A C B, immersed in the water, will have its immersed part C B, reflected on the surface, as in a mirror, but with a brilliancy far surpassing that which can be obtained from quicksilver, or from the most highly-polished metals.

OPTICAL ILLUSION UNDER WATER.

Procure a large gallipot; place on the bottom, next the side furthest from you, a sixpence, and next to it, but towards the centre,

a shilling; move to such a distance as will render the coins invisible; then let another person pour water gently in, and as it rises in the gallipot, it will cause both the sixpence and shilling to be seen, without your approaching nearer to the gallipot, or moving it towards you.

THE MAGIC WHEELS.

Cut out two card-board cog-wheels of equal size; place them upon a pin, and whirl them round with equal velocity in opposite directions; when, instead of producing a hazy tint, as one wheel would do, or as the two would if revolving in the same direction, there will be an extraordinary appearance of a fixed wheel. If the cogs be cut slantwise on both wheels, the spectral wheel, as it may be called, will exhibit slanting cogs; but if one of the wheels be turned, so that the cogs shall point in opposite directions, then the spectral wheel will have straight cogs. If wheels with radii, or arms, be viewed when moving, the deception will be similar; and however fast the wheels may move, provided it be with equal velocity, the magic of a fixed wheel will be presented.

Or, cut a card-board wheel with a certain number of teeth or cogs at its edge; a little nearer the centre, cut a series of apertures resembling the cogs in arrangement, but not to the same number; and still nearer the centre cut another series of apertures, different in number, and varying from the former. Fix this wheel upon another, with its face held two or three yards from an illuminated mirror; spin it round, the cogs will disappear, and a greyish belt, three inches broad, will become visible; but, on looking at the glass through the moving wheel, appearances will entirely change; one row of cogs, or apertures, will appear fixed, as if the wheel were not moving, whilst the other two will appear as if in motion; and, by shifting the eye, other and new effects appear.

These amusing deceptions were first experimented by Mr. Faraday. The simple apparatus for their exhibition may be purchased, for a trifling sum, of any respectable optician.

ACOUSTIC RAINBOW.

A sounding-plate, made of brass, nine inches long, and half a line in thickness, covered with a layer of water, may be employed to produce a rainbow in a chamber which admits the sun. On drawing a violin bow strongly across the plate, so as to produce the greatest possible intensity of tone, numerous drops of water fly perpendicularly and laterally upwards. The size of the drops is smaller as the tone is higher. The inner and outer rainbows are very beautifully seen in these ascending and descending drops, when the artificial shower is held opposite to the sun. When the eyes are close to the falling drops, each eye sees its appropriate rainbow; and four rainbows are perceived at the same time, particularly if the floor of the room is of a dark colour. The experiment succeeds best, if, when a finger is placed under the middle of the plate, and both of the angular points at one side are supported, the tone is produced at a point of the opposite side, a fourth of its length from one of its angles. An abundant shower of drops is thus obtained.

TRANSMISSION OF SOUND.

Suspend any sonorous body, as a bell, a glass, a silver spoon, or a tuning-fork, from a double thread, and put with the finger the extremities of the thread, one in each ear; if the body be then struck, the apparent loudness and depth of the sound will be surprising.

Again, if you shut your ears altogether, you will yet feel very

sensible of the impression of any sound conveyed through the mouth, the teeth, or the head: if you put one end of a small stick or rod in the mouth, and touch with the other extremity a watch lying on the table, the beatings will become quite audible, though the ears be actually shut. So, also, if a log of wood be scratched at one end with a pin, a person who applies his ear to the other end will hear the sound distinctly.

Fogs and falling rain, but especially snow, powerfully obstruct the free propagation of sound; and the same effect is produced by a coating of fresh-fallen snow on the ground, though when glazed and hardened at the surface by freezing, it has no such influence.

Over water, or a surface of ice, sound is propagated with remarkable clearness and strength. Dr. Hutton relates, that on a quiet part of the Thames, near Chelsea, he could hear a person distinctly at 140 feet distance, while on the land the same could only be heard at 76 feet. Lieutenant Forster, in the third Polar expedition of Captain Parry, held a conversation with a man across the harbour of Port Bowen, a distance of 6696 feet, or about a mile and a quarter. This, however remarkable, falls short of what is related by Dr. Young, on the authority of the Rev. W. Derham, *viz.* that, at Gibraltar, the voice has been heard ten miles, perhaps, across the strait.

The cannonade of a sea-fight between the English and Dutch, in 1672, was heard across England as far as Shrewsbury, and even in Wales, a distance of upwards of 200 miles from the scene of action.

At Carisbrook Castle, in the Isle of Wight, is a well 210 feet in depth, and twelve feet in diameter, into which if a pin be dropped, it will be distinctly heard to strike the water. The interior is lined with very smooth masonry.

PROGRESS OF SOUND.

A stretched string, as that of a piano-forte, may be made to vibrate not only from end to end, but in aliquot parts, the portions being separated by points of rest which interrupted the progress of the sound. This kind of effect may be shown by shaking a long piece of cane in the air, when there will be one, two, or three points of rest, according to the mode of vibrating it.

An elastic surface has, likewise, some parts in motion and others at rest; and these parts may be made visibly distinct, by strewing pieces of bristle over them upon the sounding-board of an instrument.

When a bow is drawn across the strings of a violin, the impulses produced may be rendered evident by fixing a small steel bead upon the bow; when looked at by light or in sunshine, the bead will seem to form a series of dots during the passage of the bow.

SOUND TURNING CORNERS.

Take a common tuning-fork, strike it, and hold it, (when set in vibration,) about three or four inches from the ear, with the flat side towards it, when the sound will be distinctly heard; let a strip of card, somewhat longer than the flat of the tuning-fork, be interposed at about half an inch from the fork, and the sound will be almost entirely intercepted by it; and, if the card be alternately removed and replaced in pretty quick succession, alternations of sound and silence will be produced; proving that sound is by no means propagated with so much intensity round the edge of the card, as straight forward. Indeed, to be convinced of this fact, you have only to listen to the sound of a carriage turning a corner from the street in which you happen to be, into an adjoining one. Even

where there is no obstacle in the way, sounds are by no means equally audible in all directions from the sounding body; as you may ascertain, by holding a vibrating tuning-fork or pitch-pipe near your ear, and turning it quickly on its axis.

TO TELL THE DISTANCE OF THUNDER.

Count, by means of a watch, the number of seconds that elapse between seeing the flash of lightning and hearing the report of the thunder; allow somewhat more than five seconds for a mile, and the distance may be ascertained. Thus, say the number of seconds is

$$5)20$$

4 miles distant;

or the distance may be estimated by remarking the number of beats of the pulse in the above interval; provided, of course, that we know the rate at which the pulse beats in a certain time. In a French work, it is stated that if the pulse beat six times, the distance of the thunder will be about 30,000 feet, or five miles and a half; thus reckoning 5000 feet for each pulsation.

In a violent thunder-storm, when the sound instantly succeeds the flash, the persons who witness the circumstance are in some danger; when the interval is a quarter of a minute, they are secure.

HEARING BY THE TOUCH.

If a deaf person merely place the tips of his finger-nails on the window-shutters or door of a room in which instruments are playing, he may enjoy their concert of harmony.

CONVERSATION FOR THE DEAF.

If two persons stop their ears closely, they may converse with each other by holding a long stick between their teeth, or

by resting their teeth against them. The person who speaks may rest the stick against his throat or his breast; or he may rest the stick, which he holds in his teeth, against a glass tumbler or china basin into which the other speaks. The sound may also be heard when a thread is held between the teeth by both persons, so as to be somewhat stretched.

GLASS BROKEN BY THE VOICE.

On vibrating bodies, which present a large surface, the effects of sounds are very surprising. Persons with a clear and powerful voice have been known to break a drinking-glass, by singing the proper fundamental note of their voice close to it. Looking-glasses are also said to have been broken by music, the vibrations of the atoms of the glass being so great as to strain them beyond the limits of their cohesion.

FIGURES PRODUCED BY SOUND.

Stretch a sheet of wet paper over the mouth of a glass tumbler, which has a footstalk, and glue or paste the paper at the edges. When the paper is dry, strew dry sand thinly upon its surface. Place the tumbler on a table, and hold immediately above it, and parallel to the paper, a plate of glass, which you also strew with sand, having previously rubbed the edges smooth with emery powder. Draw a violin bow along any part of the edges, and as the sand upon the glass is made to vibrate, it will form various figures, which will be accurately imitated by the sand upon the paper; or, if a violin or flute be played within a few inches of the paper, they will cause the sand upon its surface to form regular lines and figures.

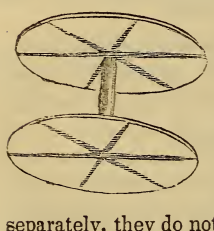
TRANSMITTED VIBRATION.

Provide a long, flat glass ruler or rod, as in the engraving, and cement it with mastic to the edge of a drinking-glass fixed into a wooden stand; support the other end of the rod very lightly on a

piece of cork, and strew its upper surface with sand; set the glass in vibration by a bow, at a point opposite where the rod meets it, and the motions will be communicated to the rod without any change in their direction. If the apparatus be inverted, and sand be strewed on the under side of the rod, the figures will be seen to correspond with those produced on the upper surface.

DOUBLE VIBRATION.

Provide two discs of metal or glass, precisely of the same dimensions, and a glass or metal rod; cement the two discs at their



centres to the two ends of the rod, as in the engraving, and strew their upper surfaces with sand. Cause one of the discs, viz. the upper one, to vibrate by a bow, and its vibration will be exactly imitated by the lower disc, and the sand strewed over both will arrange itself in precisely the same forms on both discs. But if, separately, they do not agree in their tones, the figures on them will not correspond.

CHAMPAGNE AND SOUND.

Pour sparkling champagne into a glass until it is half full, when the glass will lose its power of ringing by a stroke upon its

edges, and will emit only a disagreeable and puffy sound. Nor will the glass ring while the wine is brisk, and filled with air-bubbles; but, as the effervescence subsides, the sound will become clearer and clearer, and when the air bubbles have entirely disappeared, the glass will ring as usual. If a crumb of bread be thrown into the champagne, and effervescence be re-produced, the glass will again cease to ring. The same experiment will also succeed with soda-water, ginger wine, or any other effervescing liquid.

MUSIC FROM PALISADES.

If a line of broad palisades, set edgewise in a line directed from the ear, and at even distances from each other, be struck at the end nearest the auditor, they will reflect the sound of the blow, and produce a succession of echoes: these, from the equal distance of the palisades, will reach the ear at equal intervals of time, and will, therefore, produce the effect of a number of impulses originating in one point. Thus, a musical note will be heard.

THEORY OF THE JEW'S HARP.

If you cause the tongue of this little instrument to vibrate, it will produce a very low sound; but, if you place it before a cavity, (as the mouth,) containing a column of air, which vibrates much faster, but in the proportion of any simple multiple, it will then produce other higher sounds, dependent upon the reciprocation of that portion of the air. Now, the bulk of air in the mouth can be altered in its form, size, and other circumstances, so as to produce by reciprocation, many different sounds; and these are the sounds belonging to the Jew's Harp.

A proof of this fact has been given by Mr. Eulenstein, who fitted into a long metallic tube a piston, which, being moved, could be made to lengthen or shorten the efficient column of air within at pleasure. A Jew's Harp was then so fixed that it could be made to vibrate before the mouth of the tube, and it was found that the column of air produced a series of sounds, according as it was lengthened or shortened; a sound being produced whenever the length of the column was such that its vibrations were a multiple of those of the Jew's Harp.

MUSIC OF THE SNAIL.

Place a garden-snail upon a pane of glass, and in drawing itself along, it will frequently produce sounds similar to those of musical glasses.

TO TUNE A GUITAR WITHOUT THE ASSISTANCE OF THE EAR.

Make one string to sound, and its vibrations will, with much force, be transferred to the next string: this transference may be seen by placing a saddle of paper (like an inverted ʌ) upon the string, at first in a state of rest. When this string *hears* the other, the saddle will be shaken, or fall off; when both strings are in harmony, the paper will be very little, or not at all, shaken.

MUSIC FROM GLASS OR METAL RODS.

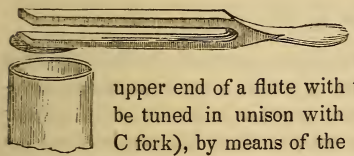
Provide a straight rod of glass or metal; strike it at the end in the direction of its length, or rub it lengthwise with a moistened finger, and it will yield a musical sound, which, unless its length be very great, will be of an extremely acute pitch; much more so than in the case of a column of air of the same length, as in a

flute. The reason of this is the greater velocity with which sound is propagated in solids than in the air. If the rod be metal, the friction will be found to succeed best when made with a bit of cloth, sprinkled with powdered resin; or, if of glass, the cloth or the finger may be moistened and touched with some very fine sand or pumice powder.

Generally speaking, a fiddle-bow, well resined, is the readiest and most convenient means of setting solid bodies in vibration. To bring out their gravest or fundamental tones, the bow must be pressed hard and drawn slowly; but, for the higher harmonies, a short, swift stroke, with light pressure, is most proper.

THE TUNING-FORK A FLUTE-PLAYER.

Take a common tuning-fork, and on one of its branches fasten with sealing-wax a circular piece of card, of the size of a small wafer, or sufficient nearly to cover the aperture of a pipe, as the sliding of the upper end of a flute with the mouth stopped: it may be tuned in unison with the loaded tuning-fork (a C fork), by means of the moveable stopper or card, or the fork may be loaded till the unison is perfect. Then set the fork in vibration by a blow on the unloaded branch, and hold the card closely over the mouth of the pipe, as in the engraving, when a note of surprising clearness and strength will be heard. Indeed, a flute may be made to "speak" perfectly well, by holding close to the opening a vibrating tuning-fork, while the fingering proper to the note of the fork is at the same time performed.



MUSICAL BOTTLES.

Provide two glass bottles, and tune them by pouring water into them, so that each corresponds to the sound of a different tuning-fork. Then apply both tuning-forks to the mouth of each bottle alternately, when that sound only will be heard, in each case, which is reciprocated by the unisonant bottle, or, in other words, by that bottle which contains a column of air susceptible of vibrating in unison with the fork.

THEORY OF WHISPERING.

Apartments of a circular or elliptical form are best calculated for the exhibition of this phenomenon. If a person stand near the wall, with his face turned to it, and whisper a few words, they may be more distinctly heard at nearly the opposite side of the apartment, than if the listener was situated nearer to the speaker.

THEORY OF THE VOICE.

Provide a species of whistle, common as a child's toy or a sportsman's call, in the form of a hollow cylinder, about three-fourths of an inch in diameter, closed at both ends by flat circular plates, with holes in their centres. Hold this toy between the teeth and lips; blow through it, and you may produce sounds varying in pitch with the force with which you blow. If the air be cautiously graduated, all the sounds within the compass of a double octave may be produced from it; and, if great precaution be taken in the management of the wind, tones even yet graver may be brought out. This simple instrument or toy, has, indeed, the greatest resemblance to the larynx, which is the organ of voice.

A speaking-machine has been invented in Germany, with which

have been distinctly pronounced the words, *mamma*, *papa*, *mother*, *father*, *summer*. This instrument consists of a pair of bellows, to which is adapted a tube terminating in a bell, the aperture of which is regulated by the hand, so as to produce the articulate sounds.

SOUND ALONG A WALL.

Whisper along the bare wall of an apartment, and you will be heard much further than in the middle of the room; for the trough or angle between the wall and the floor, forms two sides of a square pipe which conveys the sound.

SOUNDS MORE AUDIBLE BY NIGHT THAN BY DAY.

The experiment with the glass of champagne (page 40) has been employed by Humboldt, in explanation of the greater audibility of distant sounds by night than by day. This he attributes to the uniformity of temperature in the atmosphere by night, when currents of air no longer rise and disturb its equilibrium; as the air-bubbles in the champagne interfere with the vibration within the glass. Again, the universal and dead silence generally prevalent at night, renders our auditory nerves sensible to sounds which would otherwise escape them, and which are inaudible among the continual hum of noises which is always going on in the day time.

MUSICAL ECHO.

If a noise be made in a narrow passage, or apartment of regular form, the echoes will be repeated at equal very small intervals, and will always impress the ear with a musical note. This is, doubtless, one of the means which blind persons have of judging of the size and shape of any room they happen to be in.

VENTRILOQUISM.

The main secret of this surprising art simply consists in first making a strong and deep inspiration, by which a considerable quantity of air is introduced into the lungs, to be afterwards acted upon by the flexible powers of the larynx, or cavity situated behind the tongue, and the trachea, or windpipe: thus prepared, the expiration should be slow and gradual. Any person, by practice, can, therefore, obtain more or less expertness in this exercise; in which, though not apparently, the voice is still modified by the mouth and tongue; and it is in the concealment of this aid, that much of the perfection of ventriloquism lies.

But the distinctive character of ventriloquism consists in its imitations being performed by the voice *seeming* to come from the stomach: hence its name, from *venter*, the stomach, and *loquor*, to speak. Although the voice does not actually come from that region, in order to enable the ventriloquist to utter sounds from the larynx without moving the muscles of his face, he strengthens them by a powerful action of the abdominal muscles. Hence, he speaks by means of his stomach; although the throat is the real source from whence the sound proceeds. It should, however, be added, that this speaking distinctly, without any movement of the lips at all, is the highest perfection of ventriloquism, and has but rarely been attained. Thus, MM. St. Gille and Louis Brabant, two celebrated French ventriloquists, appeared to be absolutely mute while exercising their art, and no change in their countenances could be discovered.

It has lately been shown, that some ventriloquists have acquired by practice the power of exercising the veil of the palate in such a manner, that, by raising or depressing it, they dilate or contract the inner nostrils. If they are closely contracted, the sound pro-

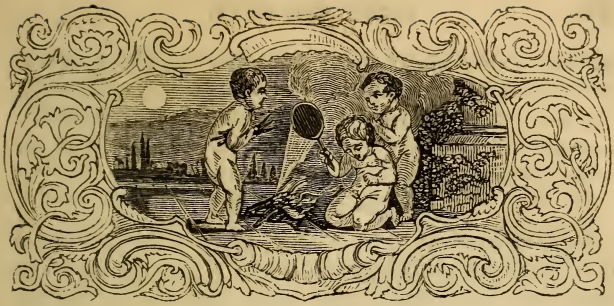
duced is weak, dull, and seems to be more or less distant; if, on the contrary, these cavities are widely dilated, the sound will be strengthened, the voice become loud, and apparently close to us.

Another of the secrets of ventriloquism, is the uncertainty with respect to the direction of sounds. Thus, if we place a man and a child in the same angle of uncertainty, and the man speaks with the accent of a child, without any corresponding motion in his mouth or face, we shall necessarily believe that the voice comes from the child. In this case, the belief is so strengthened by the imagination; for if we were directed to a statue, as the source from which we were to expect sounds to issue, we should still be deceived, and refer the sounds to the lifeless stone or marble. This illusion will be greatly assisted by the voice being totally different in tone and character from that of the man from whom it really comes. Thus, we see how easy is the deception when the sounds are required to proceed from any given object, and are such as they actually yield.

The ventriloquists of our time, as M. Alexander and M. Fitz-James, have carried their art still further. They have not only spoken by the muscles of the throat and the abdomen, without moving those of the face, but have so far overcome the uncertainty of sound, as to become acquainted with modifications of distance, obstruction, and other causes, so to imitate them with the greatest accuracy. Thus, each of these artists has succeeded in carrying on a dialogue; and each, in his own single person and with his own single voice, has represented a scene apparently with several actors. These ventriloquists have likewise possessed such power over their faces and figures, that, aided by rapid changes of dress, their personal identity has scarcely been recognised among the range of personations.

