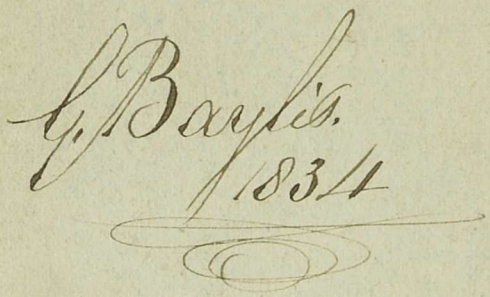
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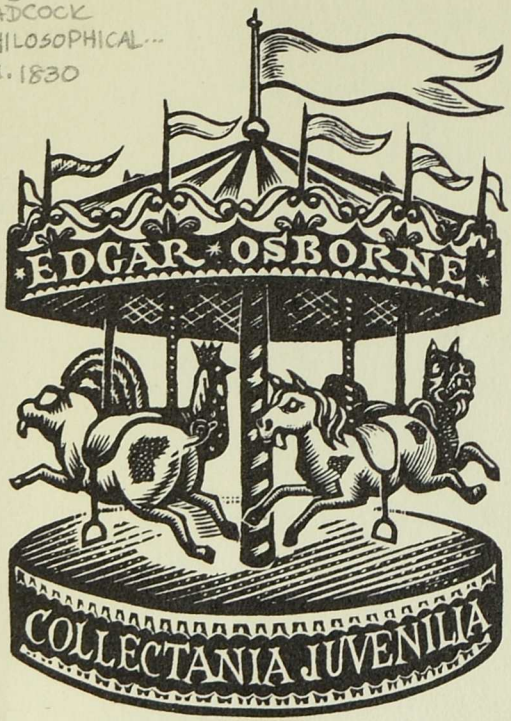


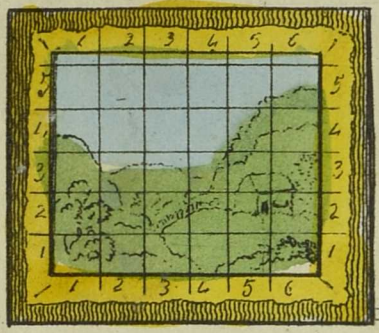
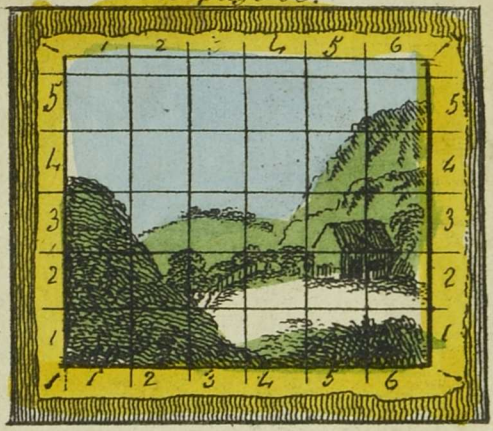


fig.6.

See page 53.



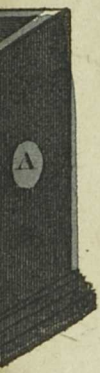
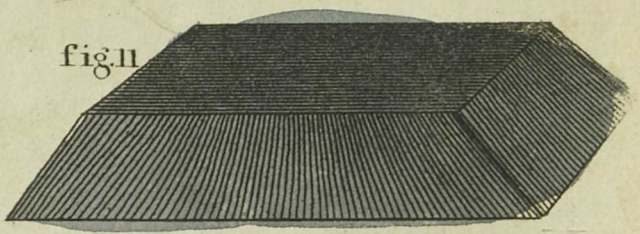


fig.11



PHILOSOPHICAL

RECREATIONS,

OR

WINTER

AMUSEMENTS:

A COLLECTION OF

ENTERTAINING & SURPRISING

EXPERIMENTS

IN

MECHANICS, ARITHMETIC, OPTICS,
HYDROSTATICS, HYDRAULICS, PNEUMATICS,
ELECTRICITY, CHEMISTRY, MAGNETISM, & PYROTECHNY,
Or Art of Making

FIRE WORKS,

TOGETHER WITH THE WONDERS OF THE

AIR PUMP,

Magic Lanthorn, Camera Obscura,

&c. &c. &c.

AND A VARIETY OF

TRICKS WITH CARDS.

The whole simplified and clearly elucidated so as to suit every capacity.

LONDON:

PRINTED FOR T. HUGHES, 3, BROADWAY,
Ludgate Hill.

PREFACE.

NATURAL Philosophy was never better taught than in these times, because simplified in the explanations and divested of its hard far-fetched terms. For these improvements we are indebted to Boyle, to Gregory, and to Joyce, not to mention the well known experimentalists and practitioners of our day, to whom the present work is chiefly indebted for what is *useful, familiar and entertaining*. But were we to go on with the enumeration of all the great names we have taxed with our selection, the space allotted to this brief exposition would be occupied with the galaxy of talent and ingenuity: for these no apology is offered, since they are above all praise, and we do not think so ill of our labours and experience as to suppose we have failed in our object—the production of an amusing and instructive little Volume, clothed in the smoother and more explicit language of the present day.

For what is *new* something more might be said, if that were necessary; but at the termination of our labours, we look back to *authority* with more complacancy than could be derived by sedate minds from novelties, however pleasing, or discoveries

however flattering to self-love. Indeed too much of this kind of vanity resides in science, and if to it we are indebted for improvement, no less does it hang upon the wheels and retard the progress of genuine practical wisdom.