Vocal imitations are much less striking and ingenious than the feats of ventriloquism. Extraordinary varieties of voice may be produced, by speaking with a more acute or grave pitch than usual, and by different contractions of the mouth. Thus may be imitated the grinding of cutlery on a wheel, the sawing of wood, the frying of a pancake, the uncorking of a bottle, and the gurgling noise in emptying its contents.


LIGHT & HEAT.



LIGHT AND HEAT.

FLASHES OF LIGHT UPON REVOLVING WHEELS.

PROVIDE a circle of card-board, six inches in diameter; divide it into sixteen parts, and paint them alternately red and black. Provide a second circle or disc of the same size, and paint on it, in large characters, the words "At rest," on a white ground. Connect both discs with the simple apparatus for causing them to turn round, used in the construction of a toy windmill. Next fill a basin with water, and provide a few small pieces of phosphuret of lime: darken the room, hold the discs over the basin, and turn them round; let the phosphuret of lime be put into the water, and bubbles of light will rise to its surface. If they come up slowly, both discs will appear stationary during their turning round; but when the bubbles come up quickly, the black and red spaces will exhibit a dancing motion, and sometimes two black spaces will seem joined

into one, to the exclusion of the intervening red, and *vice versâ:* the words on the second disc will also cross each other in various directions, when the flashes of light interfere; and, in both cases, confusion will be excited by an impression being made on the retina, before preceding impressions have departed.

DECOMPOSITION OF LIGHT.

Sir Isaac Newton first divided a white ray of light, and found it to consist of an assemblage of coloured rays, which formed an image upon a wall, and in which were displayed the following colours: red, orange, yellow, green, blue, indigo, and violet. Sir Isaac then showed that these seven colours, when again put together or combined, recomposed white light. This may be proved by painting a card wheel in circles with the above colours, and whirling it rapidly upon a pin, when it will appear white.

Light may also be decomposed by the following beautiful experiment: Form a tube about ten inches long and one inch in diameter, of paper, one side of which is of a bright blue colour. This may be done by wrapping the paper once round a cylinder of wood, and securing the edges of the paper with paste. The coloured side of the paper must be the interior of the tube. Apply this tube to one eye, the other being closed, and on looking at the ceiling, a circular orange spot will be seen, which is the result of decomposition: the white light from the ceiling enters the tube, the blue is retained, and the red and yellow rays enter the eye, and produce the impression of orange.

SOLAR REFRACTION.

The theory of solar refraction may be beautifully illustrated as follows: Put a shilling into a basin, and pour some water on it, when the silver will be refracted through the medium; and, if the

vessel be filled, you may withdraw to any distance from which the surface of the water will be visible, and, by the refraction from it, you can still observe the shilling.

INCANTATIONS.

Dissolve crystals of nitrate of copper in spirit of wine; light the solution, and it will burn with a beautiful emerald-green flame: pieces of sponge soaked in this spirit, lighted and suspended by fine wires, produce the lambent green flames now so common in incantation scenes: strips of flannel saturated with it, and applied round copper swords, tridents, &c., produce, when lighted, the flaming swords and fire-forks, brandished by the demons in such scenes: indeed, the chief consumption of nitrate of copper is for these purposes.

TO IMITATE THE LIGHT OF THE SEA.

It is well known, that on dark, stormy nights, the sea emits a brilliant light, the effect of which may be thus imitated. Scrape off four drams of the substance of putrefying fish, as whiting, herring, or mackerel, and put it into a white glass bottle, containing two ounces of sea-water, or of pure water with two drams of common salt dissolved in it; set the bottle in a dark place, and in three days a ring of light will be seen on the surface of the liquid, and the whole, if shaken, will become luminous, and continue so for some time. If it be set in a warm place, the light will be brighter; if the liquid be frozen, the light will disappear, but will re-appear on being thawed.

If more salt be added to the solution, the light will disappear, but instantly burst forth from absolute darkness by dilution with water. Lime-water, common water, beer, acids, even very dilute

alkaline leys, as pearl-ash or soda and water, will permanently extinguish this spontaneous light.

INSTANTANEOUS LIGHTS.

The oxygenated, or *chlorate matches*, are first dipped in melted sulphur, and then tipped with a paste made of chlorate of potass, sulphur, and sugar, mixed with gum-water, and coloured with vermilion: frankincense and camphor are sometimes mixed with the composition, and the wood of the match is pencil-cedar, so that a fragrant odour is diffused from the matches in burning. To obtain light, a match is very lightly dipped in a bottle containing a little asbestos soaked in oil of vitriol.

Lucifers consist of chips of wood tipped with a paste of chlorate of potass mixed with sulphuret of antimony, starch, and gum-water: when a match is pinched between the folds of glass-paper, and suddenly drawn out, a light is instantly obtained.

Prometheans consist of small rolls of waxed paper, in one end of which is a minute quantity of vitriol, in a glass bulb, sealed up, and surrounded with chlorate of potass: when the end thus prepared is pressed so as to break the bulb, the vitriol comes in contact with the composition. and produces light instantly.

For cigar-smokers, Prometheans are made with touch-paper; this ignites from the composition, and glows without flame, like a slow match; and as the wind will not extinguish it, a dry cigar may be readily lighted at it.

Lucifers and Prometheans must be used with caution, and should never be carelessly left about: by letting them fall upon a sanded floor, and being accidentally trod upon, they may take fire, and thus do great mischief.

TO COLOUR THE FLAME OF A CANDLE.

Take a piece of packthread, or cotton thread, boil it in clean water to free it from saline particles, and dry it; wet one end, and take upon it a little of either of the salts hereafter named, in fine powder, or strong solution. Then dip the wetted end of the thread into the cup of a burning wax candle, and apply it to the exterior of the flame, not quite touching the luminous part, but so as to be immersed in the cone of invisible but intensely heated air which envelopes it. Immediately, an irregular sputtering combustion of the wax on the thread will take place, and the invisible cone of heat will be rendered luminous, with a peculiarly coloured light, according to the salt employed.

Thus, common salt will give a bright yellow; muriate of potass will give a beautiful pale violet; muriate of lime will give a brick red; muriate of strontia will give a magnificent crimson; muriate of lithia will give a red; muriate of baryta will give a fine pale apple green; muriate of copper will give a beautiful bluish green; and green copperas will give a white light.

TO DIVIDE THE FLAME OF A CANDLE.

Provide about a foot square of brass or iron wire gauze, of the fineness of thirty meshes to the square inch: lower the gauze upon the flame of a wax candle, which will not rise through the meshes, but in its place will be the inflammable smoke of the flame; apply to this a piece of lighted paper, and it will be kindled, and the candle will burn with flame above and beneath the gauze. In this case, the gauze so cools the flame, as to extinguish it; and upon this principle is constructed the Davy Safety Lamp, in which the light is surrounded with wire-gauze.

To vary this experiment, place a chip of camphor in the centre of a piece of wire-gauze about a foot square, and hold it over the flame of a candle or lamp; when the vapour of the camphor will burn brightly upon the lower surface of the gauze, but cannot rise through it in consequence of its cooling power. Thus, the camphor lies upon the gauze in an uninflamed state, though it is sufficiently heated to yield inflammable vapour to feed a flame beneath.

CANE WICK LAMP.

Cut a piece of cane about one inch long: set it upright in spirit of wine, with a small portion just above the surface: the spirit will then rise through the tube of the cane, which being lighted, will burn as a wick.

CAMPHOR AND PLATINUM LAMP.

Place a small piece of camphor, or a few fragments, upon the bottom of a glass, and lay upon the camphor a piece of coiled or pressed up platinum wire, heated in the flame of a lamp; when the platinum will glow brilliantly as long as any camphor remains, and frequently light up into flame.

PLATINUM AND ETHER LAMP.

Put into a small hyacinth-glass a teaspoonful of ether, and suspend in it, by wire, a coil of fine platinum wire, first heated in the flame of a spirit-lamp; the wire will then glow with a red heat, and some of it may become white hot; in the latter case, flame will be produced by the ether burning.

FLOATING LIGHT.

Cut a chip of camphor; light it, and set it on a basin of water, when it will continue to burn and float, until it is consumed.

SUBSTITUTE FOR A WAX TAPER.

Steep a loosely twisted cotton skein in a solution of nitre; dry it, and it will readily kindle by the sparks produced from the flint and steel. If, however, the cotton be further prepared by coating portions of it, at regular intervals, alternately with sulphur and white wax, and the sparks be struck upon the sulphur, it will readily kindle, and as readily light the wax; and the flame will endure long enough for sealing a letter.

PHOSPHORESCENT FISH.

Place a very stale fish in a dark room, and it will give out a strong light, because of the numerous animalculæ, whose growth the putrefaction has promoted.

THE LUMINOUS SPECTRE.

Phosphorus in its pure state should be very cautiously handled; as, unless used very moderately, it will burn the skin. By adding to it, however, six parts of olive oil, it may be employed with perfect safety. If every part of the face, except the eyes and mouth, which should be kept shut while applying it, be anointed with this mixture, it will give the party a most frightful appearance in the dark. The eyes and mouth will seem black, and all the other parts of the face will appear lighted with a sickly, pale-bluish flame.

LIGHT, A PAINTER.

Strain a piece of paper or linen upon a wooden frame, and sponge it over with a solution of nitrate of silver in water; place it behind a painting upon glass, or a stained window-pane, and the light, traversing the painting or figures, will produce a copy of it upon the prepared paper or linen; those parts in which the rays were least intercepted being the shadows of the picture.

EFFECT OF LIGHT UPON CRYSTALLIZATION.

Place a solution of nitre in a small basin of water, in a room which has the light admitted only through a small hole in the window-shutter; crystals will then form most abundantly upon the side of the basin exposed to the aperture through which the light enters; and often the whole mass of crystals will turn towards it. This peculiar effect may also be seen in the crystals in camphor glasses in druggists' widows, which are always most copious upon the side exposed to the light.

EFFECT OF LIGHT ON PLANTS.

Shut a plant up in a room into which light is only admitted through a small hole in the window-shutter, and set the plant out of the direction of this light; it will, in a short time, turn itself, and even grow downwards, that it may expose its leaves to the light.

If plants be kept in darkness, they will soon become bleached; then, if they be exposed to the sun for three, four, or five hours, the leaves and stalks will become as intensely green as if the plants had been reared in the sun. Again, if a lighted lamp be introduced into a dark room, wherein a plant has been shut up and

bleached, it will become green, and direct itself towards the lamp. If such a plant be removed from the room, exposed for some time to the sun, and then returned to darkness, it will no longer support the privation of light, but will fade and perish.

INSTANTANEOUS LIGHT UPON ICE.

Throw upon ice a small piece of potassium, and it will burst into flame. In one experiment, the operator pressed the potassium on the ice with a penknife, when the whole length of the ice became ignited.

WHITE LIGHT FROM ZINC.

As a substance for light, zinc is far superior to any of the metals. The light which it yields on burning is as bright as that of the sun, and as white, so that the eye can scarcely endure it; and the effect is much increased by the great quantity of silvery smoke which reflects the fire, and thus widely increases the sphere of illumination. Zinc may be used in thin sheets, or in filings.

BRILLIANT LIGHT FROM TWO METALS.

Wrap a small piece of platinum in a piece of tin-foil of the same size, and expose them upon charcoal to the action of the blow pipe; when the union of the two metals will be accompanied by a rapid whirling, and by a remarkably brilliant light. If the globule thus melted be allowed to drop into a basin of water, it will remain for some time red hot at the bottom of it.

BRILLIANT LIGHT FROM STEEL.

Pour into a watch-glass a little sulphuret of carbon, and light it; hold in the flame a brush of steel-wire, and it will burn beautifully. A watch-spring may also be burnt in it.

LIGHTED TIN.

Place upon a piece of tinfoil a few powdered crystals of nitrate of copper; moisten it with water; fold up the foil gently, and wrap it in paper so as to keep out the air: lay it upon a plate, and the tin will soon inflame.

LIGHT FROM GILT BUTTONS.

Provide a new and highly-polished gilt button, and hold it in a strong light, closely but obliquely, over a sheet of white paper, when it will present radiations exactly like the spokes of a carriage-wheel; the radiations being sixteen in number, and a little contracted in the centre opposite the eye of the button, and presenting altogether a beautiful appearance.

LIGHT FROM A FLOWER.

Hold a lighted candle to the flower of the *fraxinella*, and it will dart forth little flashes of light. This beautiful appearance is caused by the essential and inflammable oil contained in small vessels at the extremities of the flower, which vessels burn at the approach of any inflamed body, setting at liberty the essential oil, as that contained in orange-peel is discharged by pressure.

LIGHT FROM SUGAR.

Simply break a bit of lump sugar between the fingers in the dark, and light will be produced at the moment of fracture.

Or, if powdered loaf sugar be put into a spoon, fused, and kindled in the flame of a lamp, it will exhibit a fine jet of flame.

LIGHT FROM THE POTATO.

Place a few potatoes in a dark cellar, and when they become in a state of putrefaction, they will give out a vivid light sufficient to read by. A few years since, an officer on guard at Strasbourg thought the barracks were on fire, in consequence of the light thus emitted from a cellar full of putrefying potatoes.

LIGHT FROM THE OYSTER.

Open an oyster, retain the liquor in the lower or deep shell, and if viewed through a microscope, it will be found to contain multitudes of small oysters, covered with shells, and swimming nimbly about; one hundred and twenty of which in a row would extend but one inch. Besides these young oysters, the liquor contains a variety of animalculæ, and myriads of three distinct species of worms, which shine in the dark like glow-worms. Sometimes their light resembles a bluish star about the centre of the shell, which will be beautifully luminous in a dark room.

LIGHT FROM DERBYSHIRE SPAR.

Pound, coarsely, some of the dark blue or the fetid variety of Derbyshire spar; heat it in a dark room, in a platinum spoon, over the low flame of a spirit-lamp, and the spar will shine with a beautiful purple tint.

Pounded swinestone, calcareous spar, and powdered quartz, will also give out light, if strewn upon a fire-shovel which has been heated red-hot, and has just ceased glowing.

A variety of fluor spar, found in granite in Siberia, will shine in the dark when warmed, with a remarkably strong phosphorescent

light, increasing as the temperature is raised. The light augments when the spar is plunged into water; and in boiling water, the spar becomes so luminous that the letters of a printed book can be seen in a dark room near the glass containing it.

Another variety of fluor spar, also found in Siberia, is of a pale violet colour, and emits a white light merely by the heat of the hand; and when put into boiling water, it will give out a green light.

LIGHT FROM OYSTER-SHELLS.

Put oyster-shells into a common fire; burn them for about half an hour; then remove them into a dark room, when many of the shells will exhibit beautiful specimens of prismatic colours.

RINGS OF LIGHT IN CRYSTAL.

This is one of the most striking of optical exhibitions, and may be thus simply produced. Provide a sheet of clear ice, about an inch thick, frozen in still weather; let the light fall through the ice upon a pane of window-glass, or a polished table, and by placing a fragment of plate-glass near the eye as a reflector, the most beautiful rings of light may be observed.

TO STRIKE LIGHT WITH CANE.

Strike a piece of rattan cane with a steel, and it contains so much silex, or flint, that it will exhibit sparks of light in the dark.

CAUSE OF TRANSPARENCY.

Moisten a piece of paper, and it will appear more transparent than when in its natural state; the cause of which is as follows: a

piece of dry paper has its pores obstructed with finely interwoven threads; these are broken by the liquor, which also fills the pores as so many small tubes, and permits the light to pass through it, whereas the dry threads had hitherto prevented its passage.

TRANSPARENCY OF GOLD.

All bodies are more or less transparent. Thus, though gold is one of the densest metals, yet, if a piece of the thinnest gold-leaf be held up to a candle, the light will pass through it; and, that it passes through the substance of the metal, and not through cracks or holes too small to be detected by the eye, is evident from the colour of the transmitted light, which is green.

TINT CHANGED BY THICKNESS.

Provide a piece of plain and polished smalt-blue glass, such as sugar-basins and finger glasses are made of. It should be of unequal thickness. Look through this glass at a strong light, as that from the crack of a window-shutter, in a darkened room, and, at the thinnest part, the colour will be purely blue. As the thickness increases, a purple tinge will come on, which will become more and more ruddy; and, if the glass be very thick, the colour will pass to a deep red.

SHADOWS MADE DARKER BY INCREASED LIGHT.

Hold a finger between a candle and the wall, and it will cast a shadow of a certain darkness; then place another candle in the same line with the other from the wall, and the shadow will appear doubly dark, although there will be more light in the room than before. Then separate the candles, and place them so as to produce two shadows of the finger, one partly overlapping the other, and that part will be of double darkness, as compared with the remainders.

MINIATURE THUNDER AND LIGHTNING.

To imitate thunder, provide a thin sheet of iron; hold it by one corner between the finger and thumb, and allow it to hang freely by its own weight. Then shake the hand horizontally, so as to agitate the corner in a direction at right angles to the surface of the sheet. Thus you may produce a great variety of sounds, from the deep growl of distant thunder to those loud claps which rattle in rapid succession immediately over our heads. The same effect may be produced by sheets of tinned iron, or tin-plate, and by thin plates of mica; but the sound is shorter and more acute.

Partial flashes of lightning, aurora borealis, &c. may be beautifully imitated by taking in a spoon about a dram of the seeds of lycopodium, and throwing them against a lighted candle, all other light being excluded from the room.

A similar effect may be produced, by laying some powdered resin on a piece of paper, and fillipping it with the finger against the flame of a candle.

THE BURNING GLASS.

If, when the sun shines brightly, a piece of paper be held in the focus of the rays drawn by the burning-glass, it will take fire. This experiment succeeds best with brown or any dark-coloured paper: for, though the glass will collect an equal number of rays upon white as upon coloured paper, the white paper reflects the rays instead of allowing them to enter it; hence, the white is not so soon burnt as the coloured paper, which absorbing more light than it reflects, soon becomes heated and takes fire.

MAGIC OF HEAT.

Melt a small quantity of the sulphate of potass and copper in a spoon over a spirit-lamp; it will be fused at a heat just below

redness, and produce a liquid of a dark green colour. Remove the spoon from the flame, when the liquid will become a solid of a brilliant emerald-green colour, and so remain till its heat sinks nearly to that of boiling water, when suddenly a commotion will take place throughout the mass, beginning from the surface, and each atom, as if animated, will start up and separate itself from the rest, till, in a few moments, the whole will become a heap of powder.

REPULSION BY HEAT.

Provide two small pieces of glass; sprinkle a minute portion of sulphur upon one piece, lay thin slips of wood around it, and place upon it the other piece of glass. Move them slowly over the flame of a lamp or candle, and the sulphur will become sublimed, and form grey nebulous patches, which are very curious microscopic objects. Each cluster consists of thousands of transparent globules, imitating, in miniature, the nebulæ which we see figured in treatises on astronomy. By observing the largest particles, we shall find them to be flattened on one side. Being very transparent, each of them acts the part of a little lens, and forms in its focus the image of a distant light, which can be perceived even in the smaller globules, until it vanishes from minuteness. If they are examined again after a certain number of hours, the smaller globules will generally be found to have retained their transparency, while the larger ones will have become opaque, in consequence of the sulphur having undergone some internal spontaneous change. But the most remarkable circumstance attending this experiment is, that the globules are found adhering to the upper glass only; the reason of which is, that the upper glass is somewhat cooler than the lower one; by which means we see that the vapour of sulphur is very powerfully repelled by heated

glass. The flattened form of the particles is owing to the force with which they endeavour to recede from the lower glass, and their consequent pressure against the surface of the upper one. This experiment is considered by its originator, Mr. H. F. Talbot, F. R. S., to be a satisfactory argument in favour of the repulsive power of heat.

HEAT PASSING THROUGH GLASS.

The following experiment is also by Mr. Talbot:—Heat a poker bright-red hot, and having opened a window, apply the poker quickly very near to the outside of a pane, and the hand to the inside; a strong heat will be felt at the instant, which will cease as soon as the poker is withdrawn, and may be again renewed, and made to cease as quickly as before. Now, it is well known, that if a piece of glass is so much warmed as to convey the impression of heat to the hand, it will retain some part of that heat for a minute or more; but, in this experiment, the heat will vanish in a moment. It will not, therefore, be the heated pane of glass that we shall feel, but heat which has come through the glass, in a free or radiant state.

METALS UNEQUALLY INFLUENCED BY HEAT.

All metals do not conduct heat at the same rate, as may be proved by holding in the flame of a candle at the same time, a piece of silver wire, and a piece of platina wire, when the silver wire will become too hot to hold, much sooner than the platina. Or, cut a cone of each wire, tip it with wax, and place it upon a heated plate, as (a fire shovel,) when the wax will melt at different periods.

SPONTANEOUS COMBUSTION.

Mix a little chlorate of potass with spirit of wine in a strong saucer; add a little sulphuric acid, and an orange vapour will arise and burst into flame.

INEQUALITY OF HEAT IN FIRE-IRONS.

Place before a brisk fire a set of polished fire-irons, and besides them a rough unpolished poker, such as is used in a kitchen, or instead of a bright poker. The polished irons will remain for a long time without becoming warmer than the temperature of the room, because the heat radiated from the fire is all reflected, or thrown off, by the polished surface of the irons, and none of it is absorbed. The rough poker will, however, become speedily hot, so as not to be used without inconvenience. Hence, the polish of fire-irons is not merely ornamental but useful.

EXPANSION OF METAL BY HEAT.

Provide an iron rod, and fit it exactly into a metal ring; heat the rod red-hot, and it will no longer enter the ring.

Observe an iron gate on a warm day, when it will shut with difficulty; whereas, it will shut loosely and easily on a cold day.

EVAPORATION OF A METAL.

Rub a globule of mercury upon a silver spoon, and the two metals will combine with a white appearance; heat the spoon carefully in the flame of a spirit-lamp, when the mercury will volatilize and disappear, and the spoon may then be polished until it recovers

its usual lustre: if, however, the mercury be left for some time on the spoon, the solid texture of the silver will be destroyed throughout, and then the silver can only be recovered by heating it in a ladle.

A FLOATING METTLE ON FIRE.

Throw a small piece of that marvellous substance, potassium, into a basin of water, and it will swim upon the surface, and burn with a beautiful light, of a red colour mixed with violet. When moderately heated in the air, potassium takes fire, and burns with a red light.

HEAT AND COLD FROM FLANNEL.

Put a piece of ice into a basin, which wrap up in many folds of flannel, and the ice may be preserved for some time by the fireside.

ICE MELTED BY AIR.

If two pieces of ice be placed in a warm room, one of them may be made to melt much sooner than the other, by blowing on it with a pair of bellows.

TO HOLD A HOT TEA-KETTLE ON THE HAND.

Be sure that the bottom of the kettle is well covered with soot; when the water in it boils, remove it from the fire, and place it upon the palm of the hand; no inconvenience will be felt, as the soot will prevent the heat being transmitted, from the water within and the heated metal, to the hand.

INCOMBUSTIBLE LINEN.

Make a strong solution of borax in water, and steep in it linen, muslin, or any article of clothing; when dry, they cannot easily be inflamed.

THE BURNING CIRCLE.

Light a stick, and whirl it round with a rapid motion, when its burning end will produce a complete circle of light, although that end can only be in one part of the circle at the same instant. This is caused by the duration of the impression of light upon the retina. Another example is, that during the twinkling of the eye we never lose sight of the object we are viewing.

WATER OF DIFFERENT TEMPERATURES IN THE SAME VESSEL.

Of heat and cold, as of wit and madness, it may be said that "thin partitions do their bounds divide." Thus, paint one-half of the surface of a tin-pot with a mixture of lamp-black and size, and leave the other half, or side, bright; fill the vessel with boiling water, and by dipping a thermometer, or even the finger, into it shortly after, it will be found to cool much more rapidly upon the blackened than upon the bright side of the pot.

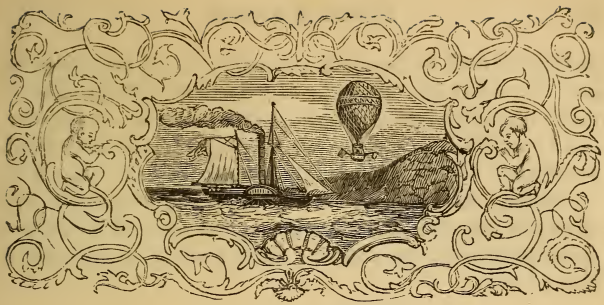
WARMTH OF DIFFERENT COLOURS.

Place upon the surface of snow, as upon the window-sill, in bright daylight or sunshine, pieces of cloth of the same size and quality, but of different colours, black, blue, green, yellow, and white: the black cloth will soon melt the snow beneath it, and sink downwards; next the blue, and then the green; the yellow but slightly; but the snow beneath the white cloth will be as firm as at first.

SUBSTITUTE FOR FIRE.

Put into a cup a lump of quick-lime, fresh from the kiln, pour water upon it, and the heat will be very great. A pailful of quick-lime, if dipped in water, and shut closely into a box constructed for the purpose, will give out sufficient heat to warm a room, even in very cold weather.


GAS & STEAM.



GAS AND STEAM.

LAUGHING GAS.

THE above fanciful appellation has been given to nitrous oxide, from the very agreeable sensations excited by inhaling it. In its pure state it destroys animal life, but loses this noxious quality when inhaled, because it becomes blended with the atmospheric air which it meets in the lungs. This gas is made by putting three or four drams of nitrate of ammonia, in crystals, into a small glass retort, which being held over a spirit lamp, the crystals will melt, and the gas be evolved.

Having thus produced the gas, it is to be passed into a large bladder having a stop-cock; and when you are desirous of exhibiting its effects, you cause the person who wishes to experience them, to first exhale the atmospheric air from the lungs, and then quickly

placing the cock in his mouth, you turn it, and bid him inhale the gas. Immediately, a sense of extraordinary cheerfulness, fanciful flights of imagination, an uncontrollable propensity to laughter, and a consciousness of being capable of great muscular exertion, supervene. It does not operate in exactly the same manner on all persons; but in most cases the sensations are agreeable, and have this important difference from those produced by wine or spirituous liquors, that they are not succeeded by any depression of mind.

THE LUMINOUS WAND.

Cover a long slip of wood, half way, with sulphur, by immersion while in a melted state. Having prepared a jar of nitrous oxide gas, as in preceding experiments, light the sulphur, and plunge the wand into the jar. The gas will extinguish the flame. Withdraw the wand, light it again, and when the flame is very brilliant, immerse it again in the jar. It will this time burn with great splendour, and of a beautiful red colour.

TO MAKE CARBONIC ACID GAS.

Put about an ounce of marble in small lumps, into an eight ounce phial, with about an equal quantity of water; pour in a little muriatic acid, and carbonic acid gas will be evolved.

CARBONIC ACID GAS IN WINE OR BEER VESSELS.

The apparently empty or upper part of vessels in which wine or beer is working, is filled with this deleterious gas; for its great weight prevents its ascent from the fermenting liquid. A variety of striking but simple experiments may be made with the

gas in this condition, Lighted paper, or a candle dipped into it, will be immediately extinguished; and the smoke remaining in the carbonic acid gas will render its surface visible, which may be thrown into waves by agitation, like water. In consequence of the great weight of the carbonic acid gas, it may be taken from a vat of fermenting liquor, in a jug or bottle, and in the latter, if well corked, it may be conveyed to great distances; or the gas may be drawn out of a vessel by a cock, like a liquid.

TO EXTINGUISH FLAME WITH GAS.

The effects produced by pouring carbonic acid gas from one vessel to another, have a very singular appearance: if a lighted candle be placed in a jar, and the gas be poured upon it, the flame will be extinguished in a few seconds, though the eye is incapable of distinguishing that anything is poured out.

EFFECT OF HYDROGEN ON THE VOICE.

Make a hole through a wine cork of sufficient size to admit a smaller cork; through which make another hole, and fix it into the larger one. Tie the corks thus fixed into the neck of a bullock's bladder, previously exhausted of air; let a tube from a bottle generating hydrogen pass very tightly through the aperture in the small cork, and the gas will distend and fill the bladder. The instant it is full, withdraw the inner cork, and either prevent the escape of the gas by means of the thumb, or cork it closely, till the operator is ready to *breathe the gas;* to do which, he should put the open cork into his mouth, and take *one* inspiration, when, on immediately speaking, his voice will be remarkably shrill. The effect will pass off in a few seconds.

MAGIC TAPER.

Provide a piece of copper wire, about ten inches long, and fix at one end of it a piece of wax taper: take a pint bottle of hydrogen, and place the mouth downwards; light the taper, introduce it into the bottle, and the gas will take fire, and burn slowly towards the mouth, where it is in contact with the air. If, however, the taper be passed up into the bottle, it will be extinguished; but, on gently withdrawing it through the burning hydrogen, the wick will be rekindled. This may be done several times in succession with the same portion of gas.

THE GAS CANDLE.

Provide a strong glass bottle which will contain about eight ounces, or half a pint, into which put a few pieces of zinc; then mix half an ounce of sulphuric acid with four ounces of water, and pour it into the bottle upon the zinc; fit the mouth closely with a cork, through which put a metal tube which ends upward in a fine opening: the mixture in the bottle will soon effervesce, and hydrogen gas will rise through the tube. When it has escaped for about a minute, apply a lighted paper to the tube, and the gas will burn like a candle, but with a pale flame. Its brightness may be increased to brilliance, by sifting over it a small quantity of magnesia.

GAS BUBBLES.

Provide a bladder, fill it with hydrogen gas, to be made as for the last experiment, and fit the end of a tobacco-pipe closely into the bladder; dip the bowl of the pipe into soap and water, and,

by pressing the bladder, soap-bubbles will be formed, filled with hydrogen gas; which bubbles, or balloons, will rise in the air, and keep there for some time.

GAS-LIGHT IN THE DAY-TIME.

Light a stream of hydrogen gas, and it will be scarcely visible in the day-light; but place in it a small coil of platinum wire, or project a little oxide of zinc through the flame, and it will become very luminous.

MINIATURE BALLOONS.

One of the simplest and most beautiful experiments in aërostation, is to take a turkey's maw, or stomach, properly prepared, and to fill it either with pure hydrogen gas, or the carburetted hydrogen produced from coal. If the balloon be then allowed to escape in the open air, it will ascend rapidly in the atmosphere: but the best method of showing the experiment, is to let the balloon off a high staircase, and observe it ascend to the cupola or light, where it will remain near the highest point till the escape of the gas allow it to descend. The prepared maw for this balloon may be purchased of any optician.

MINIATURE GAS-LIGHTING.

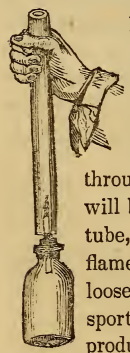
Bicarburetted hydrogen is the principal constituent of the gas burned in the streets: it is procured from coal, and the process may readily be performed on a small scale. Put about two ounces of pounded coal into an earthen retort, and fix a glass tube into the neck, terminating in an aperture of one-fifth of an inch in diameter; heat the retort red-hot, and apply the flame of a taper

to the orifice of the tube, when the gas will burn with a bright white light, very different from that afforded by the combustion of hydrogen; a circumstance owing to the presence of particles of carbon in the carburet, which being intensely ignited, are highly luminous.

It is no less strange than true, that bicarburetted hydrogen, the substance which we so largely consume to illuminate our towns, is ether when united to water in one proportion, and spirit when combined with it in another; a fluid which constitutes the strength of all wines, beer, and fermented liquors.

MUSICAL GAS.

Into a half-pint glass bottle, put some zinc, granulated by being melted in a ladle, and then poured gradually into water.



Add some sulphuric acid, diluted with eight parts by weight of water. Then pass a glass tube with a capillary bore, through a cork, which you have previously made to closely fit the bottle, and cork the bottle well. In a short time, the atmospheric air will be expelled, and hydrogen gas will rise through the tube; you then apply a light, and the gas will become ignited. If you now hold another glass tube, about eighteen or twenty inches long over the flame sufficiently wide to enclose the other tube very loosely (*see engraving*), the little speck of flame will sport along the larger tube, and musical sounds will be produced, which may be varied by using other tubes of different dimensions, and made of different materials; the wide tubes forming the lower, and the narrow tubes the upper notes.

MINIATURE WILL O'-THE-WISP.

Put a small piece or two of the phosphuret of lime into a saucer of water, when bubbles of phosphuretted hydrogen gas will rise to the surface, explode into flame, and cause a white smoke; representing, on a small scale, the *ignis fatuus*, or will o'-the-wisp, as seen over marshy ground, or stagnant pools of water.

PHOSPHORIC ILLUMINATION.

A light so brilliant that the eye can scarcely bear to contemplate it, is produced by the immersion of phosphorus in oxygen gas. To perform this experiment, you place a piece of phosphorus in a copper cup, of the circumference of a sixpence, which is fastened to a thick piece of iron wire, attached to a cork which fits a bottle (as in the foregoing experiment) filled with oxygen gas. Set fire to the phosphorous, and quickly plunge it into the bottle; when the splendour of the combustion will be surpassingly beautiful.

It is necessary to observe, that the heat is so excessive, that if the piece of phosphorous in this experiment be larger than a small pea, there will be great danger of breaking the bottle.

COMBUSTION OF IRON IN OXYGEN GAS.

Twist a piece of fine iron wire, such as is used by piano-forte makers, round a cylindrically-shaped piece of wood or metal, which will give it a spiral form; or a broken watch-spring, which may be bought for a trifle of the watch-makers, will answer the same purpose. Fasten round one end of it some waxed cotton thread or twine, and attach the other end to a cork, which fits a glass jar or bottle, that will hold a quart, filled with oxygen gas. Having made the wire red-hot by setting light to the thread, plunge it into

the bottle. Do not cork the bottle, but let the cork merely lay on the mouth, and to prevent its being burned, a small a piece of lead should be fastened to the bottom of it. The iron will instantly begin to burn with great brilliancy, throwing out luminous scintillations.

To prevent the bottle from being broken by the sparks, a small quantity of sand should be previously poured into it.

GLOW-WORM IN OXYGEN GAS.

If a glow-worm be placed in a jar of oxygen gas, in a dark room, it will shine with a far surpassing brilliancy to that which it exhibits in atmospheric air.

LUMINOUS CHARCOAL.

Attach a small piece of charcoal to the end of a copper-wire; make it red-hot, and immerse it in a jar of oxygen gas. The charcoal will burn with great brilliance, throwing out splendid scintillations. The bark of the wood converted into charcoal must be selected, otherwise there will be no scintillations.

BRILLIANT COMBUSTION IN OXYGEN.

Place in a bottle of oxygen gas a lighted taper, and it will burn with a flame of increased brilliancy.

Extinguish the taper immediately; put it into the same or another bottle of oxygen, and it will be again lighted provided a spark remain on the wick.

Bend a piece of iron wire in a spiral form, and tie on to one end some cotton or flax; sprinkle some flour of sulphur on it, set it on fire, dip it into a bottle of oxygen gas, and beautiful corruscations will be thrown off the wire.

FLAME FROM COLD METALS.

Provide a bottle of the gas chlorine, which may be purchased of any operative chemist, and with it you may exhibit some brilliant experiments.

For example, reduce a small piece of the metal antimony to a very fine power in a mortar; place some of this on a bent card, then loosen the stopper of the bottle of chlorine, and throw in the antimony, it will take fire spontaneously, and burn with much splendour; thus exhibiting a cold metal spontaneously bursting into flame.

If, however, a *lump* of antimony be dropped into the chlorine, there will be no spontaneous combustion, nor immediate change: but, in the course of time, the antimony will be become incrusted with a white powder, and no chlorine will be found in the bottle.

Or, provide copper in fine leaves, known as "Dutch metal;" slightly breathe on one end of a glass rod, about ten inches long, and cause one or two leaves of the metal to adhere to the damp end; then open a bottle of chlorine, quickly plunge in the leaves, when they will instantly take fire, and burn with a fine red light, leaving in the bottle a greenish-yellow solid substance.

A small *lump* of copper, or "Duch metal," will not burn as above, but will be slowly acted upon, like the antimony.

Immerse gold leaf in a jar of chlorine gas, and combustion with a beautiful green flame will take place.

PHOSPHORUS IN CHLORINE.

Put into a deflagrating spoon about four grains of phosphorus, and let it down into a bottle of chlorine, when the phosphorus will ignite instantaneously.

Or, fold a slip of blotting-paper into a match five inches long; dip it into oil of turpentine, drain it an instant, drop it into another bottle of chlorine, when it will burst into a flame, and deposit much carbon.

CAOUTCHOUC BALLOONS.

Put a little ether into a bottle of caoutchouc, close it tightly, soak it in hot water, and it will become inflated to a considerable size. These globes may be made so thin as to be transparent.

A piece of caoutchouc, the size of a walnut, has thus been extended to a ball fifteen inches in diameter; and a few years since, a caoutchouc balloon, thus made, escaped from Philadelphia, and was found 130 miles from that city.

TO INCREASE THE LIGHT OF COAL GAS.

Lay a piece of wire-gauze upon the glass chimney of a common argand gas burner, when the flame will be enlarged to twice its former dimensions, and its light fully doubled. If the experiment be made with a common argand oil-lamp, the flame will be often enlarged, but so discoloured as to yield less light.

GAS FROM INDIAN RUBBER.

Put caoutchoucine, or the spirit distilled from caoutchouc, or Indian rubber, into a phial, little more than sufficient to cover the bottom, and the remainder of the phial will be filled with a heavy vapour; pour this off the spirit into another phial, apply to it a piece of lighted paper, and the vapour will burn with a brilliant flame.

ETHER GAS.

Let fall a few drops of ether into a large drinking-glass, and cover it with a plate for a few minutes; during this time the glass will be filled with vapour from the ether, so that, on removing the plate, and applying a piece of lighted paper at the mouth of the glass, the invisible vapour will take fire; thus proving how readily a volatile fluid, such as ether, combines with the air.

MAGIC VAPOUR.

Provide a glass tube, about three feet long and half an inch in diameter, nearly fill it with water, upon the surface of which pour a little coloured ether; then close the open end of the tube carefully with the palm of the hand, invert it in a basin of water, and rest the tube against the wall: the ether will rise through the water to the upper end of the tube; pour a little hot water over the tube, and it will soon cause the ether to boil within, and its vapour may thus be made to drive nearly all the water out of the tube into the basin; if, however, you then cool the tube by pouring cold water over it, the vaporized ether will again become a liquid, and float upon the water as before.

GAS FROM THE UNION OF METALS.

Nearly fill a wine-glass with diluted sulphuric acid, and place in it a wire of silver and another of zinc, taking care that they do not touch each other; when the zinc will be changed by the acid, but the silver will remain inert. But, cause the upper ends of the wires to touch each other, and a stream of gas will issue from them.

INVISIBLE GASES MADE VISIBLE.