Experiment secures the test by which all philosophy is best tried: that which is *abstract* seldom comes rightly into *life*, whilst the more beneficial, that depends upon natural objects and results, alone, is worth nothing until reduced to experience. Thus we may be said to *learn* without rudiments, and to begin at the termination; the mines of learning and the depths of research are at once laid open without the pains of exploration; and if we have in the ensuing pages *broken ground* fruitlessly, or for trivial ends, it has been with the wish to teach the pupil and the uninitiated how to dig the borders of the paths of learning more systematically hereafter.

Upon one or two occasions we have smoothed the usual abruptness of *mere experiment*, by some brief general notices; we have reduced the usual quantity of *jejune*, or unimportant *tricks*, that have no other quality to recommend them; abandoning the impracticable and rendering the whole subserviant to some useful, practicable end, among which the ghost and goblin notions usually attached to matters of this sort are successfully ridiculed and exposed.

J. B.

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Philosophical Recreations,

OR,

WINTER AMUSEMENTS

1. *Microscopes, how to form.*

TAKE platina, and having perforated several holes therein, fit into those holes, as near as may be, small bits of glass of good quality; then with a blow-pipe, melt the glass in the hole, and you will have a good multiplying lens. Small ones are found to come off most perfectly; but the art being in infancy, there is good reason to expect much improvement will be made herein by every operator. Platina is preferred, on account of its resisting heat better than any other metal; and a *convex lens* may be also made by simply melting an irregular mass of glass upon a plane surface of platina, the upper side whereof will form itself into a regular convexity.

2. *Proof that Chemical Combination lessens Quantity.*

TAKE of oil of vitriol one pint, and add thereto a pint of water; combustion and heat, with an acidulated vapour, will arise, though both articles, when separate, are

cold. Pour them off into a quart bottle, and it will not near fill it.

The same experiment taught in other words.

THE bulk of two liquids, when mixed, is less than the sum of the two bulks taken separately, before their mixture. Put into a glass globe, of the size of an orange, furnished with a long narrow neck, (or bolt head), as much water as will fill it halfway up, and pour upon the water highly rectified alcohol, nearly up to the top of the neck of the globe. It is essential that the alcohol be poured very carefully upon the water, without shaking the globe. When this has been done, the stratum of the alcohol will be seen floating on the water unmixed, particularly if the water has been previously coloured. Then mark on the neck or tube of the instrument, the exact height to which the alcohol reaches; and having closed the open end of the tube with the finger, shake the globe so as to mix the fluid, and considerable heat may be felt in the glass. When the heat subsides, the level to which the liquor now rises, will be found much lower than before the mixing took place.

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3. *To suspend a Ring by a Thread that has been Burnt.*

THE thread having been previously soaked in chamber-lye, 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, though the thread burn to ashes, it will yet sustain the ring.

4. *A Christmas gambol of Ghastly Features.*

INFUSE saffron in spirits of wine, and dissolve salt therein. Dip a little tow in this solution, and having set fire to it, extinguish all the other lights that may be in the room.

5. *To make any Linen appear like Diaper.*

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

6. *Chimney Ornaments made of Variegated Eggs.*

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

7. *Figures in relief on Eggs,*

MAY be formed, previously to the application of coloured patterns (as in the last experiment) by drawing

upon the egg the desired figure or ornament with melted tallow, or any other fatty substance. Then soak the egg in very strong vinegar, until it has corroded that part of the shell which remains bare, and the parts covered with grease will appear in relief exactly as they were drawn.

8. *Method of giving to Plaster of Paris Figures the appearance of Marble.*

One ounce of Windsor soap, being grated, is to be put into four fluid pounds of clear water, and dissolved in a well glazed earthen vessel. Then add of white bees' wax, one ounce, cut into thin slices; and as soon as the whole is incorporated, the compost is fit for use. Having dried the figure well before the fire, suspend it by a wire or twine, and dip it once in the varnish: upon taking it out the moisture will appear to have been absorbed; in two minutes time, stir the compost, and dip it a second time, and this generally suffices. Put it aside, covered from dust, for a week; then with a bit of soft muslin rag, or cotton wool, rub the figure gently, when a most brilliant gloss will be produced. Great care, however, is necessary to avoid abrasion of the coat of varnish, which would render the labour useless, and the figure would require dipping again.

9. *Pearls.*

The Chinese are reported to have constructed natural pearls (if the antithetical term may be used) by means of oysters; and we see no reason why the same way may not be adopted in our own country; if, indeed, as has been shrewdly suspected, the practice does not already prevail secretly. Buffon had long ago suggested, and (in 1773) when this information reached Europe, that the

puncturing of oysters, while yet alive, might produce pearls, and we know that they were often found in this shell-fish on our own coasts. But two characters belonged to *the naturalist:* he was a visionary—a fabulist also; and he left us in the dark, as to the secret of *puncturing*, which the industry and discrimination of the present day has fully developed. *The process*, which is worthy of trial, wherever it can be put in execution, consists in taking the oysters alive, and having perforated holes with a wire or awl, so as not to hurt vitality, a small iron wire is to be introduced, having knobs at a small distance from each other, formed probably of knots tied in the wire. The oysters are then to be replaced in their beds, and by the time the *season* comes round again, a concretion of pearly matter will be found to have covered the knobs of wire, which will become more perfect and larger the longer the oysters are suffered to remain.