Pour a little sulphuric acid upon some common salt in a saucer. Into another saucer put a mixture of about two parts of quick-lime and one of sal ammoniac, both in powder, adding to these a very small quantity of boiling water. Each saucer apart will yield an invisible gas: but the moment they are brought closely together, very visible vapours will be the result.

LIGHT UNDER WATER.

Put into an *eau de Cologne* bottle two drams of chlorate of potass, and upon that salt about a dozen chips of phosphorous, and fill up the bottle with cold water: provide a glass tube which will reach to the potass, through which pour half-an-ounce, by measure, of strong sulphuric acid, when a gas will instantly rise, give to the liquid a deep yellow colour, and inflame the phosphorous in a striking manner.

GASEOUS EVANESCENCE.

Add a tea-spoonful of fuming nitric acid to two tea-spoonfuls of spirit of wine, in a cup, and the liquids will presently disappear in the form of vapour.

VIOLET-COLOURED GAS.

Put three or four grains of iodine into a small clean Florence oil flask, and close it with a cork. Warm the flask gently over a candle, or before the fire, and the iodine will become converted into a beautiful violet-coloured vapour, which condenses again into brilliant metallic crystals, when the flask is suffered to become cold. The experiment may be repeated with the same flask for any number of times.

Or, upon a small sheet of any metal, place a few grains of iodine, and add a chip of dry phosphorous; when the latter will inflame, and the iodine pass off in a violet vapour.

TO COLLECT GASES.

Provide a moistened bladder, tie a piece of tobacco-pipe firmly into its neck, twisting it so as to expel the common air. This may be fitted to any vessel by means of the pipe, which may be fixed in the cork of a bottle containing gas, and closely luted with putty or clay, or powdered lime and white of egg.

THE DEFLAGRATING SPOON.

To introduce substances into gases, a deflagrating spoon is required. It may be bought for half-a-crown; but an instrument equally useful may be made as follows: cut a piece of sheet copper somewhat larger than a sixpence, and bend it into a shallow, cup-like, form; twist four fine brass wires, each nine inches long, tightly together, leaving an inch at the extremities, which must be spread to hold the copper, as the strings or chains of a balance support the scale-pan. To complete it, take a piece of sheet-lead, the size of a penny-piece; make a hole through the centre large enough to admit the twisted wires, but, at the same time, retaining them firmly in their position: then, if the wires will not rest in the lead by adhesion, the hole may be enlarged, the wire put in, and secured by a piece of solder. The spoon being then let down through the mouth of a bottle, the circular piece of lead rests upon and stops the mouth.

WHAT IS STEAM?

Invert a glass goblet over a cup of hot water, when the vapour or steam will be seen to rise in it, to condense upon the cold glass,

and then to run down its inside; thus showing that steam is vaporized water, and will, when the heat is abstracted from it, become water again.

THE STEAM-ENGINE SIMPLIFIED.

The steam-engine is much more intelligible than its name first suggests. That part by which the machinery is set in motion, may be compared to a syringe, or squirt, the rod of which is driven up and down by steam admitted above and below, one end of the rod being connected with the machinery to be worked. Thus, the piston is made to turn the wheels of a railway carriage, or the paddles of a steam-boat.

The elastic force of the steam, or vapour, by which the rod is driven up and down, may be explained by this simple experiment. Provide a test tube, put into it a little water, hold the thumb over the mouth, and cause the water to boil by holding it over a spirit-lamp. There will soon be felt a pressure against the thumb; when, if the tube be dipped into cold water, the thumb being still held at the end, a kind of suction will be felt against it. Now, the tube resembles the cylinder of the steam-engine, in which the piston moves up and down; to imitate which, wrap a little tow about the end of a piece of stick, grease it with tallow, and fit it moderately tight into the tube; when the water is made to boil, the stick will be raised, and when the end is dipped into cold water, the stick will fall as the piston rises and falls in the cylinder.

TO BOIL WATER BY STEAM.

Nearly fill a retort with water, and boil it over a lamp; then immerse the beak into a tumbler of cold water, and the disengaged

steam will raise the water to the boiling temperature, though it be at a distance from the source of heat.

DISTILLATION IN MINIATURE.

Fill a kettle with water, and set it on the fire; fix a long metal tube to the spout, and as soon as the water boils, the steam will pass into the tube, and being condensed into water, will drip at the other end of the tube, which corresponds with the worm in the still; it soon, however, becomes as hot as the water, and then the condensation will cease: but, were the tube passed through cold water, as is the worm of the still in a tub, the whole water in the kettle might be boiled away, but reproduced in the tube, and collected from it without the loss of a drop. This simple process resembles distillation, and the kettle and tube the still.

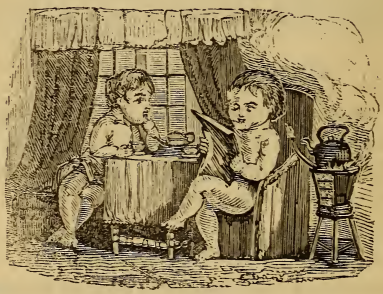
CANDLE OR FIRE CRACKERS.

Provide a number of little glass bulbs, put into each a drop of water, and seal it up; if it be then put into the flame of a candle, or the fire, the heat will soon convert the water into steam, and cause the bulb to burst with a loud report.

STEAM FROM THE KETTLE.

Observe attentively the steam that escapes from the spout of a tea-kettle, at the moment the water begins to boil, and you will perceive the steam to be condensed in minute drops on the interior edges of the spout. A few moments afterwards, provided the water continue to boil, the spout of the kettle will become perfectly dry; and, at the same time, close to it, there will be a certain space, say from one-half to three-fourths of an inch,

throughout which not a particle of steam will be perceptible. This may be easily explained. When the water in the kettle begins to boil, the spout being cooler than the steam issuing from it, a portion of that steam is condensed. As more steam escapes, the metal soon becomes as hot as the steam, will no longer condense it, and the spout becomes dry. By this time the steam will displace the air immediately opposite the orifice of the spout, whence it will issue dry and invisible. As it is cooled by mixing with the surrounding air, it assumes its well-known cloudy appearance.




FIRE, WATER,
AND AIR.

FIRE, WATER, AND AIR.

COLOURED FLAMES.

A VARIETY of rays of light is exhibited by coloured flames, which are not to be seen in white light. Thus, pure hydrogen gas will burn with a blue flame, in which many of the rays of light are wanting. The flame of an oil-lamp contains most of the rays which are wanting in sunlight. Alcohol, mixed with water, when heated or burned, affords a flame with no other rays but yellow. The following salts, if finely powdered, and introduced into the exterior flame of a candle, or into the wick of a spirit-lamp will communicate to flame their peculiar colours:

Muriate of Soda (common salt) . .	Yellow.
Muriate of Potash	Pale violet.
Muriate of Lime	Brick red.
Muriate of Strontia	Bright crimson.

Muriate of Lithia	Red.
Muriate of Baryta	Pale *apple*-green.
Muriate of Copper	Bluish green.
Borax	Green.

Or, either of the above salts may be mixed with spirit of wine, as directed for Red Fire.

YELLOW FLAME.

Burn spirits of wine on common table salt or saltpetre.

ORANGE-COLOURED FLAME.

Burn spirit of wine on chloride of calcium, a substance obtained by evaporating muriate of lime to dryness.

EMERALD GREEN FLAME.

Burn spirit of wine on a little powdered nitrate of copper.

INSTANTANEOUS FLAME.

Heat together potassium and sulphur, and they will instantly burn very vividly.

Heat a little nitre in a fire-shovel, sprinkle on it flour of sulphur, and it will instantly burn. If iron filings be thrown upon red-hot nitre, they will detonate and burn.

Pound, separately, equal parts of chlorate of potash and lump sugar; mix them, and put upon a plate a small quantity; dip a thread into sulphuric acid, touch the powder with it. and it will burst into a brilliant flame.

Or, put a few grains of chlorate of potash into a table-spoonful of spirit of wine; add one or two drops of sulphuric acid, and the whole will burst into a beautiful flame.

THE CUP OF FLAME.

Put a little newly calcined magnesia into a tea-cup upon the hearth or hob, and suddenly pour in as much concentrated sulphuric acid as will cover the magnesia; in an instant, sparks will be thrown out, and the mixture will become completely ignited. To prevent accidents, the phial containing the sulphuric acid should be tied to the end of a long stick.

TO COOL FLAME BY METAL.

Encircle the very small flame of a lamp with a cold iron wire, which will instantly cause its extinction.

PROOF THAT FLAME IS HOLLOW.

Pour some spirit of wine into a watch-glass, and inflame it; place a straw across this flame, and it will only be ignited and charred at the outer edge; the middle of the straw will be uninjured, for there is no ignited matter in the centre of the flame.

Or, introduce into the middle of the flame one end of a glass tube, when the vapour will rise through it, and may be lighted at the other end of the tube.

CAMPHOR SUBLIMED BY FLAME.

Set a metallic plate over the flame of a spirit-lamp; place upon it a small portion of camphor under a glass funnel; and the camphor will be beautifully sublimed by the heat of the lamp, in an efflorescent crust on the sides of the funnel.

GREEN FIRE.

A beautiful green fire may be thus made. Take of flour of sulphur, thirteen parts; nitrate of baryta, seventy-seven; oxy-muriate of potassa, five; metallic arsenic, two; and charcoal, three. Let the nitrate of baryta be well dried and powdered; then add to it the other ingredients, all finely pulverized, and exceedingly well mixed and rubbed together. Place a portion of the composition in a small tin pan, having a polished reflector fitted to one side, and set light to it; when a splendid green illumination will be the result. By adding a little calamine, it will burn more slowly.

BRILLIANT RED FIRE.

Weigh five ounces of dry nitrate of strontia, one ounce and a half of finely-powdered sulphur, five drams of chlorate of potash, and four drams of sulphuret of antimony. Powder the chlorate of potash and the sulphuret of antimony separately in a mortar, and mix them on paper; after which, add them to the other ingredients, previously powdered and mixed. No other kind of mixture than rubbing together on paper is required. For use, mix with a portion of the powder a small quantity of spirit of wine, in a tin pan resembling a cheese-toaster, light the mixture, and it will shed a rich crimson hue: when the fire burns dim and badly, a very small quantity of finely-powdered charcoal or lamp-black will revive it.

PURPLE FIRE.

Dissolve chloride of lithium in spirit of wine; and when lighted, it will burn with a purplish flame.

SILVER FIRE.

Place upon a piece of burning charcoal a morsel of the dried crystals of nitrate of silver, (not the lunar caustic,) and it will immediately throw out the most beautiful sparks that can be imagined, whilst the surface of the charcoal will be coated with silver.

THE FIERY MOUNTAIN.

Put into a glass tumbler fifteen grains of finely granulated zinc, and six grains of phosphorus cut into very small pieces, beneath water. Mix in another glass, gradually, a dram of sulphuric acid with two drams of water. Remove both glasses into a dark room, and there pour the diluted acid over the zinc and phosphorus in the glass: in a short time, beautiful jets of bluish flame will dart from all parts of the surface of the mixture; it will become quite luminous, and beautiful luminous smoke will rise in a column from the glass; thus representing a fountain of fire.

THE ARTIFICIAL CONFLAGRATION.

Put into a small, narrow-necked earthen bottle, half an ounce of muriate of ammonia, an ounce of camphor, and two ounces of highly rectified spirit of wine; set fire to it, and the room will seem to be in flames. This experiment should be performed in the dark.

INFLAMMABLE POWDER.

Heat a small portion of the grey powder of aluminum, and it will ignite, inflame, and burn with great rapidity. Or, blow a little of this powder into the flame of a candle, and it will produce a small shower of sparks, brilliant as those from iron filings.

COMBUSTION WITHOUT FRAME.

Light a small *green* wax-taper; in a minute or two, blow out the flame, and the wick will continue red-hot for many hours; and, if the taper were regularly and carefully uncoiled, and the room kept free from currents of air, the wick would burn on in this manner until the whole taper were consumed. The same effect is not produced when the colour of the wax is red, on which account, red wax-tapers are safer than green; for the latter, if left imperfectly extinguished, may set fire to any object with which they are in contact.

COMBUSTION OF THREE METALS.

Mix a grain or two of potassium with an equal quantity of sodium; add a globule of quicksilver, and the three metals, when shaken, will take fire, and burn vividly.

TO MAKE PAPER INCOMBUSTIBLE.

Take a smooth cylindrical piece of metal, about one inch and a half in diameter, and eight inches long; wrap very closely round it a piece of clean writing paper, then hold the paper in the flame of a spirit-lamp, and it will not take fire; but it may be held there for a considerable time, without being in the least affected by the flame.

SINGULAR EXPERIMENTS WITH GLASS TUBES.

A most remarkable phenomenon is produced in glass tubes, under certain circumstances. When these are laid before a fire in a horizontal position, having their extremities properly supported, they acquire a rotatory motion round their axis, and also a

progressive motion towards the fire, even when their supports are declining from the fire, so that the tubes will move a little way upwards to the fire. When the progressive motion of the tubes towards the fire is stopped by any obstacle, their rotation still continues. When the tubes are placed in a nearly upright posture, leaning to the right hand, the motion will be from east to west; but if they lean to the left hand, the motion will be from west to east; and the nearer they are placed to the upright posture, the less will the motion be either way. If the tube be placed horizontally on a glass plane, the fragment, for instance, of coach window glass, instead of moving towards the fire, it will move from it, and about its axis in a contrary direction to what it had done before; nay, it will recede from the fire, and move a little upwards, when the plane inclines towards the fire. These experiments succeed best with tubes about twenty or twenty-two inches long, which have in each end a pretty strong pin fixed in cork for their axis.

AQUATIC BOMB.

Drop about two grains of potassium into a saucer of cold water. It will instantly burst into flame, with a slight explosion, burn vividly on the surface, and dart about with great violence in the form of a red-hot fire ball.

HEAT NOT TO BE ESTIMATED BY TOUCH.

Hold both hands in water which causes the thermometer to rise to ninety degrees, and when the liquid has become still, you will be insensible of the heat, and that the hand is touching any thing. Then remove one hand to water that causes the thermometer to rise to 200 degrees, and the other in water at thirty-two degrees.

After holding the hands thus for some time, remove them, and again immerse them in the water at ninety degrees; when you will fell *warmth* in one hand and *cold* in the other. To the hand which had been immersed in the water at thirty-two degrees, the water at ninety degrees will feel hot; and to the hand which had been immersed in the water at 200 degrees, the water at ninety degrees will feel cold. If, therefore, the touch in this case be trusted, the same water will be judged to be hot and cold at the *same* time.

FLAME UPON WATER.

Fill a wine-glass with cold water, pour lightly upon its surface a little ether; light it by a slip of paper, and it will burn for some time.

ROSE-COLOURED FLAME ON WATER.

Drop a globule of potassium, about the size of a large pea, into a small cup nearly fully of water, containing a drop or two of strong nitric acid; the moment that the metal touches the liquid, it will float upon its surface, enveloped with a beautiful rose-coloured flame, and entirely dissolve.

TO SET A MIXTURE ON FIRE WITH WATER.

Pour into a saucer a little sulphuric acid, and place upon it a chip of sodium, which will float and remain uninflamed; but the addition of a drop of water will set it on fire.

WAVES OF FIRE ON WATER.

On a lump of refined sugar let fall a few drops of phosphuretted ether, and put the sugar into a glass of warm water,

which will instantly appear on fire at the surface, and in waves, if gently blown with the breath. This experiment should be exhibited in the dark.

EXPLOSION IN WATER.

Throw very small pieces of phosphuret of potassium into a basin of water, and they will produce separate explosions. The same substance will also burn with great brilliancy, when exposed to air.

WATER FROM THE FLAME OF A CANDLE.

Hold a cold and dry bell-glass over a lighted candle, and watery vapour will be directly condensed on the cold surface; then close the mouth of the glass with a card or plate, and turn the mouth uppermost; remove the card, quickly pour in a little lime-water, a perfectly clear liquid, and it will instantly become turbid and milky, upon meeting with the contents of the glass, just as lime-water changes when dropped into a glass of water.

FORMATION OF WATER BY FIRE.

Put into a tea-cup a little spirit of wine, set it on fire, and invert a large bell-glass over it. In a short time, a thick watery vapour will be seen upon the inside of the bell, which may be collected by a dry sponge.

BOILING UPON COLD WATER.

Provide a tall glass jar, filled with cold water, and place in it an air thermometer. which will nearly reach the surface; upon the surface place a small copper basin, into which put a little live charcoal: the surface of the water will soon be made to boil,

while the thermometer will show that the water beneath is scarcely warmer than it was at first.

CURRENTS IN BOILING WATER.

Fill a large glass tube with water, and throw into it a few particles of bruised amber; then hold the tube, by a handle for the purpose, upright in the flame of a lamp, and, as the water becomes warm, it will be seen that currents, carrying with them the pieces of amber, will begin to ascend in the centre, and to descend towards the circumference of the tube. These currents will soon become rapid in their motions, and continue till the water boils.

HOT WATER LIGHTER THAN COLD.

Pour into a glass tube, about ten inches long, and one inch in diameter, a little water coloured with pink or other dye; then fill it up gradually and carefully with colourless water, so as not to mix them: apply heat at the bottom of the tube, and the coloured water will ascend and be diffused throughout the whole.

The circulation of warm water may be very pleasingly shown, by heating water in a tube similar to the foregoing; the water having diffused in it some particles of amber, or other light substance not soluble in water.

EXPANSION OF WATER BY COLD.

All fluids, except water, diminish in bulk till they freeze. Thus, fill a large thermometer tube with water, say of the temperature of eighty degrees, and then plunge the bulb into pounded ice and salt, or any other freezing mixture: the water will go on shrinking in the tube till it has attained the temperature of about forty degrees; and then, instead of continuing to contract till it freezes, (as is the case

with all other liquids,) it will be seen slowly to expand and consequently to rise in the tube until it congeals. In this case, the expansion below forty degrees, and above forty degrees, seems to be equal: so that the water will be of the same bulk at thirty-two degrees as at forty-eight degrees, that is, at eight degrees above or below forty degrees.

THE CUP OF TANTALUS.

This pretty toy may be purchased at any optician's for two or three shillings. It consists of a cup, in which is placed a standing human figure, concealing a syphon, or bent tube, with one end longer than the other. This rises in one leg of the figure to reach the chin, and descends through the other leg through the bottom of the cup to a reservoir beneath. If you pour water in the cup, it will rise in the shorter leg by its upward pressure, driving out the air before it through the longer leg; and when the cup is filled above the bend of the syphon, (that is, level with the chin of the figure,) the pressure of the water will force it over into the longer leg of the syphon, and the cup will be emptied: the toy thus imitating Tantalus of mythology, who is represented by the poets as punished in Erebus with an insatiable thirst, and placed up to the chin in a pool of water, which, however, flowed away as soon as he attempted to taste it.

IMITATIVE DIVING BELL.

Nearly fill a basin with water, and put upon its surface a floating lighted wick or taper; over this place a glass goblet, mouth downwards, and push it into the water, which will be kept out, whilst the wick will continue to float and burn under the goblet; thus imitating the living inmate of a diving bell, which is merely a larger goblet, with a man instead of a candle within it.

THE WATER-PROOF SIEVE.

Fill a very fine wire-gauze sieve with water, and it will not run through the interstices, but be retained among them by capillary attraction.

MORE THAN FULL.

Fill a glass to the brim with water, and you may add to it spirit of wine without causing the water to overflow, as the spirit will enter into the pores of the water.

TO CAUSE WINE AND WATER TO CHANGE PLACES.

Fill a small narrow-necked bulb with port wine, or with water and coloured spirit of wine, and put the bulb into a tall, narrow glass jar, which is then to be filled up with cold water: immediately, the coloured fluid will issue from the bulb, and accumulate on the surface of the water in the jar, while colourless water will be seen accumulating at the bottom of the bulb. By close inspection, the descending current of the water may also be observed, and the coloured and the colourless liquids be seen to pass each other in the narrow neck of the bulb without mixing. The whole of the coloured fluid will shortly have ascended, and the bulb will be entirely filled with clear water.

PYRAMID OF ALUM.

Put a lump of alum into a tumbler of water, and, as the alum dissolves, it will assume the shape of a pyramid. The cause of the alum decreasing in this peculiar form is briefly as follows: at first, the water dissolves the alum very fast, but as the alum becomes united with the water, the solvent power of the latter diminishes. The water, which combines first with the alum, be-

comes heavier by the union, and falls to the bottom of the glass; where it ceases to dissolve any more, although the water which it has displaced from the bottom has risen to the top of the glass, and is there acting upon the alum. When the solution has nearly terminated, if you closely examine the lump, you will find it covered with geometrical figures, cut out, as it were, in relief, upon the mass; showing, not only that the cohesion of the atoms of the alum resists the power of solution in the water, but that, in the present instance, it resists it more in some directions than in others. Indeed this experiment beautifully illustrates the opposite action of cohesion and repulsion.

VISIBLE VIBRATION.

Provide a glass goblet about two-thirds filled with coloured water, draw a fiddle-bow against its edge, and the surface of the water will exhibit a pleasing figure, composed of fans, four, six, or eight in number, dependent on the dimensions of the vessel, but chiefly on the pitch of the note produced.

Or, nearly fill a glass with water, draw the bow strongly against its edge, the water will be elevated and depressed; and, when the vibration has ceased, and the surface of the water has become tranquil, these elevations will be exhibited in the form of a curved line, passing round the interior surface of the glass, and above the surface of the water. If the action of the bow be strong, the water will be sprinkled on the inside of the glass, above the liquid surface, and this sprinkling will show the curved line very perfectly, as in the engraving. The water should be carefully poured, so that the glass above the liquid be preserved dry; the

portion of the glass between the edge and the curved line, will then be seen partially sprinkled; but between the level of the water and the curved line, it will have become wholly wetted, thereby indicating the height to which the fluid has been thrown.

CHARCOAL IN SUGAR.

The elements of sugar are carbon and water, as may be proved by the following experiment: Put into a glass a table-spoonful of powdered sugar, and mix it into a thin paste with a little water, and rather more than its bulk of sulphuric acid; stir the mixture together, the sugar will soon blacken, froth up, and shoot like a cauliflower out of the glass: and, during the separation of the charcoal, a large quantity of steam will also be evolved.

FLOATING NEEDLES.

Fill a cup with water, gently lay on its surface small fine needles, and they will float.

WATER IN A SLING.

Half fill a mug with water, place it in a sling, and you may whirl it around you without spilling a drop; for the water tends more away from the centre of motion towards the bottom of the mug, than towards the earth by gravity.

ATTRACTION IN A GLASS OF WATER.

Pour water into a glass tumbler, *perfectly dry*, and it may be raised above the edge, in a convex form; because the particles of the water have more attraction for each other than for the dry glass; wet the edge, and they will be instantly attracted, and overflow, and the water will sink into a concave form.

TO PREVENT CORK FLOATING IN WATER.

Place at the bottom of a vessel of water, a piece of cork, so smoothly cut that no water gets between its lower surface and the surface of the bottom, when it will not rise, but remain fixed there, because it is pressed downward by the water from above, and there is no pressure from below to counter-balance it.

INSTANTANEOUS FREEZING.

During frosty weather, let a vessel be half filled with water, cover it closely, and place it in the open air, in a situation where it will not experience any commotion: it will thereby frequently acquire a degree of cold more intense than that of ice, without being frozen. If the vessel, however, be agitated ever so little, or receive even a slight blow, the water will immediately freeze with singular rapidity. The cause of this phenomenon is, that water does not congeal unless its particles unite together, and assume among themselves a new arrangement. The colder the water becomes, the nearer its particles approach each other; and the fluid which keeps it in fusion gradually escapes; but the shaking of the vessel destroys the equilibrium, and the particles fall one upon another, uniting in a mass of ice.

Or, provide a glass full of cold water, and let fall on its surface a few drops of sulphuret of carbon, which will instantly become covered with icy network: feathery branches will then dart from the sulphuret, the whole contents of the glass will become solidified, and the globules will exhibit all the colours of the rainbow.

TO FREEZE WATER WITH ETHER.

Fill a very thin glass tube with water. Close it at one end, and wrap muslin round it: then frequently immerse the tube in

strong ether, allowing what the muslin soaks each time to evaporate, and in a short time the water will be frozen.

PRODUCTION OF NITRE.

Dip into the above solution a piece of paper: if its colour be changed to brown, a drop or two more acid must be cautiously applied: if, on the contrary, it reddens litmus paper, a small globule or two of potassium will be required; the object being to obtain a neutral solution: if it then be carefully evaporated to about half its bulk, and set aside, beautiful crystals will begin to form, which will be those of the nitrate of potash, commonly called nitre, or saltpetre.

CURIOUS TRANSPOSITION.

Take a glass of jelly, and place it mouth downward, just under the surface of warm water in a basin: the jelly will soon be dissolved by the heat, and, being heavier than the water, it will sink, while the glass will be filled with water in its stead.

ANIMAL BAROMETER.

Keep one or two leeches in a glass bottle nearly filled with water; tie the mouth over with coarse linen, and change the water every two or three days. The leech may then serve for a barometer, as it will invariably ascend or descend in the water as the weather changes from dry to wet; and it will generally come to the surface prior to a thunder-storm.

MAGIC SOAP.

Pour into a phial a small quantity of oil, with the same of water, and, however violently you shake them, they cannot be

mixed, for the water and oil have no affinity for each other; but, if a little ammonia be added, and the phial be then shaken, the whole will be mixed into a liquid soap.

EQUAL PRESSURE OF WATER.

Tie up in a bladder of water, an egg and a piece of very soft wax, and place it in a box, so as to touch its sides and bottom; then, lay loosely upon the bladder a brass or other metal plate, upon which place a hundred pounds weight, or more; when the egg and the wax, though pressed by the water with all its weight, being equally pressed in all directions, will not be in the least either crushed or altered in shape.

TO EMPTY A GLASS UNDER WATER.

Fill a wine-glass with water, place over its mouth a card, so as to prevent the water from escaping, and put the glass, mouth downwards, into a basin of water. Next, remove the card, and raise the glass partly above the surface, but keep its mouth below the surface, so that the glass still remains completely filled with water. Then insert one end of a quill or reed in the water below the mouth of the glass, and blow gently at the other end, when air will ascend in bubbles to the highest part of the glass, and expel the water from it; and, if you continue to blow through the quill, all the water will be emptied from the glass, which will be filled with air.

TO EMPTY A GLASS OF WATER WITHOUT TOUCHING IT.

Hang over the edge of the glass a thick skein of cotton, and the water will slowly be decreased till the glass is empty. A towel will empty a basin of water in the same way.

DECOMPOSITION OF WATER.

The readiest means of decomposing water is as follows: take a gun-barrel, the breech of which has been removed, and fill it with iron wire, coiled up. Place it across a chafing-dish filled with lighted charcoal, and connect to one end of the barrel a small glass retort containing some water; and, to the other, a bent tube, opening under the shelf of a water bath. Heat the barrel red hot, and apply a lamp under the retort: the stream of water, in passing over the red-hot iron of the barrel, will be decomposed, the oxygen will unite with the iron, and the hydrogen may be collected in the form of gas at the end of the tube over the water.

WATER HEAVIER THAN WINE.

Let a tumbler be half-filled with water, and fit upon its surface a piece of white paper, upon which pour wine; then carefully draw out the paper, say with a knitting-needle, so as to disturb the liquids as little as possible, and the water, being the heavier, will continue at the lower part of the glass; whilst the wine, being the lighter, will keep above it. But, if a glass be first half-filled with wine, and water be poured over it, it will at once sink through the wine, and both liquids will be mixed.

TO INFLATE A BLADDER WITHOUT AIR.

Put a tea-spoonful of ether into a moistened bladder, the neck of which tie up tightly; pour hot water upon the bladder, and the ether, by expanding, will fill it out.

AIR AND WATER BALLOON.

Procure a small hollow glass vessel, the shape of a balloon, the lower part of which is open, and place it in water, with the

mouth downwards, so that the air within prevents the water filling it. Then fill a deep glass jar nearly to the top with water, and place the balloon to float on its surface; tie over the jar with bladder, so as to confine the air between it and the surface of the water. Press the hand on the bladder, when more water will enter the balloon, and it will soon sink to the bottom of the jar; but, on removing your hand, the balloon will again ascend slowly to the surface.

HEATED AIR BALLOON.

Make a balloon, by pasting together gores of bank post paper; paste the lower ends round a slender hoop, from which proceed several wires, terminating in a kind of basket, sufficiently strong to support a sponge dipped in spirit of wine. When the spirit is set on fire, its combustion will produce a much greater degree of heat than any ordinary flame: and by thus rarefying the air within the balloon, will enable it to rise with great rapidity, to a considerable height.

THE PNEUMATIC TINDER-BOX.

Provide a small stout brass tube, about six inches long, and half an inch in diameter, closed at one end, and fitted with a hollow air-tight piston, containing in its cavity a scrap of amadon, or German tinder. Suddenly drive the piston into the tube by a strong jerk of the hands; and the compression of the air in the tube will give out so much heat as to light the tinder; and upon quickly drawing out the piston, the glowing tinder will kindle a match.

THE BACCHUS EXPERIMENT.

This experiment, showing the elasticity of air, is performed with a pleasing toy. It represents a figure of Bacchus sitting

across a cask, in which are two separate compartments. Put into one of them a portion of wine or coloured liquid, and place the apparatus under the exhausted receiver of an air-pump, when the elastic force of the confined air will cause the liquid to ascend a transparent glass tube, (fitted on purpose,) into the mouth of the Bacchanalian figure. To render the experiment more striking, a bladder, with a small quantity of air therein, is fastened around the figure, and covered with a loose silken robe, when the air in the bladder will expand, and produce an apparent increase in the bulk of the figure, as if occasioned by the excess of liquor drunk.

THE MYSTERIOUS CIRCLES.

Cut from a card two discs or circular pieces, about two inches in diameter; in the centre of one of them make a hole, into which put the tube of a common quill, one end being even with the surface of the card. Make the other piece of card a little convex, and lay its centre over the end of the quill, with the concave side of the card downward; the centre of the upper card being from one-eighth to one-fourth of an inch above the end of the quill. Attempt to blow off the upper card by blowing through the quill, and *it will be found impossible.*

If, however, the edges of the two pieces of card be made to fit each other very accurately, the upper card will be moved, and sometimes it will be thrown off; but when the edges of the card are on two sides sufficiently far apart to permit the air to escape, the loose card will retain its position, even when the current of air sent against it be strong. The experiment will succeed equally well, whether the current of air be made from the mouth or from a pair of bellows. When the quill fits the card rather loosely, a comparatively light puff of air will throw both cards

three or four feet in height. When, from the humidity of the breath, the upper surface of the perforated card has a little expanded, and the two opposite sides are somewhat depressed, these depressed sides may be distinctly seen to rise and approach the upper card, directly in proportion to the force of the current of air.

Another fact to be shown with this simple apparatus, appears equally inexplicable with the former. Lay the loose card upon the hand with the concave side up; blow forcibly through the tube, and, at the same time, bring the two cards towards each other, when, within three-eighths of an inch, if the current of air be strong, the loose card will suddenly rise and adhere to the perforated card. If the card through which the tube passes have several holes made in it, the loose card may be instantly thrown off by a slight puff of air.

For the explanation of the above phenomenon, a gold medal and one hundred guineas were offered, some years since, by the Royal Society. Such explanation has been given by Dr. Robert Hare, of Philadelphia, and is as follows:

Supposing the diameter of the discs of card to be to that of the hole as 8 to 1, the area of the former to the latter, must be as 64 to 1. Hence, if the discs were to be separated, (their surfaces remaining parallel,) with a velocity as great as that of the air blast, a column of air must meanwhile be interposed, sixty-four times greater than that which would escape from the tube during the interim; consequently, if all the air necessary to preserve the balance be supplied from the tube, the discs must be separated with a velocity as much less than that of the blast, as the column required between them is greater than that yielded by the tube, and yet the air cannot be supplied from any other source, unless

a deficit of pressure be created between the discs, unfavourable to their separation.

It follows, then, that, under the circumstances in question, the discs cannot be made to move asunder with a velocity greater than one-sixty-fourth of that of the blast. Of course, all the force of the current of air through the tube will be expended on the moveable disc, and the thin ring of air which exists around the orifice between the discs: and, since the moveable disc can only move with one-sixty-fourth of the velocity of the blast, the ring of air in the interstice must experience nearly all the force of the jet, and must be driven outwards, the blast following it in various currents, radiating from the common centre of the tube and discs.

PRINCE RUPERT'S DROPS.

Let fall melted glass into cold water, and it will become suddenly cooled and solidified on the outside before the internal part is changed; then, as this part hardens, it is kept extended by the arch of the outside crust: and, if the finely drawn-out point of the drop be broken off, the cohesion of the atoms of the glass is destroyed, and the whole crumbles to dust with a smart explosion.

VEGETABLE HYGROMETER.

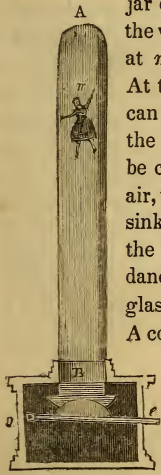
The dampness of the air, and the consequent approach of rain, is denoted by several simple means, which are termed hygrometers. Thus, if an ear of the wild oat be hung up, its awn or bristly points will be contracted by a rotatory motion in damp air, and relaxed by a contrary motion when the air is dry. Similar effects are observable on all cordage, string, and every description of twisted material; as the moisture smells the threads, and increase

their diameter, but reduces their length ; hence, catgut is used in the construction of a weather-house, in which the man and woman foretel wet or dry weather, moving as the catgut stretches or contracts, according as the air is moist or dry.

To prove the moving power of the awn, separate one from the ear, and, holding the base between the finger and thumb, moisten the awn with the lips, when it will be seen to turn round for some time.

THE PNEUMATIC DANCER.

This amusing pneumatic toy consists of a figure made of glass or enamel, and so constructed as to remain suspended in a glass jar of water. An air-bubble, communicating with the water, is placed in some part of the figure, shown at *m*, near the top of the jar, A, in the engraving. At the bottom, B, of the vessel is a bladder, which can be pressed upwards by applying the finger to the extremity of a lever, *e o*, when the pressure will be communicated through the water to the bubble of air, which is thus compressed. The figure will then sink to the bottom ; but, by removing the pressure, the figure will again rise, so that it may be made to dance in the vessel, as if by magic. Fishes, made of glass, are sometimes substituted for the human figure. A common glass jar may be used for this experiment, in which case the pressure should be applied to the upper surface, which should be a piece of bladder, instead of being placed at the bottom, as shown in the figure engraved.



THE ASCENDING SNAKE.

To construct this pretty little pneumatic toy, take a square piece of stiff card, or sheet copper or brass, about two and a-half or three inches in diameter, and cut it out spirally, so as to resemble a snake, as in the engraving (fig. 1.). Then paint the body on each side of the card the colours of a snake; take it by the two ends, and draw out the spiral till the distance from head to tail is six or seven inches, as in fig. 2. Next, provide a slender piece of wood on a stand, and fix a sharp needle at its summit; push the rod up through the spiral, and let the end of the spiral rest upon the summit of the needle. Now place the apparatus as nearly as possible to the edge of the mantel-shelf above the fire, and the snake will begin to revolve in the direction of its head; and, if the fire be strong, or the current of heated air which ascends from it is made powerful, by two or three persons coming near it, so as to concentrate the current, the snake will revolve very rapidly. The rod *a*, *b*, should be painted, as so to resemble a tree, which the snake will appear to climb; or, the snake may be suspended by a thread from the ceiling, over the current of air from a lamp. Two snakes may be made to turn round in opposite directions, by merely drawing out the spiral of one from the upper side, and of the other from the under side of the figure, and fixing them, of course, on separate rods.

Fig. 2.

Fig. 1.

THE PNEUMATIC PHIAL.

Provide a phial one-fourth filled with any coloured water, and with a glass tube passing through the cork, or cemented into the

neck of the phial, so as to be air-tight; the tube may reach to within a quarter of an inch of the bottom of the phial, so as to dip below the surface of the liquid. Hold this little instrument before the fire, or plunge it into hot water, when the air that is in the phial will expand, and force up the coloured liquor into the tube.

RESIN BUBBLES.

Dip the bowl of a tobacco-pipe into melted resin, hold the pipe in a vertical position, and blow through it; when bubbles of various sizes will be formed, of a brilliant silvery hue, and in a variety of colours.

MOISTURE OF THE ATMOSPHERE.

Moisture is always present in the air, even when it is driest. To prove this, press a piece of sheet copper into the form of a cup; place on it a piece of phosphorus, thoroughly dried between blotting-paper; put the cup on a dry plate, and beside it a small piece of quick lime; turn over it a glass tumbler, and leave it for ten minutes, that the lime may remove all moisture from the included air; take off the tumbler, touch the phosphorus with a hot wire, and instantly replace the glass; when a dry solid will be formed, resembling snow. As soon as the flame is extinct, examine the plate; when the solid will, in a very short time, attract so much water from the air, that it will pass into small drops of liquid.

CLIMATES OF A ROOM.

The air in a room may be said to resemble two climates: as it is lighter than the external air, a current of colder or heavier air is continually pouring in from the crevices of the windows and

doors; and the light air must find some vent, to make way for the heavy air. If the door be set a-jar, and a candle held near the upper part of it, the flame will be blown outwards, showing that there is a current of air flowing out from the upper part of the room; and, if the candle be placed on the floor, close by the door, the flame will bend inwards, showing that there is also a current of air setting into the lower part of the room. The upper current is the warm, light air, which is driven out to make way for the stream of cold, dense air, which enters below.

BUBBLES ON CHAMPAGNE.

Pour out a glass of champagne, or bottled ale, and wait till the effervescence has ceased; you may then renew it by throwing into the liquor a bit of paper, a crumb of bread, or even by violently shaking the glass. The bubbles of carbonic acid chiefly rise from where the liquor is in contact with the glass, and is in greatest abundance at those parts where there are asperities. The bubbles setting out from the surface of the glass are at first very small; but they enlarge in passing through the liquor. It seems as if they proceeded more abundantly from the bottom of the glass than from its sides; but this is an ocular deception.

PROOFS THAT AIR IS A HEAVY FLUID.

Expel the air out of a pair of bellows, then close the nozzle and valve-hole beneath, and considerable force will be requisite to separate the boards from each other. This is caused by the pressure or weight of the atmosphere, which, acting equally upon the upper and lower boards externally, without any air inside, operates like a dead weight in keeping the boards together. In like manner, if you stop the end of a syringe, after its piston-rod

has been pressed down to the bottom, and then attempt to draw it up again, considerable force will be requisite to raise it, depending upon the size of the syringe, being about fourteen or fifteen pounds to every square inch of the piston rod. When the rod is drawn up, unless it be held, it will fall to the bottom, from the weight of the air pressing it in.