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

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10. *To make Pomatum of Water and Wax.*

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

11. *Iron transformed into Copper.*

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

12. *Art of Bronzing Plaster Figures.*

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

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

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

13. *How to lift up a Flint Glass Bottle with a Straw.*

TAKE a straw, which is not broken or bruised, and having bent one end of it into a sharp angle A B C, fig. 1.; if this end be put into the bottle, so that the bent part of it may rest against its side, you may take the other end in your hand, and lift up the bottle by it, without breaking the straw; and this will be the more readily accomplished, as the angular part of the straw approaches nearer to that which comes out of the bottle.

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

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

15. *The two Communicative Busts.*

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

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

16. *The Oracular Head.*

PLACE a bust on a pedestal in the corner of a room, and let there be two tubes, as in the preceding article, one to go from the mouth, and the other from the ear, through the pedestal and the floor to an under apartment. There may be also wires, that go from the under jaw, and the eyes of the bust, by which they may be easily moved.

A person being placed in the room underneath, and applying his ear to one of the tubes at a signal given, will hear any question asked, and can immediately reply,

by applying his mouth to the tube which communicates below, at the same time moving the eyes by the wire, to accompany his speech.

17. *Method of obtaining Flowers of different Colours on the same Stem.*

SPLIT a small twig of the elder-bush lengthwise, and having scooped out the pith, fill each of the compartments with seeds of flowers of different colours, but which blossom about the same time. Surround them with mould, and then tying together the two bits of wood, plant the whole in a pot filled with earth, properly prepared.

The stems of the different flowers will thus be so incorporated, as to exhibit to the eye only one stem throwing out branches covered with flowers analogous to the seed which produced them. If the plants bear some affinity in the texture of their stems, and germinate at the same period nearly, less hazard will be run of the strong choking the weak.

18. *A Picture that Changes with the Weather.*

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

With this ink, take a brush and trace over the trees and fields of a print that represents the dreary aspect of winter, observing the usual rules of perspective, to make some parts deeper than others, according to their dis-

tance, leaving the remainder of their natural colours. Then put the print into a frame with a glass, and cover the back with paper that is pasted only at the extremities.

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

19. *The Changeable Rose.*

TAKE a common full blown rose, and having thrown flowers of sulphur into a chafing-dish of hot coals, hold the rose over the fumes thereof, and it will change to nearly white. If the rose has been a long time plucked, the *white* will be perfectly so. Afterwards dip it in water a short time, lay it aside for a few hours, and its *colour* will return, as the effects of the sulphur is decomposed. A damp or humid atmosphere, will bring about the same decomposition, but slower.

20. *The Blind Abbess and her Nuns.*

THEY were twenty-four in number, placed in eight cells, which the abbess caused to be built round a quad-

rangle; and it being deemed essential to their mystical seclusion, that she should find *nine* in each row, *three* nuns were placed in each cell, as in figure 1. With this arrangement, she was content; and so she was upon visiting her nuns a *second* time, although four men had been introduced among them. Nor were the blind abbess's rules a whit more transgressed, when, upon a *third* visit, she found the four men had gone off, and carried each man a nun with him, for she still found nine in each row. The affair was thus managed:—When the men got in, they occupied each a corner cell, but displaced two out of the three nuns who inhabited these, and who now took up their abodes in the four middle cells; thus making five persons in these middle cells, while two only remained at the corners. Still there were the mystical numbers—nine in each row, (see fig. 2.) But when the four men went off, as has been said, with the four nuns, and the abbess came to make her *third* visit, a new arrangement became necessary, to cover the estrangement which had taken place. Accordingly, four nuns removed into each of the four corner cells, leaving one only in each of the four middle cells, and there were still nine in each row, as the abbess had directed; so that she neither knew of the increase of habitants at one time nor of the decrease at another.

1

3	3	3
3		3
3	3	3

2

2	5	2
5		5
2	5	2

3

4	1	4
1		1
4	1	4

21. *Counterfeit Money, how to detect; a good Practical Experiment.*

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

22. *An Experiment for ascertaining the Quantity of Baser Metal contained in a given Mass.*

IN principle, the same as the preceding, is the story told by Vitruvius, in his treatise "of Architecture," which seems to point out the period, and the name of the great man to whom we are indebted for this discovery. He tells, that Hiero, king of Sicily at that time, having employed a goldsmith to make a crown of pure gold, which was designed to be dedicated to the gods, suspected that the goldsmith had stolen part of the gold, and substituted silver in the place of it. Being desirous of discovering the cheat, he proposed the question to Archimedes desiring to know if he could, by his art, discover

whether any other metal was mixed with the gold. This celebrated mathematician being soon afterwards bathing himself, observed, that as he entered the bath the water ascended and flew out of it, and as he came out of it the water descended in like manner, from which he inferred, that if a mass of pure gold, silver, or any other metal, was thrown into a vessel of water, the water would ascend in proportion to the bulk of the metal. Being so intensely occupied with the invention, he leaped out of the bath, and ran naked about the streets, crying, " I have found it, I have found it."

The way in which Archimedes applied this circumstance to the solution of the question proposed, was this: he procured two masses, the one of pure gold, and the other of pure silver, each equal in weight to the crown, and consequently of unequal magnitudes, then immersing the three bodies separately in a vessel of water, and collecting the quantity of water expelled by each, he was presently enabled to detect the fraud, it being obvious, that if the crown expelled more water than a mass of gold of its own weight, it must be mixed with silver, or some baser metal. Suppose, for example, that each of the three masses weighed eighteen pounds a piece; and that the mass of gold displaced one pound of water, that of silver a pound and a half, and the crown one pound and a quarter only: then since the mass of silver displaced half a pound of water more than the same weight of gold, and the crown a quarter of a pound more than the gold, it appears, from the rule of proportion, that half a pound is to eighteen pounds, as a quarter of a pound is to nine pounds; which was, therefore, the quantity of silver mixed in the crown.