Or, fill a glass tumbler to the brim with water, cover it with a piece of thin wet leather, invert it on a table, and try to pull it straight up, when it will be found to require considerable force. In this manner do snails, periwinkles, limpets, and other shells adhere to rocks, &c. Flies are enabled to walk on the ceiling of a room, up a looking-glass, or window-pane, by the air pressing on the outside of their peculiarly-constructed feet, and thus supporting them.

To the same cause must be attributed the firmness with which the oyster closes itself; for, if you grind off a part of the shell, so as to make a hole in it, though without at all injuring the fish, it may be opened with great ease.

TO SUPPORT A PEA ON AIR.

This experiment may be dexterously performed by placing a pea upon a quill, or the stem of a tobacco-pipe, and blowing upwards through it.

PYROPHORUS, OR AIR-TINDER.

Mix three parts of alum with one of wheat flour, and put them into a common phial; set it in a crucible, up to the neck in sand; then surround the crucible with red-hot coals, when first a black smoke, and next a blue sulphureous flame, will issue from

the mouth of the phial; when this flame disappears, remove the crucible from the fire, and when cold, stop the phial with a good cork. If a portion of this powder be exposed to the air, it will take fire.

Or, a very perfect and beautiful pyrophorus may be obtained by heating tartrate of lead in a glass tube, over a lamp. When some of the dark brown mass thus formed is shaken out in the air, it will immediately inflame, and brilliant globules of lead cover the ignited surface.

Or, mix three parts of lamp-black, four of burnt alum, in powder, and eight of pearl-ash, and heat them for an hour, to a bright cherry red, in an iron tube. When well made, and poured out upon a glass plate or tile, this pyrophorus will kindle, with a series of small explosions, somewhat like those produced by throwing potassium upon water; but this effect should be witnessed from a distance.

Put a small piece of grey cast-iron into strong nitric acid, when a porous, spongy substance will be left untouched, and will be of a dark grey colour, resembling plumbago. If some of this be put upon blotting paper, in the course of a minute it will spontaneously heat and smoke; and, if a considerable quantity be heaped together, it will ignite and scorch the paper; nor will the properties of this pyrophorus be destroyed by its being left for days and weeks in water.

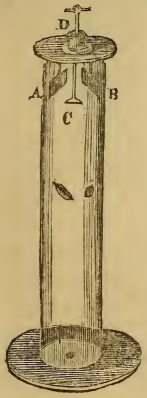
BEAUTY OF A SOAP BUBBLE.

Blow a soap bubble, cover it with a clean glass to protect it from the air, and you may observe, after it has grown thin by standing a little, several rings of different colours within each

other round the top of it. The colour in the centre of the rings will vary with the thickness; but, as the bubble grows thinner, the rings will spread, the central spot will become white, then bluish, and then black; after which the bubble will burst, from its extreme tenuity at the black spot, where the thickness has been proved not to exceed the 2,500,000th part of an inch.

WHY A GUINEA FALLS MORE QUICKLY THAN A FEATHER THROUGH THE AIR.

The resistance of the air to fallen bodies is not proportioned to the weight, but depends on the surface which the body opposes to the air. Now, the feather exposes, in proportion to its weight, a much greater surface to the air than a piece of gold does, and therefore suffers a much greater resistance to its descent. Were the guinea beaten to the thinness of gold-leaf, it would be as long, or even longer in falling than the feather; but, let both fall in a vacuum, or under the receiver of an air-pump, from which the air has been pumped out, and they will both reach the bottom at the same time; for gravity, acting independently of other forces, causes all bodies to descend with the same velocity.



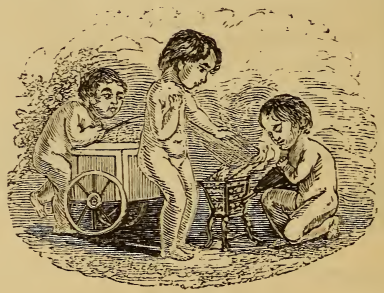
An apparatus for performing this experiment is shown in the engraving: the coin and the feather are to be laid together, on the brass flap, A or B: this may be let down by turning the wire, C, which passes through a collar of leather, D, placed in the head of the receiver.

SOLIDITY OF AIR.

Provide a glass tube, open at each end; close the upper end by the finger, and immerse the lower one in a glass of water, when it will be seen that the air is material, and occupies its own space in the tube, for it will not permit the water to enter it until the finger is removed, when the air will escape, and the water rise to the same level in the inside as on the outside of the tube.

BREATHING AND SMELLING.

Hold the breath, and place the open neck of a phial, containing oil of peppermint, or any other essential oil, in the mouth, and the smell will not be perceived; but, after expiration, it will be easily recognised.




SLEIGHTS
AND
SUBTLETIES.

SLEIGHTS AND SUBTLETIES.

THE chief requisites for success in the performance of feats of Magic are manual dexterity and self-possession. The former can only be acquired by practice; the latter will be the natural result of a well-grounded confidence. We subjoin a few preliminary hints, of considerable importance to the amateur exhibiter.

1. Never acquaint the company before-hand with the particulars of the feat you are about to perform, as it will give them time to discover your mode of operation.

2. Endeavour, as much as possible, to acquire various methods of performing the same feat, in order that if you should be likely

to fail in one, or have reason to believe that your operations are suspected, you may be prepared with another.

3. Never venture on a feat requiring manual dexterity, till you have previously practised it so often as to acquire the necessary expertness.

4. As diverting the attention of the company from too closely inspecting your manœuvres is a most important object, you should manage to talk to them during the whole course of your proceedings. It is the plan of vulgar operators to gabble unintelligible jargon, and attribute their feats to some extraordinary and mysterious influence. There are few persons at the present day credulous enough to believe such trash, even among the rustic and most ignorant; but as the youth of maturer years might inadvertently be tempted to pursue this method, while exhibiting his skill before his younger companions, it may not be deemed superfluous to offer a caution against such a procedure. He may state, and truly, that every thing he exhibits can be accounted for on rational principles, and is only in obedience to the unerring laws of Nature; and although we have just cautioned him against enabling the company themselves to detect his operations, there can be no objection (particularly when the party comprises many younger than himself) to occasionally show by what simple means the most apparently marvellous feats are accomplished.

THE RING AND THE HANDKERCHIEF.

This may be justly considered one of the most surprising sleights; and yet it is so easy of performance, that any one may accomplish it after a few minutes' practice.

You previously provide yourself with a piece of brass wire, pointed at both ends, and bent round so as to form a ring, about the size of a wedding-ring. This you conceal in your hand. You then commence your performance by borrowing a silk pocket handkerchief from a gentleman, and a wedding-ring from a lady; and you request one person to hold two of the corners of the handkerchief, and another to hold the other two, and to keep them at full stretch. You next exhibit the wedding-ring to the company, and announce that you will make it appear to pass through the handkerchief. You then place your hand under the handkerchief, and substituting the false ring, which you had previously concealed, press it against the centre of the handkerchief, and desire a third person to take hold of the ring through the handkerchief, and to close his finger and thumb through the hollow of the ring. The handkerchief is held in this manner for the purpose of showing that the ring has not been placed within a fold. You now desire the persons holding the corners of the handkerchief to let them drop; the person holding the ring (through the handkerchief as already described) still retaining his hold.

Let another person now grasp the handkerchief as tight as he pleases, three or four inches befow the ring, and tell the person holding the ring to let it go, when it will appear to the company that the ring is secure within the centre of the handkerchief. You then tell the person who grasps the handkerchief to hold a hat over it, and passing your hand underneath, you open the false ring, by bending one of its points a little aside, and bringing

one point gently through the handkerchief, you easily draw out the remainder; being careful to rub the hole you have made in the handkerchief with your finger and thumb, to conceal the fracture.

You then put the wedding-ring you borrowed over the outside of the middle of the handkerchief, and desiring the person who holds the hat, to take it away, you exhibit the ring (placed as described) to the company.

THE KNOTTED HANDKERCHIEF.

This feat consists in tying a number of hard knots in a pocket-handkerchief borrowed from one of the company, then letting any person hold the knots, and by the operator merely shaking the handkerchief, all the knots become unloosed, and the handkerchief is restored to its original state.

To perform this excellent trick, get as soft a handkerchief as possible, and taking the opposite ends, one in each hand, throw the right hand over the left, and draw it through, as if you were going to tie a knot in the usual way. Again throw the right-hand end over the left, and give the left-hand end to some person to pull, you at the same time pulling the right-hand end with your right hand, while your left hand holds the handkerchief just behind the knot. Press the thumb of your left hand against the knot to prevent its slipping, always taking care to let the person to whom you gave one end pull first, so that, in fact, he is only pulling against your *left hand.*

You now tie another knot exactly in the same way as the first, taking care always to throw the right-hand end over the left. As you go on tying the knots, you will find the right-hand end of the handkerchief decreasing considerably in length, while the left-hand one remains nearly as long as at first; because, in fact, you are

merely tying the right-hand end *round the left.* To prevent this from being noticed, you should stoop down a little after each knot, and pretend to pull the knots tighter; while, at the same time, you press the thumb of the right hand against the knot, and with the fingers and palm of the same hand, draw the handkerchief, so as to make the left-hand end shorter, keeping it at each knot as nearly the length of the right-hand end as possible.

When you have tied as many knots as the handkerchief will admit of, hand them round for the company to feel that they are firm knots; then hold the handkerchief in your right hand, just below the knots, and with the left hand turn the loose part of the centre of the handkerchief over them, desiring some person to hold them. Before they take the handkerchief in hand, you draw out the right-hand end of the handkerchief, which you have in the right hand, and which you may easily do, and the knots being still held together by the loose part of the handkerchief, the person who holds the handkerchief will declare he feels them: you then take hold of one of the ends of the handkerchief which hangs down, and desire him to repeat after you, one—two—three, —then tell him to let go, when, by giving the handkerchief a smart shake, the whole of the knots will become unloosed.

Should you, by accident, whilst tying the knots, give the wrong end to be pulled, a hard knot will be the consequence, and you will know when this has happened the instant you try to draw the left-hand end of the handkerchief shorter. You must, therefore, turn this mistake to the best advantage, by asking any one of the company to see how long it will take him to untie one knot, you counting the seconds. When he has untied the knot, your other knots will remain right as they were before. Having finished tying the knots, let the same person hold them, and tell

him that as he took two minutes to untie one knot, he ought to allow you fourteen minutes to untie the seven; but as you do not wish to take any advantage, you will be satisfied with fourteen seconds.

You may excite some laughter during the performance of this trick, by going to the owner of the handkerchief, and desiring him to assist you in pulling a knot, saying, that if the handkerchief is to be torn, it is only right that he should have a share of it; you may likewise say that he does not pull very hard, which will cause a laugh against him.

THE INVISIBLE SPRINGS.

Take two pieces of white cotton *cord*, precisely alike in length; double each of them separately, so that their ends meet; then tie them together very neatly, with a bit of fine cotton *thread*, at the part where they double (*i. e.* the middle). This must all be done beforehand.

When you are about to exhibit the sleight, hand round two other pieces of cord, exactly similar in length and appearance to those which you have prepared, but not tied, and desire your company to examine them. You then return to your table, placing these cords at the edge, so that they fall (apparently accidentally) to the ground behind the table; stoop to pick them up, but take up the prepared ones instead, which you have previously placed there, and lay *them* on the table.

Having proceeded thus far, you take round for examination three ivory rings; those given to children when teething, and which may be bought at any of the toyshops, are the best for your

purpose. When the rings have undergone a sufficient scrutiny, pass the prepared double cords through them, and give the two ends of one cord to one person to hold, and the two ends of the other to another. Do not let them pull hard, or the thread will break, and your trick be discovered. Request the two persons to approach each other, and desire each to give you one end of the cord which he holds, leaving to him the choice. You then say, that, to make all fast, you will tie these two ends together, which you do, bringing the knot down so as to touch the rings; and returning to each person the end of the cord next to him, you state that this trick is performed by the rule of contrary, and that when you desire them to pull hard, they are to slacken, and *vice versâ*, which is likely to create much laughter, as they are certain of making many mistakes at first.

During this time, you are holding the rings on the fore-finger of each hand, and with the other fingers preventing your assistants from separating the cords prematurely, during their mistakes; you at length desire them, in a loud voice, to slacken, when they will pull hard, which will break the thread, the rings remaining in your hands, whilst the strings will remain unbroken: let them be again examined, and desire them to look for the springs in the rings.

THE MIRACULOUS APPLE.

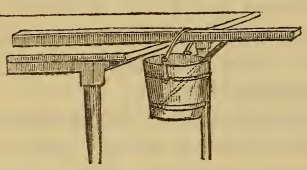
To divide an apple into several parts, without breaking the rind:—Pass a needle and thread under the rind of the apple, which is easily done by putting the needle in again at the same hole it came out of; and so passing on till you have gone round the apple. Then take both ends of the thread in your hands and draw it out; by which means the apple will be divided into two parts. In the same manner, you may divide it into as many

parts as you please, and yet the rind will remain entire. Present the apple to any one to peel, and it will immediately fall to pieces.

THE SELF-BALANCED PAIL.

You lay a stick across the table, letting one-third of it project over the edge; and you undertake to hang a pale of water on it, without either fastening the stick on the table, or letting the pail rest on any support; and this feat, the laws of gravitation will enable you literally to accomplish.

You take the pail of water, and hang it by the handle upon the projecting end of the stick, in such a manner that the handle may rest on it in an inclined position, with the middle of the pail within the edge of the table. That it may be fixed in this situation, place another stick with one of its ends resting against the side at the bottom of the pail, and its other end against the first stick, where there should be a notch to retain it. By these means, the pail will remain fixed in that situation, without being able to incline to either side; nor can the stick slide along the table, or move along its edge, without raising the centre of gravity of the pail, and the water it contains.



THE PHANTOM AT COMMAND.

This feat is performed by means of confederacy.—Having privately apprised your confederate that when he hears you strike one blow, it signifies the letter A; when you strike two, it means B; and so on for the rest of the alphabet, you state to the company, that if any one will walk into the adjoining room, and have the

door locked upon him, perhaps the animal may appear to him which another person may name.

In order to deter every one except your confederate from accepting the offer, you announce at the same time, that the person who volunteers to be shut up in the room must be possessed of considerable courage, or he had better not undertake it. Having thus gained your end, you give your confederate a lamp, which burns with a very dismal light; telling him, in the hearing of the company, to place it on the middle of the floor, and not to feel alarmed at what he may happen to see. You then usher him into the room, and lock the door.

You next take a piece of black paper, and a bit of chalk, and giving them to one of the party, you tell him to write the name of any animal he wishes to appear to the person shut up in the room. This being done, you receive back the paper, and after showing it round to the company, you fold it up, burn it in the candle, or lamp, and throw the ashes into a mortar; casting in at the same time a powder, which you state to be possessed of valuable properties.

Having taken care to read what was written, you proceed to pound the ashes in the mortar thus: Suppose the word written to be CAT, you begin by stirring the pestle round the mortar several times, and then strike three distinct blows, loud enough for the confederate to hear, and by which he knows that the first letter of the word is C. You next make some irregular evolutions of the pestle round the mortar, that it may not appear to the company that you give nothing but blows, and you then strike one blow to denote A. Work the pestle about again, and then strike twenty blows, which he will know to mean T; finishing your manœuvre by working the pestle about the mortar, the object being to make the blows as little remarkable

as possible. You then call aloud to your confederate, and ask him what he sees. At first he is to make no reply. At length, after being interrogated several times, he asks if it be a CAT.

That no mistake may be made, each party should repeat to himself the letters of the alphabet in the order of the blows.

THE MIRACULOUS SHILLING.

Provide a round box, the size of a large snuff-box, and likewise eight other boxes, which will go easily into each other, letting the least of them be of the size to hold a shilling. Observe that all these boxes must shut so freely that they may all be closed at once, by the covers accurately fitting within each other.

Previously to commencing your performance, fit the boxes within each other, and place them in a table drawer at another part of the room. You also fit the covers in the same manner, and lay them by the side of the boxes; you likewise provide a silk handkerchief, into one corner of which a shilling is sewed.

You now commence your operations, by borrowing a shilling, desiring the lender to mark it, that it may not be changed. Take this shilling in your right hand, and the handkerchief in your left, pretending to place the shilling in the centre of the handkerchief; instead of which, you put the corner of the handkerchief in which a shilling was sewed, as previously described, concealing the borrowed shilling in your right hand. You then desire the person to feel that the shilling is there, and tell him to hold it tight.

You now go to the drawer, and placing the borrowed shilling in the smallest of the boxes, you put on all the covers, by taking them in the centre between the fore-finger and thumb, to prevent their separation, and fit them on, by carefully sliding them along, and then pressing them down.

Having thus closed your boxes, you produce what appears to be a single box, and lay it on the table. You now ask the person, who still retains his hold of the shilling in the handkerchief, if he is sure that it is there. He will reply in the affirmative; you then request him to allow you to take the handkerchief, and having done so, you strike that part of the handkerchief containing the shilling on the box, and immediately shake out the handkerchief, holding it by two corners, and shifting it round so as to get the shilling within your grasp: it will thus appear that the shilling is no longer there. You desire the person to open the box, and hand it round, till the shilling be found; and when the last box is opened, and the shilling taken out, you ask the lender to state whether it is the one which he marked; to which he must, of course, reply in the affirmative.

THE LOCOMOTIVE SHILLING.

Privately place a shilling, which you previously mark on the head side with a cross, under a candlestick, or in any other out-of-the-way situation, where it is not likely to be discovered. You next borrow a shilling of one of the company, and say: "Now I am going to show you a trick with this shilling, but that you may know it again, I will mark it." Then take your penknife, and cross it in the same manner as the one you have concealed; show it to the person who lent it to you, and ask him if he will know it again. He will reply: "Yes; it is marked with a cross." Knock under the table, and say "Presto! fly quickly!" at the same time, adroitly conveying the shilling into your pocket. You then tell the spectators that it is gone; but you have a strong notion that if they look they will find it under the candlestick, (or whatever other place you may have concealed it in,) where the first shilling you marked will of course be found, and having the same marks as the genuine one will be mistaken for it.

THE PENETRATIVE SIXPENCE.

You profess that you will make a sixpence appear to pass through the table. To perform this feat, you must have a handkerchief, in one corner of which is sewed a sixpence.—Take it out of your pocket, and ask one of the company to lend you a sixpence, which you must seem to carefully wrap up in the middle of the handkerchief, but instead of which, you keep it in the palm of your hand, and in its stead, wrap up the corner in which the other sixpence is sewed, in the midst of the hankerchief, and bid the person from whom you borrowed the sixpence, feel that it is there. You then lay it under a hat upon the table, take a glass in the hand in which you have concealed the sixpence, and hold it under the table. Give three knocks upon the table, crying "Presto! come quickly!" Then drop the sixpence into the glass; bring the glass from under the table, and exhibit the sixpence to the spectators. You lastly take the handkerchief from under the hat, and shake it, taking care to hold it by the corner in which the sixpence was sewed.

THE VANISHING SIXPENCE.

Having previously stuck a small piece of white wax on the nail of your middle finger, lay a sixpence on the palm of your hand, and addressing the company, state that it will vanish at the word of command. "Many persons," you observe, "perform this feat, by letting the sixpence fall into their sleeve; but to convince you that I shall not have recourse to any such deception, I will turn up my cuffs." You then close your hand, and bringing the waxed nail in contact with the sixpence, it will firmly adhere to it. You then blow your hand, and cry "Begone!" and suddenly opening it, and exhibiting the palm, you show that the sixpence has

vanished. If you borrow the sixpence of any of the company, take care to rub off the wax, before you restore it to the owner.

TO MAKE A SIXPENCE BALANCE AND SPIN ON ITS EDGE, ON THE POINT OF A NEEDLE.