Since the time of Archimedes, several other methods have been devised for solving this problem ; but the most natural and easy is that of weighing the crown both in air and water, and observing the difference.

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23. *How to make a Peg that will exactly fit three different kinds of Holes.*

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

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

Two bottles having been procured as nearly equal as possible, both in neck and belly, let one be filled with wine, the other with water. Then clap the one that is full of water dextrously upon the other, so that the two necks shall exactly fit each other ; and as the water is heavier than the wine, it will naturally descend into the lower bottle, and make the wine ascend into its place ; but it must be observed, that the wine, by this experiment, will be considerably altered, both in taste and

quality; and, therefore, if this be thought too expensive, the same thing may be done with any other two liquors of different specific gravities.

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25. *To place three Sticks, or Tobacco Pipes, upon a Table in such a manner, that they may appear to be unsupported by any thing but themselves.*

TAKE one of the sticks, or pipes, A, B, fig. 2. and place it in an oblique position, with one of its ends, A, resting on the table; then put one of the other sticks, as C D, across this in such a manner that one end of it, C, may be raised, and the other touch the table at D. Having done this, take the third stick E, and complete the triangle with it, making one of its ends E rest on the table, and running it under the first, A B, in such a manner that it may rest upon the second, C D, then will the three sticks, thus placed, mutually support each other; and even if a weight be laid upon them, it will not cause them to fall, but by simple compression does it strengthen and keep them firmer in their position.

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26. *How to prevent a heavy Body from falling, by adding another heavier Body to it on that Side towards which it inclines.*

ON the edge of a shelf, or table, or any other horizontal surface, lay a key C D, fig. 3. in such a manner, that being left to itself, it would fall to the ground; then in order to prevent this, take a crooked stick D F G, with a weight H at the end of it; and having inserted one

end of the stick in the open part of the key at D, let it be so placed that the weight H may fall perpendicularly under the edge of the table, and the body by this means will be effectually prevented from falling.

The same thing may be done by hanging a weight at the end of a tobacco pipe, a stick, or any other body, the best means of accomplishing which, will be readily known after a few trials.

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27. *Imitative Storms.*—1*st, Thunder and Lightening ;* 2*nd, Rain and Hail.*

CUSTOM having dictated the above inversions in language of the order of Nature, we have *so titled* the method adopted at public spectacles of producing artificial imitations of lightening followed by thunder, and hail by rain.

Several tin lamps having been provided, (see fig. 4.) the wicks whereof rise in pyramidal order, each containing twenty-five wicks, (five in heighth, and five in each rank), they are to be placed close to the area to be illuminated, but out of sight of the auditory. The operator now takes in both hands the matter which is to cause the flashes : this being no other than *rosin*, finely powdered and sifted, he throws at one or more of the lamps, as much powdered rosin as may be deemed necessary to agree with the representation, every throw producing a flash more or less vivid. He may add to the horror of the scene by dropping gently smaller quantities in constant succession, whereby a continued blaze may be kept up.

A readier method, *upon a small scale*, will be to use a flambeau instead of the pyramidal lamps, and to substi-

tute a tin tube in which the powdered rosin may be contained, and thrown from it upon the light.

Meantime, thunder being the consequent of lightening, and following in due proportion to its flashes and their vividness, is to be thus contrived. Two deal *spouts*, constructed like the rain-gutters of a dwelling-house, are to be erected one above the other on tressels, with an *inclination* towards each other at one end, which will throw them more apart at the other. The lowermost being nearly on the ground, is to receive from the upper one an iron shot, (of twelve or eighten pounds), which the operator has put into its highest end : this shot rolling along the upper spout, which should be roughed at the bottom, produces a rumbling sound, that increases into the imitation of a *clap* of thunder, when the ball falls out of the upper into the lower spout. Out of this latter the operator takes the ball, and again passes it into the upper, incontinently, as long as the imitative thunder is intended to last. Two balls are usually employed, and lesser *claps* may be produced by nailing small ribs of wood across to obstruct the ball, so as it may hop over it, and increase the rumbling noise.

Hail and *rain* being generally produced by such a commotion in the atmosphere, as has been just *represented*, according to the season of the year, imitations thereof commonly make part of the illusions of a theatre. Take a hollow cylinder resembling the domestic ashes-sieve, or *the thing* itself. Divide its inside into five equal parts by means of thin boards, four or five inches wide, placed in a sloping position as regards each other, but leaving a small space next the sides of the cylinder. Four or five pounds of common shot, being placed therein, turn the cylinder at first gently, and in proportion as its motion is

increased, will be the seeming pitilessness of the hail storm. Smaller shot will resemble rain.

28. *The Convertable Coins—a Legerdemain Trick.*

PROCURE two imitative guineas, or medals, and two white pieces resembling shillings, but not the *genuine money*, because of the laws enacted against 'defacing the coin of the realm.' Grind those pieces to half their thickness respectively, upon a stone, or at the glass-grinders; then placing a yellow and a silver piece together, you shall have two pieces seemingly gold on one side, and silver on the other. A neat rivet has been employed to keep the grinded coins together; but if the one be composed of tin or regulus of antimony, (Queen's metal), and the other contains iron, adhesion will take place by mere contact and pressure.

Lay one of these double pieces on the palm of one hand, *yellow* uppermost, the other hand to have *white* uppermost; then, having bid the company to notice this, shut both hands, strike them together, or with one hand underneath the table, the other a top, order the pieces to 'change Presto!' While this is going on, the pieces must be *turned*, by dropping them over from the palm to the lower joints of the fingers, dexterously, or *vice versa*. Two or three such turns may be afterwards made somewhat quicker, and the trick is always looked upon with undiminished admiration; especially if the conjuror has the address to borrow a shilling and a guinea of the company: neither whereof, however, does he make use of, but places them aside until the juggle is completed.

29. *Impenetrable Winter Cloaks, made of Feathers.*

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

30. *Muffs and Tippets, method of making, from the Plumage and Skins of Birds.*

We are indebted to a Frenchman for having brought to perfection this useful and ornamental art. Domestic animals of all the feathered kinds, afford the material of which these articles may be made; but those with rich, variegated colours for gay wear, as they are less liable to decay than the sable coverings of birds, of prey, would no doubt be preferred. Above all, those animals should be selected whose plumage lies close and smooth upon their backs—for obvious reasons. Diseased birds, or those

killed in moulting time, are to be rejected, as the feathers would drop off at no distant period; but the birds must therefore be killed in full health, and the skin carefully striped off soon after their death, especially when the weather is hot, otherwise the same effects would be produced from corruption as from disease. When the skin has been freed from its impurities, it is spread upon a small table, the plumage downwards,—the feathers having been previously arranged over each other, according to the natural order. To keep it well stretched, tacks or pins may be driven in, or threads passed round underneath the table.

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

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31. *A Fulminating Powder,*

May be made by rubbing together, in a hot marble mortar, with a wooden pestle, three parts, by weight, of nitre, two of mild vegetable alkali, and one of flowers of

sulphur, till the whole is accurately mixed. If a dram of this powder be exposed to a gentle heat, in an iron ladle, till it melts, it will explode with a noise as loud as the report of a cannon.

32. *A more powerful Fulminating Powder.*

THE most wonderful instance of chemical detonation is formed by the combination of volatile alkali with silver. Neither gunpowder, or fulminating gold, are to be compared with this invention; and the great danger attending its manufacture prevents us from giving a methodical account of its preparation to our readers, seeing too, that it can be purchased, properly prepared, at the chemists'.

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

33. *To make the Phosphorus Match Bottles.*

NOTHING more is necessary for this purpose, than to drop small pieces of dry phosphorus into a common phial; gently heat it till it melts; and then turn the bottle round, that it may adhere to the sides. The phial should be closely corked; and, when used, a common brimstone match is to be introduced, and rubbed against the sides of the phial; this inflames the match when it is brought out of the bottle. Though there is no danger in phosphorous, till friction, or fire, is applied, yet persons cannot be too cautious in the use of it, as instances have been known of one of these bottles catching fire in the pocket, and very much endangering the person who carried it; likewise, if carelessly used, small particles are apt to get under the nails, or on the hand; and if, by accident, they are held to the fire, or rubbed together, a flame will presently kindle.

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34. *Magical Transmutation of Colours.*

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

in strong vinegar. In the third glass, the red liquor will assume a violet tint.

35. *Ladies' Cloathes catching Fire, to Extinguish.*

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

or confidently set about extinguishing the flame herself.

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

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36. *To enter a Room which may be on Fire without Injury to one's Person.*

It is necessary to wear the hat, perhaps to *wet* it, if that can be done readily, as well as the gloves, wrist-bands, &c. Then stooping down, with the head as low as possible, crawling upon the knees, a person may penetrate an apartment with comparative safety, a current of air, or of atmosphere, always pervading the ground.

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37. *Ostrich Feathers, substitute for.*

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

38. *The Pressure of the Atmosphere,*

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

39. *Artificial Flowers.*

MAKE paste of divers colours, with gum dragon, well steeped and mixed up with sugar, beating it up with the paste in a mortar. For *red*, take cochineal; for *yellow*, use gamboge, indigo and orris for *blue*; and, for the *green*, the juice of beet leaves, scalded over the fire to take away their crudeness. Mould the parts thus ordered into thin pieces, in *forms* resembling the flowers of roses, tulips, &c. by means of tin moulds, or cut out with the

points of knives: finish the whole as nearly together as possible, and dry them on egg-shells, or some such substance. Out of the green paste, cut different shaped leaves, which may be mixed among the flowers, in various situations, so as to make them appear larger or smaller; make the stalks of slips of lemon-peel, or wire covered with green silk, which may be bought ready covered. Garnish the tops of pyramids of sweetmeats, fruits, &c. with those flowers, or make a separate *bouquet* of the leaves alone, to be placed in the centre of a desert dish. It is usual also to lay such in a basket, or kind of shell, made of fine pastry work of crackling crust, neatly cut and dried for that purpose.

40. *Artificial Fruit, with Stems of the Natural Fruit.*

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

Then take cow heels and calves feet, and boil them to jelly, strain it through a sieve, put it into a saucepan, and sweeten it; put in some lemon-peel with perfume, and colour it like the fruit intended to be imitated. Stir up each sort well, give it a boil up, and fill your tins while it is warm, having placed the ends of the stalks (with the stones on) in the most natural way possible. Should the fruit be rather too heavy while wet, the

stalks and tins must be suspended, whilst drying, by pieces of thread made fast above to nails in the wall, or on the case or box in which they may be placed to dry.