Procure a common wine-bottle, two forks, two corks, a needle, a sixpence, and a penknife. Having corked the bottle, force the eye of the needle into the cork perpendicularly, leaving more than half the needle sticking up. You next cut a small slit with the penknife in the centre of the bottom of the second cork, into which you insert the sixpence edgewise; then stick the forks into the upper cork, and, with a steady hand, place the edge of the sixpence on the point of the needle, and it will immediately find its balance. You may now take the upper cork between the finger and thumb, and spin it round as fast as you please, as the sixpence will not fall off. When it goes slow, hit one of the forks with your finger as it goes round, to increase its velocity.

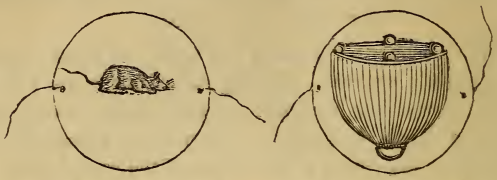
THE MULTIPLYING COIN.

Let a tumbler be half-filled with water; put a sixpence in it; and holding a plate over the top, turn the glass upside down. The sixpence will fall down on the plate, and appear to be a shilling; while at the same time a sixpence will seem to be swimming in the water. If a shilling is put in the glass, it will have the appearance of a quarter of a dollar and a shilling; and if a quarter of a dollar were put in, it would seem to be half a dollar and a quarter of a dollar.

MAGIC RAT TRAP.

Prepare a pasteboard circle, upon one side of which draw a figure of a cage, and on the other side that of a rat. Near

the outer edge of the circle fasten two strings opposite each other. So that they may be held between the fore finger and thumb in such manner that the circle may be made to revolve



rapidly. When it is set in motion the transition is so quick, that it presents the appearance of a rat in the cage.

TO SHOW THE VELOCITY OF MOTION.

Take a long hollow stalk or reed, suspend it horizontally by two loops of single hairs; by striking it with a sharp quick stroke at a point nearly in the centre, between the hairs, it may be cut through without breaking either of them. The hairs in this case would have been ruptured, if they had partaken of the force applied to the stalk; but the division of the latter being affected before the impulse could be propagated to the hairs, they must consequently remain unbroken.

A smart blow, with a slight wand or hollow reed on the edge of a glass tumbler, would break the wand, without injury to the glass.

Lay a small piece of money upon a card placed over the mouth of a glass tumbler, and resting upon the rim of the glass. The card may be withdrawn with such speed and dexterity, that the piece of money will not be removed laterally, but will drop into the glass.

THE EXPLODING BUBBLE.

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

THE MAGIC PICTURE.

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

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

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

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

Then fasten with gum a picture or print, painted on very thin

paper, with its face to one of the glasses, and if you like, you may fix the whole in a frame.

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

ARTIFICIAL LIGHTNING.

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

THREE OBJECTS, DISCERNIBLE ONLY WITH BOTH EYES.

If you fix three pieces of paper against the wall of a room at equal distances, at the height of your eye, placing yourself directly before them, at a few yards' distance, and close your right eye, and look at them with your left, you will see only two of them, suppose the first and second; alter the position of your eye, and you will see the first and third; alter your position a second time, you will see the second and third, but never the whole three together; by which it appears, that a person who has only one eye can never see three objects placed in this position, nor all the parts of one object of the same extent, without altering the situation of his eye.

TO TELL BY A WATCH DIAL THE HOUR WHEN A PERSON INTENDS TO RISE.

The person is told to set the hand of his watch at any hour he pleases, which hour he tells you; and you add in your own mind 12 to it. You then desire him to count privately the number of that addition on the dial, commencing at the next

hour to that at which he intends to rise, and including the hour at which he has placed the hand; which will give the answer; for example,

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

The hour the hand is placed at is 8

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

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

Making 20

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

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

TO MELT A PIECE OF MONEY IN A WALNUT-SHELL, WITHOUT INJURING THE SHELL.

Bend any thin coin, and put it into half a walnut-shell; place the shell on a little sand, to keep it steady. Then fill the shell, with a mixture made of three parts of very dry pounded nitre,

one part of flowers of sulphur, and a little saw-dust well sifted. If you then set light to the mixture, you will find, when it is melted, that the metal will also be melted in the bottom of the shell, in form of a button, which will become hard when the burning matter round it is consumed; the shell will have sustained very little injury.

THE MAGICAL MIRRORS.

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

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

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

There should be a sconce with a lighted candle, placed on each side of the two glasses in the wainscot, to enlighten the

* That is, half-way between a line drawn perpendicularly to the ground and its surface.

faces of the persons who look in them, or the experiment will not have so remarkable an effect.

THE ENCHANTED BOTTLE.

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

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

THE ARMED APPARITION.

If a person with a drawn sword place himself before a large concave mirror, but further from it than its focus, he will see an inverted image of himself in the air, between him and the mirror, of a less size than himself. If he steadily present the sword towards the centre of the mirror, an image of the sword will come out from it, point to point, as if to fence with him; and by his pushing the sword nearer, the image will appear to come nearer to him and almost to touch his breast. If the mirror be

turned 45 degrees, or one-eighth round, the reflected image will go out perpendicular to the direction of the sword presented, and apparently come to another person placed in the direction of the motion of the image, who, if he be unacquainted with the experiment, and does not see the original sword, will be much surprised and alarmed.

TO EXTRACT THE SILVER OUT OF A RING, THAT IS THICK GILDED, SO THAT THE GOLD MAY REMAIN ENTIRE.

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

CURIOUS EXPERIMENT WITH A GLASS OF WATER.

Saturate a certain quantity of water in a moderate heat, with three ounces of sugar; and when it will no longer receive that there is still room in it for two ounces of salt of tartar, and after that for an ounce and a drachm of green vitriol, nearly six drachms of nitre, the same of salammoniac, two drachms and a scruple of alum, and a drachm and a half of borax.

A LUMINOUS BOTTLE, WHICH WILL SHOW THE HOUR ON A WATCH IN THE DARK.

Throw a bit of phosphorous, of the size of a pea, into a long glass phial, and pour boiling oil carefully over it, till the phial is one-third filled. The phial must be carefully corked, and when used should be unstopped, to admit the external air, and closed again. The empty space of the phial will then appear luminous, and give as much light as an ordinary lamp. Each time that

the light disappears, on removing the stopper it will instantly re-appear. In cold weather the bottle should be warmed in the hands before the stopper is removed. A phial thus prepared may be used every night for six months.

RUSES.

THE WONDERFUL HAT.

Place three pieces of bread, or other eatable, at a little distance from each other on a table, and cover each with a hat; you then take up the first hat, and removing the bread, put it into your mouth, and let your company see that you swallow it; then raise the second hat, and eat the bread which was under that, and do the same with the third. Having eaten the three pieces, give any person in company liberty to choose under which hat he would wish those three pieces of bread to be; when he has made choice of one of the hats, put it on your head, and ask him if he does not think that they are under it.

TO BRING A PERSON DOWN UPON A FEATHER.

This is a practical pun:—You desire any one to stand on a chair or table, and you tell him that, notwithstanding his weight, you will bring him down upon a feather. You then leave the room, and procuring a feather from a feather-bed, you give it to him, and tell him you have performed your promise,—that you engaged to bring him *down* upon a feather, which you have done; for there is the feather, and, if he looks, he'll find *down* upon it.

THE APPARENT IMPOSSIBILITY.

You profess yourself able to show any one what he never saw, what you never saw, and what nobody else ever saw, and which, after you two have seen, nobody else ever shall see.

After requesting the company to guess this riddle, and they have professed themselves unable to do so, produce a nut, and having cracked it, take out the kernel, and ask them if they have ever seen that before; they will of course answer, No; you reply, neither have I, and I think you will confess that nobody else has ever seen it, and now no one shall ever see it again; saying which, you put the kernel into your mouth and eat it.

AN OMELET COOKED IN A HAT, OVER THE FLAME OF A CANDLE.

You ask the company if they would like an omelet cooked; then you break four eggs in a hat, place the hat for a short time over the flame of a candle, and shortly after produce an omelet, completely cooked, and quite hot.

Some persons would be credulous enough to believe that by the help of certain ingredients you had been enabled to cook the omelet without fire; but the secret of the trick is, that the omelet had been previously cooked and placed in the hat, but could not be seen, because the operator, when breaking the eggs, placed it too high for the spectators to observe the contents. The eggs were empty ones, the contents having been previously extracted, by being sucked through a small aperture, but to prevent the company from suspecting this, the operator manages, as if by accident, to let a full one fall on the table, which breaking, induces a belief that the others are also full.

THE IMPOSSIBLE OMELET.

You produce some butter, eggs, and other ingredients for making an omelet, together with a frying-pan, in a room where there is a fire, and state, that the cleverest cook will not be able to make an omelet with them. The wager is won by having previously caused the eggs to be boiled very hard.

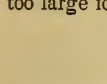
GO IF YOU CAN.

You tell a person that you will clasp his hands together in such a manner, that he shall not be able to leave the room without unclasping them, although you will not confine his feet, or bend his body, or in any way oppose his exit.

The trick is performed by clasping the party's hands round the pillar of a large circular table or other bulky article of furniture, too large for him to drag through the doorway.

THE FIGURE PUZZLE.

You assert that you can prove the half of nine to be either four or six; and the half of twelve to be seven. To make this manifest you have only to draw a nine or a twelve in numerals, and fold the paper across the middle, as in the margin.



THE VISIBLE INVISIBLE.

You tell the company that you will place a candle in such a manner that every person in the room, except one, shall see it; yet you will not blindfold him, nor in any way restrain his person, or offer the least impediment to his examining or going

to any part of the room he pleases. This trick is accomplished by placing the candle on the party's head; but it cannot be performed if a looking-glass is in the room, as that will enable him to turn the laugh against you.

THE DOUBLE MEANING.

Place a glass of any liquid upon the table, put a hat over it, and say: "I will engage to drink the liquid under that hat, and yet I'll not touch the hat." You then get under the table, and after giving three knocks, you make a noise with your mouth as if you were swallowing the liquid. Then getting from under the table, you say: "Now, gentlemen, be pleased to look." Some one, eager to see if you have drunk the liquid, will raise up the hat, when you instantly take the glass, and drink the contents, saying: "Gentlemen, I have fulfilled my promise. You are all witnesses that *I* did not touch the hat."

QUITE TIRED OUT.

You undertake to make a person so tired, by attempting to carry a small stick out of the room, as to be unable to accomplish it, although you will add nothing to his burthen, nor lay any restraint upon his personal liberty. To perform this manœuvre, you take up the stick, and cutting off a very small sliver, you direct him to carry it out of the room. and return for more; concluding by telling him, that you mean him to perform as many similar journeys as you can cut pieces off the stick. As this may be made to amount to many thousands, he will of course gladly give up the undertaking.

SOMETHING OUT OF THE COMMON.

Having picked a stick or stone off a common, you tell a person that you are about to show him something which will surprise him,

—something, in fact, *quite out of the common.* Having thus excited his curiosity, you produce the stick or stone, or whatever else you may have picked up, which of course he will examine very intently, and at length observe, that he sees nothing extraordinary in it. "That may be," you reply, "and yet, I assure you, that it is really something out of the common." This will, no doubt, set him upon a fresh examination, which will naturally end in his asking for an explanation. This you give, by telling him that "though not *uncommon*, it is *out of the common*, for it is *out of*—— *Common*;" and no doubt, the company present will indulge in a hearty laugh at the querist's expense.

TO RUB ONE SIXPENCE INTO TWO.

Previously wet a sixpence slightly, and stick it to the under edge of a table, (without a cover,) at the place where you are sitting. You then borrow a sixpence from one of the company, and tucking up your sleeves very high, and opening your fingers, to show that you have not another concealed, rub it quickly backwards and forwards on the table, with your right hand, holding your left under the edge of the table to catch it. After two or three feigned unsuccessful attempts to accomplish your object, you loosen the concealed sixpence with the tips of the fingers of the left hand, at the same time that you are sweeping the borrowed sixpence into it; and rubbing them a little while together in your hands, you throw them both on the table.

MAGIC CIRCLE.

You tell a person you will place him in the centre of a room, and draw a circle of chalk round him, which shall not exceed three feet in diameter, yet out of which he shall not be able to

leap, though his legs shall be perfectly free. When the party has exhausted his ingenuity in trying to discover by what means you can prevent his accomplishing so seemingly easy a task, you ask him if he will try, and on his assenting, you bring him into the middle of the room, and having requested him to button his coat tightly, you draw with a piece of chalk, a circle round his waist, outside his coat, and tell him to jump out of it!

It will greatly improve this trick if the person be blindfolded, as he will not be aware of the mode of performing it till the bandage is removed, provided his attention be diverted while you are drawing the line round him.


MELANGE.

ILLUSIONS OF TOUCH.

APPLY the points of a pair of compasses, distant from each other one or two lines, to the cheek, just before the ear; then move them successively to several other parts of the cheek, and you will find, on approaching the mouth, that the points will appear to recede from each other; this effect being produced by the great difference of the sense of touch in these parts. It is a general law, that in the more sensitive portions of the skin, any two points appear to be further asunder from each other, than points of equal distance appear to be to a less sensitive portion. The same experiments may be made by holding together the extremities of the forefinger and thumb, and then passing the tips of both in a line from the ear to either the upper or the under lip; as they approach the latter, they will feel to the cheek as if they were becoming more and more distant from each other.

If the skin be touched with the points of a pair of compasses, one inch asunder, the person so touched, while he shuts his eyes,

will instantly be aware that his skin is touched in two places; but by continually drawing the two points closer, a degree of nearness may be reached at which the person will imagine his skin to be touched by only one body: he will, however, describe this body, or the compasses, to be a little longer in one direction than another; and it appears that this difference of length corresponds with the distance between the two points of the compasses. When these points are brought still nearer together, the inequality will no longer be felt, and the person will fancy he is being touched by one body only.

Handle a pea: it is *one*—place it between the first and second fingers of the right hand, in their natural position, and you will still feel the pea but as *one*. Then cross the two fingers, bringing the second over the first, and place the pea in the fork between them, so as to feel the left side of the pea with the right side of the second finger, and the right with the left of the first. The impression will then be that you have *two* peas touching the fingers, especially if the eyes be shut, and the fingers be placed by another person. The illusion will be equally strong if the two fore-fingers of both hands be crossed, and the pea placed between them.

ILLUSION OF THE TASTE.

If the nose be held tightly while you are eating cinnamon you will perceive scarcely any difference between its flavour and that of a deal shaving.

THE GENERAL BLEACHER.

Provide some strong chloride of lime, soak in it strips of printed cotton; take them out, dry them, and you will find them

very white, but very rotten, slitting and dropping into holes upon the slightest touch.

The dazzling whiteness of paper is caused by bleaching it with chloride of lime. Thus, if you write on printing paper with common ink, it will fade, because the chloride will destroy the colouring matter of writing ink. It will not, however, change printing ink, as that owes its blackness to charcoal, which is a singularly permanent substance. Blot over a printed page with common writing ink, wash it with chloride of lime, when the blots will disappear, and leave the printing unchanged.

INFLUENCE OF COLOURED GLASS ON BULBOUS ROOTS.

Put a bulb, as a hyacinth, narcissus, &c., into a white glass, and another into a purple glass: the latter will grow faster than the former; and, if a pinch of salt, or a piece of nitre, be put into the water whenever it is changed, the brightness of the colour of the flower will be considerably heightened.

THE SPINNING-TOP "ASLEEP."

Spin a top, and it will for some time stand "asleep," as it is called in the parlance of the play-ground. The cause is thus explained by Dr. Arnot, in his valuable *Elements of Physics:* "While the top is perfectly upright, its point being directly under its centre, supports it steadily, and although turning so rapidly, has no tendency to move from the place; but, if the top incline at all, the *side* of the peg, instead of the very *point*, comes in contact with the floor, and the peg then becomes a little wheel or roller, advancing quickly, and, with its touching

edge, describing a curve somewhat as a skaiter does, until it becomes directly under the body of the top, as before. It thus appears that the very fact of the top inclining causes the point to shift its place, so that it cannot rest until it come again directly under the centre of the top."

TO JUDGE OF WEIGHTS.

Persons accustomed to estimate weights by poising them in their hands, will distinguish perfectly between two, only differing by a thirtieth part. In comparing two weights, poise one and then instantly the other, *in the same hand;* the few seconds of time that pass between the poising of the two weights will not prevent their accurate comparison. The interval may amount to twenty seconds, yet a just estimate may still be made; but when it amounts to forty seconds, all accuracy will be lost.

QUICKSILVER AND OIL UNITED.

Let fall a very small drop of oil upon a large drop of mercury, and the latter will become enlarged. This phenomenon is attributed to a combination of the oil with the mercury, which produces a compound, the attraction of which is less strong than that of pure mercury.

TO DISSOLVE THE SODA IN GLASS.

Glass consists of sand, carbonate of soda, and red lead, heated together. If water be poured into a glass vessel, neither of the ingredients will be affected by it; but, if the glass be reduced to a fine powder, and water be poured on it, the soda will instantly be dissolved.

Or, moisten, with water a piece of tumeric, or test-paper, drop on it a little powdered glass, and the soda in it will change the yellow paper to brown.

WATERPROOF PAPER.

Make a solution of caoutchouc in caoutchoucine, plunge into it, once or twice, unsized paper, and dry it by a gentle heat. It may then be used as writing paper, and will resist all humidity; and small vessels made of it will even contain water.

TO DISSOLVE GOLD OR PLATINUM.

Mix a little nitric acid with half the quantity of muriatic acid, into which put the metal for solution.

Or, pour a little aqueous solution of chlorine into a small glass, and put in a bit of pure gold leaf; stir it with a glass rod, and the gold will dissolve. Thus gold, which cannot be dissolved in nitric, sulphuric, or other strong acids, will quickly disappear in water, with a little chlorine in solution.

COLDER THAN ICE.

Mix common salt with pounded ice or snow, and they will run into brine, which will be much colder than the ice or snow.

CONTRA-CRYSTALLIZATION.

Dissolve two ounces of nitre and three of Glauber salts in five ounces of warm water; fill two bottles with the solution, into one of which put a crystal of nitre, and into the other a crystal of Glauber salts; place both bottles in ice-cold water, when nitre only will crystallize in the one and Glauber salts in the other.

ONE AND ONE DO NOT MAKE TWO.

Mix a wine-glass full of sulphuric acid with a wine-glass full of water, cautiously; and, on re-measuring the mixture, it will not be found sufficient to re-fill both glasses.

TO COPY WRITING INSTANTLY.

Add a little sugar to ink, with which write the letter to be copied; then lay a sheet of thin unsized paper, damped with a sponge, on the writing; pass lightly over it a flat iron, very moderately heated, and a reverse impression of the writing will be accurately taken off.

THE RIVAL DIALS.

Fix two pendulum clocks to the same wall, or lay two watches upon the same table, and they will take the same rate of going, though they would vary in that rate if they were placed in separate apartments. Indeed, it has been observed, that the pendulum of one clock will even stop that of the other, and that the stopped pendulum will, after a certain time, go again, and, in its turn stop the other pendulum.

TO SPIN INDIAN RUBBER.

Dissolve a small piece of Indian rubber in a little caoutchoucine, and put a drop or two of the solution upon a looking-glass or window-pane; touch it lightly with a dry piece of Indian rubber, quickly draw out a fine thread, which attach to a card, and wind off as silk.

INDELIBLE WRITING.