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

41. *A perfect copy of any Print or other Picture may be obtained,*

By taking a sheet of the finest white paper, and wetting it over with clean linseed oil on one side completely. Wipe off the oil as clean as possible, let it stand to dry a few days, otherwise it will spoil the picture: laying several sheets aside will be equally effectual to prevent this accident, and render them more smoothly transparent. Lay a sheet of this prepared tracing paper, on the picture to be copied, keeping it firmly down by means of weights on the corners, and elsewhere; and then with a black lead pencil, copy over all the leading outlines of the figures, *filling up the shades* as may suit your fancy, or be consistent with the subsequent genius

to be evinced in this part of the affair. This being done, lay the tracing paper, face downwards upon the paper, or other substance, that is to receive the picture, when the pencil marks are to be transferred from the transparent tracing paper to this new substance. Pressure does this, and a pair of smooth boards in a common press will effect it, and is to be preferred when *the copy* is meant to be worked out in oil colours, for the greasy nature of the oiled paper may probably come off at the same time, a circumstance which then signifies very little. But for water colour, or pencil copies, a stump made of a skewer, or a sharp pointed tracer, very smooth, is to be used, going over your former strokes of the outlines, &c. and you shall have the same very neatly and exactly copied.

Learners, however, who wish to perfect themselves in the art of drawing, will merely take the rough outline; filling up the shades by the eye, which is a facile method of teaching distances, relief, keeping, and other points, in the art of drawing.

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

The specific gravity of water is inferior to that of metals, and consequently water, absolutely speaking, cannot support a globe of iron or lead; but if this ball be flattened, and beat out to a very thin plate, it will, if put softly upon still water, be prevented from sinking, and will swim upon its surface like any light substance. In like manner, if a fine steel needle, which is perfectly

dry, be placed gently upon some still water in a vessel, it will float upon the surface without sinking.

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

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

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

Lay the print or drawing, which is intended to copy over a sheet of paper, and with a pin or fine needle, as the case may require, prick the outlines of the print through both papers; then take the clean paper with the holes in it, and lay it upon the article you wish to have the *design* transferred to, fasten it there tolerably close, and dust it over with finely powdered charcoal, placed in

a coarse bag, through the meshes whereof the dust will penetrate, and leave a correct copy of the original. Its adherence may be rendered more sure, by previously moistening the substance that is to receive the pattern, with a thin gum.

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

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44. *Any number being mentioned, how to add a figure to that number which shall render the whole divisible by* 9.

ADD the figures together in your mind, which compose the number named ; and the figure which must be added to this sum, in order to make it divisible by 9, is the one required.

Suppose, for example, the number named was 8654; you find that the sum of its figures is 23 ; and that 4 being added to this sum, will make it 27 ; which is a number exactly divisible by 9.

You therefore desire the person who named the number 8654, to add 4 to it, and the result, which is 8658, will be divisible by 9, as was required.

This recreation may be diversified, by your specifying, before the sum is named, the particular place where the figure shall be inserted, to make the number divisible by 9 ; for it is exactly the same thing, whether the figure be put at the end of the number, or between any two of its digits.

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

PROVIDE a small bag, divided into two parts; into one of which, put several tickets, numbered 6, 9, 15, 36, 63, 120, 213, 309, &c. and in the other part put as many different tickets marked with the number 3 only.

Draw a handful of tickets from the first part, and, after shewing them to the company, put them into the bag again; and having opened it a second time, desire any one to take out as many tickets as he thinks proper.

When he has done this, open privately the other part of the bag, and tell him to take out of it one ticket only.

You may then pronounce, that this ticket shall contain the number by which the amount of the other numbers is divisible; for, as each of these numbers are some multiple of 3, their sum must evidently be divisible by that number.

This recreation may also be diversified, by marking the tickets in one part of the bag with any numbers which are divisible by 9, and those in the other part of the bag with the number 9 only; the properties of both 9 and 3 being the same.

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46. *A Person striking a Figure out of the Sum of two given Numbers, to tell him what that Figure was.*

ARBITARILY command those numbers only, as are

divisible by 9; such, for instance, as 36, 63, 18, 117, 126, 162, 207, 216, 252, 261, 306, 315, 360, and 432.

Then, let a person choose any two of these numbers; and, after adding them together in his mind, strike out from the sum any one of the figures he pleases.

After he has done this, desire him to tell you the sum of the remaining figures; and it follows the number you are obliged to add to this amount, in order to make it 9, or 18, is the one he struck out.

For Example. Suppose he choose the numbers 126, and 252, whose sum is 378.

Then, if he strike out 7 from this amount, the remaining figures, 3 and 8, will make 11: to which 7 must be added, to make 18.

If he strike out the 3, the sum of the remaining figures, 7 and 8, will be 15; to which 3 must be added, to make 18: and so, in like manner, for the 8.

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

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

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

Then open that part of the bag which contains the number 73, and desire a person to take out one ticket

only; after which, dexterously change the opening, and desire another person to take a ticket from the other part.

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

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

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

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

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

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

In order to this, you must first stake one, and, remembering the order of the above series, constantly add to what he stakes as many as will make one more than the

numbers 11, 22, 33, &c. of which it is composed, till you come to 89; after which, the other party cannot possibly make the even century himself, or prevent you from making it.

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

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

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

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

consisting of two figures, the first of which, to the left, is the number of points on the first die, and the second figure, to the right, the number on the other.

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

THE AIR PUMP.

This instrument, and its powers, though tolerably well known to *the learned* by its effects, is not very familiar to the generality of persons. But a description of the principles upon which it is constructed would be superfluous *here*, as it can be purchased ready made at the manufacturers of mathematical instruments, at much less expense than it can be made for by any individual. Suffice it to say, for the information of the reader, that *the receiver* is a glass cone placed with its mouth upon a wet skin of leather, stretched on a plane, out of which, the atmosphere may be pumped or drawn, so as to leave an entire *vacuum* within the receiver. The properties of the air pump is best known by its operation, as exhibited in the following experiments.

50. *Bottles broken by Air.*

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

II. An opposite effect will be produced, if the mouth of a bottle be sealed so close that air cannot escape; then having placed it in the receiver, exhaust the air from its surface. The air which is confined within the bottle, when the external air is drawn off, will act so powerfully as to break the bottle in pieces.

51. *Glass broken by Air.*

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

52. *The Hand fixed by Air.*

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

53. *Water boiled by Air.*

TAKE water made so warm that you can just bear your hand in it, but which has not been boiled; put it under

the receiver, and exhust the air. Bubbles of air will soon be seen to rise, at first very small, but presently become larger, and will at length be so great, and rise with such rapidity, as to give the water the appearance of boiling. This will continue till the air is let into the receiver, when the phenomenon will instantly cease.

54. *Aerial Bubbles.*

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

55. *The floating Stone.*

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

56. *Withered Fruit restored.*

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

57. *Vegetable Air-Bubbles.*

THE small branch of a tree with its leaves, or part of a small plant, being put into a vessel of water, and the vessel placed under the receiver, exhaust the air.

When the pressure of the external air is taken off, the spring of that contained in the air-vessels of the plant, by expanding the particles, will make them rise from the orifices of all the vessels for a long time together, and produce a most beautiful appearance.

58. *The Mercurial Wand.*

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

the mercury into the pores of the wood, where it possesses the place of the air.

When the rod is taken out, it will be found considerably heavier than before; and that it has changed its colour, also, being now all over of a blueish hue. If cut aslant-wise, the quicksilver, *i. e. mercury*, will be seen to glitter in every part of it.

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59. *The Magic Bell.*

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

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60. *Feathers heavier than Lead.*

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

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61. *The Self-moving Wheel.*

Having taken a circular piece of tin, about ten inches in diameter, or of any other size that will go into the receiver, to its edge fix a number of *tin vanes*, each about

an inch square. Let this wheel be placed between two upright pieces, on an axis, whose extremities are very small so that the wheel may turn in a vertical position with the least possible force. Place the wheel and axis in the receiver, and exhaust the air. Let there be a small pipe with a cock; one end of the pipe to be outside the top of the receiver, and the other to come directly over the vanes of the wheel.

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

62. *An Artificial Halo, or Glory.*

PLACE a candle on one side of a glass receiver and the spectator having placed himself at a distance on the other side, let the air be exhausted, and the light of the candle will be refracted in circles of various colours, like the *halo* which encircles the sun.

63. *The Mercurial Shower.*

CEMENT a piece of wood into the lower part of the neck of an open receiver, and pour mercury over it. After a few strokes of the pump the pressure of the air on the mercury will force it through the pores of the wood in form of a beautiful shower. If the receiver be clear and free from spots and dust, and it is dry weather, it will appear like a fiery shower, if exhibited in a dark room.

64. *Magic Fountain.*

TAKE a tall glass tube, sealed hermetically at top and bottom, by means of a brass cap screwed on to a stop cock, and this to the plate of the pump. When the air is exhausted, turn the cock, take the tube off the plate, and plunge it into a bason full of quicksilver or water. Then the cock, being again turned, the fluid, by the pressure of the air, will play upon the tube, in the form of a beautiful fountain.

65. *The Exploded Bladder.*

TAKE a glass pipe open at both ends, to one of which tie fast a wet bladder, and let it dry. Then place it on the plate of the pump. While the air presses the bladder equally on both sides, it will lie *even* and strait; but as soon as the air is exhausted, it will press inwards, and be quite concave on the upper side. Soon, however, as the air is completely exhausted, the bladder will become stretched; then yield to the incumbent pressure, and burst with a loud explosion. To render the termination of this experiment more certain, one part of the bladder should be scraped with a knife, and some of its external fibres taken off.

66. *The Cemented Bladder.*

TIE the neck of a bladder to a stop cock, which is to be screwed to the plate of the pump, and the air ex-

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

67. *Cork heavier than Lead.*

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

68. *The animated Bacchus.*

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

69. *The Artificial Balloon.*

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

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70. *A contrivance, whereby Two Persons may correspond secretly, though the Writing be perused by a Third Person.*

TAKE two pieces of pasteboard, or stiff paper, out of which cut a number of *oblong holes*, at different distances from each other, as in the following example, both being alike. Keep one of these pieces for yourself, and give one to your correspondent, and when you are desirous of sending him any secret intelligence, lay the pasteboard upon a sheet of paper of the same size, and within the spaces which are cut out, write what you would have him to understand; the intermediate parts of the paper are then to be filled up with something which makes with these words a different sense. So when your correspondent receives this letter, by applying it to his pasteboard, and reading only that which appears through the *oblong holes*, he will be able to comprehend your meaning.

For Example:

" [*I shall be*] much obliged to you, as reading [*alone*] engages my attention [*at*] present, if you will send me any of the [*eight*] volumes of the Spectator; I hope you will excuse [*this*] freedom, but for a winter's [*evening*] I [*don't*] know a better entertainment. If I [*fail*] to return it soon, never trust me for the time [*to come.*] " The *secret* will read thus: " I shall be alone at eight this evening; don't fail to come." The remainder, or *filling up*, being gratuitous nonsense.