As the art of man can unmake whatever his ingenuity can make, we have no right to expect an indelible ink; however, an approximation to it may be made as follows: make a saturated solution of indigo and madder in boiling water, in such proportions as to give a purple tint; add to it from one-sixth to one-eighth of its weight of sulphuric acid, according to the thickness and strength of the paper to be used. Write with this ink, and expose the paper to a gradual heat from the fire, when the characters will be completely black, the letters being burnt in and charred by the sulphuric acid. If the acid has not been used in sufficient quantity to destroy the texture of the paper, and reduce it to the state of tinder, the colour may be discharged by washing it with a strong solution of oxalic acid in water. When the full proportion of acid has been employed, crumple and rub the paper, and the charred letters will fall out; then by placing a black ground behind the letters, they may be preserved, and thus a species of indelible writing may be procured, the letters being, as it were, stamped out of the paper.

VEGETABLE ANATOMY.

Soak any part of a plant in nitric acid for a short space of time, and all power of cohesion will be lost by the vessels, which will become transparent, and be easily separable from each other by gentle dissection. So complete will be the effect, that even the most delicate cells of the cellular tissue will become disengaged from each other, and may be examined singly with perfect ease. This discovery will enable persons who have not compound microscopes, and delicate directing instruments, to anatomize plants with facility.

TO TELL WHAT O'CLOCK IT IS BY THE MOON.

This may be calculated by the shadow which the moon casts upon a sun-dial, it being only necessary to know the moon's age, which may be found in an 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 four and divided by five. The quotient must either be added to the hour, which the shadow indicates on the sun-dial, and the sum will give the time sought; or subtract from the quotient the hour shown by the moon upon the dial, and the remainder will give 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 are examples:

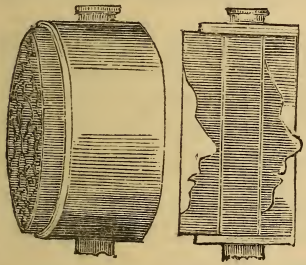
1st. Suppose the moon to be ten days old, and the shade cast by the moon upon the sun-dial to be at half-past two; or, that the shadow cast by the moon falls on the place at which the shadow cast by the sun stands at half-past two;—what o'clock was it then? The answer is calculated as follows:—The moon's age, 10 days $\times 4 = 40\ \frac{40}{5} = 8$. Eight, 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.

2d. Suppose the moon to have been 18 days old, and the shadow cast by it on the sun-dial to have marked eleven. This time is subtracted from the hour when the moon was in the meridian on that day, and from which the hour marked by the shadow must be deducted. The shadow shows here 11 o'clock in the forenoon, or one hour before noon, which, deducted from 2h. 24m. gives 1h. 24m.; $2\frac{2}{5} - 1 = 1\frac{2}{5}$, or 24 minutes past one o'clock.

THE PHYSIOGNOTYPE.

This is a newly-invented instrument, by the aid of which a person may have a plaster cast of his face taken without submitting to the usual unpleasant process.

It consists of an assemblage of very fine moveable wires, confined closely together within a broad hoop or band, after the manner of the bristles in a telescope hearth-brush, but not closed at the back, in order to allow to the wires a free passage. The wires slide in a metal plate, perforated all over with holes, very fine and close together. The apparatus is surrounded by an outer case which is filled with warm water, in order to prevent any unpleasant sensation on the contact of the instrument with the skin.



When it is desired to take a likeness, the instrument is applied to the face with a gentle and gradual pressure, the wires easily yield and slide back, conformably to the prominences of the countenance; they are then fixed tightly in their position, and thus form a mould which will yield a perfect and faithful cast of the face, in which even the most minute line will appear with the strictest accuracy.

INFINITE DIVISIBILITY OF MATTER.

Dissolve a single grain of copper in about one dram of nitric acid, and dilute the solution with about one ounce of water, when

it will be evident that a single drop of the mixture must contain an almost immeasurably small portion of copper. Yet, if the blade of a knife be dipped into it, it will become covered with a coat of copper; thus showing that the copper can be infinitely divided without any alteration in its properties.

HOLDING THE BREATH.

If a person inspire deeply, he will be able, immediately after, to hold breath for a time, varying with his health, state of exertion, or repose. A man, during an active walk, may not be able to cease breathing for more than half a minute; but, after resting on a chair or bed, he may refrain from breathing for a minute and a half, or even two minutes. But if he will prepare himself by breathing deeply, hardly, and quickly (as he would naturally do after running), and ceasing that operation with his lungs full of air, then hold his breath as long as he is able, he will find that the time, during which he can remain without breathing, will be double, or even more than double the former. This effect may be rendered exceedingly serviceable, as on many occasions a man who can hold breath for a minute, or two minutes, may save the life of another; such as in entering a chamber on fire, rescuing from drowning, &c.

SAND IN THE HOUR-GLASS.

It is a remarkable fact, that the flow of sand in the hour-glass is perfectly equable, whatever may be the quantity in the glass; that is, the sand runs no faster when the upper half of the glass is quite full than when it is nearly empty. It would, however, be natural enough to conclude that, when full of sand, it would

be more swiftly urged through the aperture, than when the glass was only a quarter full, and near the close of the hour.

The fact of the even flow of sand may be proved by a very simple experiment. Provide some silver sand, dry it over or before the fire, and pass it through a tolerably fine sieve. Then take a tube, of any length or diameter, closed at one end, in which make a small hole, say the eighth of an inch; stop this with a peg, and fill up the tube with the sifted sand. Hold the tube steadily, or fix it to a wall, or frame, at any height from a table; remove the peg, and permit the sand to flow in any measure for any given time, and note the quantity. Then, let the tube be emptied, and only half or a quarter filled with sand, measure again, for a like time, and the same quantity of sand will flow: even if you press the sand in the tube with a ruler or stick, the flow of the sand through the hole will not be increased.

The above is explained by the fact, that when the sand is poured into the tube, it fills it with a succession of conical heaps, and that all the weight which the bottom of the tube sustains, is only that of the heap which *first* falls upon it; as the succeeding heaps do not press downward, but only against the sides or walls of the tube.

RESISTANCE OF SAND.

From the above experiment it may be concluded, that it is extremely difficult to thrust sand out of a tube by means of a fitting plug or piston; and this, upon trial, is found to be the case. Fit a piston to a tube (exactly like a boy's pop-gun), pour some sand in, and try with the utmost strength of the arm to push out the sand. It will be found impossible to do this:

rather than the sand should be shot out, the tube will burst at the sides.

GLASS BROKEN BY SAND.

If bullets be let fall on glass which has been cooled in the open air, they will not break it; but, if a few grains of sand be let fall on the same kind of glass, it will be broken into a thousand pieces! This is explained by the lead not scratching the surface of the glass; whereas the sand, being sharp and angular, scratches sufficiently to break it.

TO BLEACH IVORY.

Place any piece of discoloured ivory beneath a glass, expose it to the sun, and it will soon be restored to pure whiteness; whereas, if the ivory be exposed to the sun without the glass covering, it will become more discoloured.

VANISHING SHELLS.

Put into a little diluted muriatic acid, a common whelk-shell, when it will be completely dissolved, and not a sensible trace of it left behind.

If an oyster-shell, or land snail-shell be put into the acid, their substances will disappear, but the form or skeleton of the shells will remain.

THE MAGIC EGG.

Fill a basin with dilute muriatic acid, and put into it an egg, which will sink; but, in a few seconds, the whole of the egg-shell being covered with bubbles of carbonic acid gas, will rise to the surface, a portion of the egg will be lifted above the surface, and

the whole egg will slowly rotate. This rotation is formed by the bubbles of gas forming at the under part of the egg, and over all the submersed portions, which render them lighter than the portions above the liquid level, till the under portion ascends and the other descends.

THE MAGIC WHIRLPOOL.

Fill a glass tumbler with water, throw upon its surface a few fragments or thin shavings of camphor, and they will instantly begin to move and acquire a motion, both progressive and rotatory, which will continue for a considerable time. During these rotations, if the water be touched by any substance which is at all greasy, the floating particles wlll quickly dart back, and, as if by a stroke of magic, be instantly deprived of their motion and vivacity.

In like manner, if thin slices of cork be steeped in sulphuric ether in a closed bottle, for two or three days, and then placed upon the water, they will rotate for several minutes, like the camphor; until the slices of cork having discharged all their ether, and become soaked with water, they will keep at rest.

If the water be made hot, the motion of the camphor will be more rapid than in cold water, but it will cease in proportionately less time. Thus, provide two glasses, one containing water at 58 degrees, and the other at 210 degrees; place raspings of camphor upon each at the same time; the camphor in the first glass will rotate for about five hours, until all but a very minute portion has evaporated, while the rotation of the camphor in the hot water will last only nineteen minutes; about half the camphor will pass off, and the remaining pieces, instead of being dull, white, and

opaque, will be vitreous and transparent, and evidently soaked with water. The gyrations, too, which at first will be very rapid, will gradually decline in velocity, until they become quite sluggish.

The stilling influence of oil upon waves has become proverbial: the extraordinary manner in which a small quantity of oil instantly spreads over a very large surface of troubled water, and the stealthy manner in which even a rough wind glides over it, must have excited the admiration of all who have witnessed it.

By the same principle, a drop of oil may be made to stop the motion of the camphor as follows: throw some camphor, both in slices and in small particles, upon the surface of water, and while they are rotating, dip a glass rod into oil of turpentine, and allow a single drop thereof to trickle down the inner side of the glass to the surface of the water; the camphor will instantly dart to the opposite point of the liquid surface, and cease to rotate. If a piece of hard tallow or lard be employed, the motion of the camphor will be more slowly stopped than by oil or fluid grease, as the latter spreads over the surface of the water with greater rapidity.

If a few drops of sulphuric or muriatic acid be let fall into the water, they will gradually stop the motion of the camphor; but, if camphor be dropped into nitric acid diluted with its own bulk of water, it will rotate rapidly for a few seconds and then stop.

If a piece of the rotating camphor be attentively examined with a lens, the currents of the water can be well distinguished, jetting out, chiefly from the corners of the camphor, and bearing it round with irregular force.

The currents, as given out by the camphor, may also be seen by means of the microscope; a drop or two of pure water being placed

upon a slip of glass, with a particle of camphor floating upon it. By this means, the currents may be detected, and it will be seen that they cause the rotations.

Or, a flat watch-glass, called a *lunar*, may be employed, raised a few inches, and supported on a wire ring, kept steady by thrusting one end into an upright piece of wood, like a retort stand. Then put the camphor and water in the watch-glass, and place under the frame a sheet of white paper, so that it may receive the shadow of the glass, camphor, &c., to be cast by a steady light placed above, and somewhat on one side of the watch-glass. On observing the shadow, which may be considered a magnified representation of the object itself, the rotations and currents can be distinguished.*

MAGIC PORCELAIN.

A peculiar kind of porcelain was formerly manufactured in China, which exhibited its colour and devices only when filled with water. Though the art of manufacturing this porcelain has been lost, and the mode cannot now be described with accuracy, the following has been conjectured as not very remote from the truth. The first requisite was that the vessel be extremely thin, so that the figures to be formed might be sufficiently clear and perceptible. After the vessel has been baked, the figures, which were mostly fish, (as those were most appropriate with the water), were formed on the inside; and, after the colour had dried, a second extremely thin coat, of the same substance as that of which the vessel was constructed, was lain on the inside and varnished. The fish, or other device, would then, it is evident,

* Abridged from the Magazine of Popular Science, vol. iii.

be enclosed between the two coats of the ware of which the vessel was made. All that remained to be done was to grind the outside of the vessel as close to the figures as possible, to varnish it again, and bake it a second time; and though, after this operation, the figures and embellishments would not be at all perceptible, yet, so soon as the vessel was filled with water, they would at once be rendered clear and distinct to a degree scarcely credible. Attempts have been made to revive this beautiful art, but hitherto without success.

A GALVANIC TONGUE.

Coat the point of the tongue with tin-foil, and its middle part with gold or silver leaf; when a sourish taste will be produced, and the tongue will be galvanised.

DRINKING PORTER OUT OF PEWTER.

If porter be drunk out of a pewter pot, it will produce a more brisk sensation than when it is taken out of a glass vessel, which is ascribed to a galvanic effect. In this instance there is a combination of one metal and two dissimilar fluids, which combination constitutes a galvanic circle. In the act of drinking, one side of the pewter pot is exposed to the action of the saliva, which moistens the lip, while the other metallic side is in contact with the porter; the circuit being thus completed, an agreeable relish is communicated to the beverage when it comes in contact with the tongue.

ELECTRIC OR GALVANIC PRESERVATION.

Immerse a slip of copper in dilute nitric acid, and it will be soon corroded and dissolved; but, if a slip of zinc be immersed

with the copper, the zinc will be dissolved, and the copper remain unaltered and uninjured.

LIGHT FROM THE DIAMOND.

Expose a fine diamond to the sunbeams, and carry it into a dark room, when it will exhibit phosphorescence: and it has been stated that such diamonds as do not display this peculiarity, may be made to do so by dipping them into melted borax.

The diamond becomes phosphorescent also when fixed to the prime conductor of an electrical machine, and a few sparks may be taken from it. It likewise becomes electric by friction; and the Hon. Mr. Boyle obtained electric gleams by rubbing two diamonds together in the dark.

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.

MIMIC FROST-WORK.

Fasten a sprig of fresh rosemary, or any similar shrub, to the inside of a small bandbox, near the top; heat a thick tile, and sprinkle it with gum benzoic, and immediately place the bandbox

over it, when the acid will be sublimed by the heat, and will condense in a white vapour upon the green plant, giving it the appearance of being covered with hoarfrost.

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 everywhere 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.

HYDROSTATIC BALANCE.

Provide a pair of scales, in one of which place a tumbler filled with water, and poise it by placing weights in the opposite scale; then hold in the tumbler a block of wood, or any substance nearly the size of the tumbler, but so that it shall not touch the sides or bottom; when, although nearly the whole of the water will have to run over the sides, and only a spoonful may remain, the scales will continue balanced; and all this without regard to the weight of the body you plunge into the water, taking care to hold it entirely clear of the tumbler, so that it touch it nowhere; for the effect will be the same if what you plunge in be scooped hollow and made water-tight. A bladder blown up, tied fast, and held down in the water, so as to leave only a spoonful of water surrounding it, will keep the scales balanced just as well as a block of lead of the same size.

METALLIC REDUCTION.

Mix a little red lead with some powdered charcoal, and with the mixture fill the bowl of a tobacco-pipe; set it over a common fire, and in about twenty minutes the lead will be found reduced to its metallic state.

SIMPLE ELECTRICITY.

ELECTRICAL ATTRACTION AND REPULSION.

Rub a piece of amber, a stick of red sealing-wax, or a smooth glass tube, smartly upon the sleeve of a coat, or any other dry woollen substance, and it will attract to itself bits of straw, paper, fragments of gold leaf, or any small and light bodies. The amber, wax, or glass, is then said to be excited, and the attractive power thus developed, is called electrical attraction.

Select a clean and dry downy feather, and suspend it from a beam by a long thread of white silk; to be used in the following experiments:

Provide a glass tube, about three feet long and three quarters of an inch diameter; wipe it dry, and rub it gently with a warm silk handkerchief; then apply the tube to the feather, and it will *attract* it; withdraw the tube gently, apply it again, and the

feather will be repelled for a time, but then attracted, and then again repelled. In this case, the feather having received electricity from the glass, is repelled by it; for bodies similarly electrified repel each other.

Fold a silk handkerchief, warm it, and with it rub the tube; apply it to the feather, and it will first attract and then repel it; when the feather has just been repelled by the silk, apply the tube, and the feather will be attracted. The handkerchief must be folded so thickly as to keep the hand as far as possible from the glass tube.

Roll up flannel thickly, rub it with sealing-wax, and the roll will by turns attract and repel the feather; when thus repelled, apply the excited wax, and it will instantly attract the feather.

When the atmosphere is dry, take in one hand a rod of glass and in the other a stick of sealing-wax, and rub them against silk or worsted; with one of them approach a bit of gold-leaf, floating in the air, it will first attract and then repel it. When the gold has just been repelled, approach it with the other rod, and it will be immediately attracted; and this alternate attraction and repulsion may be strikingly displayed by placing the two excited rods at a small distance asunder, with the gold leaf between them.

ALCHEMICAL ELECTRICITY.

Nearly fill a wine-glass with a weak solution of blue vitriol in water, and place in it the blade of a knife and a small silver spoon; the knife will soon acquire a copper coating, but the spoon will remain bright until it is touched with the blade of the knife, when it will also become plated with copper.

THE ELECTRIC BALLS.

Provide two small balls of equal size; both made of gum-lac, and cover one with gold leaf. Suspend these balls from a beam by fine white silk threads, at a little distance from each other, so as to allow a comparison of their motions. Then rub a stick of red sealing-wax upon any woollen substance, or warm it at the fire, and present it to the balls; when it will be at once seen that the gilt ball, which readily admits of the transfer of electricity from one side to the other, will be sooner and more powerfully attracted than the other ball, which allows of no motion in its electricity. The latter ball will, however, by slow degrees be feebly attracted, and may, at length, be made to adhere for a considerable time to the sealing-wax.

THE ELECTRIC DANCE.

Lay on a table small pieces of paper or cotton, feathers, or gold-leaf; then rub with a silk handkerchief a glass tube, hold it parallel to the table, and the several pieces will be alternately attracted and repelled, and a kind of electrical dance will be kept up.

If to the further end of the tube you hang a brass ball, by a thread of linen, hemp, or metallic wire, the ball will participate in the magic power of the rubbed tube; but if the ball be suspended by a cord of silk, worsted, or hair, or be attached by wax or pitch, the attractive and repulsive properties of the rod will not pass into the ball.

ELECTRIC LIGHT.

Shake a barometer in a dark room, and light will be produced in the empty part of it by the friction of the quicksilver electri-

fying the glass tube. Even the friction of air upon glass is attended by electricity, as has been found by blowing upon a dry plate of glass with a pair of bellows.

ELECTRIC LIGHT FROM BROWN PAPER.

Provide a piece of thick brown paper, thoroughly dry and warm; rub the paper briskly in a dark room, and there will dart forth flashes of electric light to the fingers, to a key, or to any other conductor that may be presented to it.

Heat a small portion of sulphate of quinine in a spoon over the flame of a lamp, and it will become luminous and highly electrical.

SUDDEN PRODUCTION OF LIGHT.

Take a piece of dry and warm wood into a dark room, suddenly rend it asunder, and a flash of light will be perceived. The same effect may likewise be produced by suddenly snapping asunder a stick of sealing-wax in the dark.

Or, break a Prince Rupert's drop, and electrical light will pervade the whole, so that its form will be distinctly visible in the dark. The light will appear, even if the experiment be made under water.

ELECTRICITY OF THE CAT.

Place your left hand upon the throat of the cat, and, with the middle finger and the thumb, press slightly the bones of the animal's shoulders; then, if the right hand be gently passed along the back, perceptible shocks of electricity will be felt in the left hand. Shocks may also be obtained by touching the tips of the ears after rubbing the back. If the colour of the cat be black,

and the experiment be made in a dark room, the electric sparks may be very plainly seen.

Very distinct discharges of electricity may also be obtained by touching the tips of the ears, after applying friction to the back; and the same may be obtained from the foot. Placing the cat on your knees, apply your right hand to the back; the left fore paw resting on the palm of your left hand, apply the thumb to the upper side of the paw, so as to extend the claws, and, by this means, bring your fore-finger into contact with one of the bones of the leg, where it joins the paw; when, from the knob or end of this bone, the finger slightly pressing on it, you may feel distinctly successive shocks, similar to those obtained from the ears.

It is, perhaps, unnecessary to add, that, in order to this experiment being conveniently performed, the experimenter must be on good terms with the cat.