N.B. Such a paper may be placed in four different positions, 1*st*, By turning it over; 2*nd*, By turning it upside down; and, 3*rd*, Then turning it over once more; or, 4*th*, Its original position, as when the *oblong holes* were first cut. A measure that will become necessary according to *the secret* we may wish to write, the better to adopt this to the measure of the *holes* in the pasteboard.

71. *Arithmetical Transposition.*

Twenty-five numbers placed in so many squares, in arithmetical order, may be so transposed, as if added together, either *upward*, *crosswise*, or *diagonally*, their product shall be exactly the same, as the numbers in the centre, cross squares, and both diagonals of the *natural*

square. Thus, if we reckon from A to B, or from C to D, from E to F, or G to H, the product is alike 65 in each set of five squares each: so is it in every rank of five squares each, by the following rules of transposition, which may be applied to larger progressive numbers, where an *odd* one is introduced. The *middle number*, 13, being placed in the centre of the transposed square, proceed to transpose the figures at right angles with it in the natural square, to the diagonals of the transposed square, or E F and G H of the one, to A B and C D of the other. Then place the number 1 under the central number 13, and the number 2 in the next diagonal downward. The number 3 should be placed in the same diagonal line; but as there is no room in the square, you are to place it in that part it would occupy if another square were placed under this. For the same reason, the number 4, by following the diagonal direction, falling out of the square, it is to be put into the part it would hold in another square, placed by the side of this. You then proceed to numbers 5 and 6, still descending; but as the place 6 should hold is already filled, you then go back to the diagonal, and consequently place the 6 in the second case under the 5, so that there may remain an empty space between the two numbers.

A		G			C
	1	2	3	4	5
	6	7	8	9	10
E	11	12	13	14	15 F
	16	17	18	19	20
	21	22	23	24	25
D		H			B

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

The same rule is to be observed, whenever you find a space already filled.

Proceed in this manner to fill all the empty squares in the angle where the 15 is placed; and as there is no space for the 16 in the same diagonal, descending, you must place it in the part it would hold in another square, and continue the same plan till all the spaces are filled.

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72. *To find the difference between Two Numbers, the greatest of which is unknown.*

TAKE as many *nines* as there are figures in the least number, and subtract that sum from the number of *nines*. Let another person add that difference to the largest number; then taking away the *first figure* of the amount, add it to the *last figure*, that sum will be the difference of the two numbers, as required.

For example, Roger, who is 22, tells George, who is older, that he can discover the difference of their ages. He, therefore, privately deducts 22 from 99, and the difference, which is 77, he tells George to add to *his* age, and to take away the first figure from the amount. Then, if this figure, so taken away, be added to the remaining ones, the sums will be *the difference* between their ages.

Roger's age and 99, is	77
To which George adding his age	35
The sum	112
	12
	1
Then by taking away the first figure 1, and adding it to the last fixure 2, the sum is	13
Which added to Roger's age	22
Gives George's age, which is	35

The secret consits in working with 99, and having taken away 100, an unit is added to make up the difference.

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73. *La Bagatelle Boards, and Bumble Puppy Grounds, how to arrange the holes, so as fifteen shall count every way. Thus:*

4	9	2
3	5	7
8	1	6

An example of this species of arrangement was given in the preceding pages, and to it, as well as this, has been attributed some connection with magic. This, however, must be a mistake, as regards the *former* at least, which has nothing but ingenuity or contrivance to recommend it, in which point of view only it is worthy of notice. But combinations of figures, or the congregation of other objects, that should produce *fifteen*, as a balance, or a congrees of totals were long held in high veneration by the Egyptian Magii, and their scholars, from Greece, Syria, and Abyssina, all of whom attributed many virtues to numbers so disposed, as to produce fifteen.

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74. *Another example of the (so called) Magic Disposition of the First One Hundred Numbers, so as to produce* 505, *when cast upwards, or crosswise in twenty different ways.*

10	92	93	7	5	96	4	98	99	1	505
11	19	18	84	85	86	87	13	12	90	505
71	29	28	77	76	75	24	23	22	80	505
70	62	63	37	36	35	34	68	69	31	505
41	52	53	44	46	45	47	58	59	60	506
51	42	43	54	56	55	57	48	49	50	505
40	32	33	67	65	66	64	38	39	61	505
30	79	78	27	26	25	74	73	72	21	505
81	89	88	14	15	16	17	83	82	20	505
100	9	8	94	95	6	97	3	2	91	505
505	505	505	505	505	505	505	505	505	505	505

75. *How to part an Eight Gallon Bottle of Wine, equally between two Persons, using only two other Bottles, one of Five Gallons, and the other of Three.*

This question is usually proposed in the following manner :—A certain person having an eight gallon bottle filled with excellent wine, is desirous of making a present of half of it to one of his friends; but as he has nothing to measure it out with but two other bottles, one of which contains five gallons, and the other three, it is required to find how this may be accomplished.

In order to answer the question, let the eight gallon bottle be called A, the five gallon bottle B, and the three gallon C; then, if the liquor be poured out of one bottle into another, according to the manner denoted in either of the two following examples, the proposed conditions will be answered.

8	5	3
A	B	C
8	0	0
3	5	0
3	2	3
6	2	0
6	0	2
1	5	2
1	4	3
4	4	0

8	5	3
A	B	C
8	0	0
5	0	3
5	3	0
2	3	3
2	5	1
7	0	1
7	1	0
4	1	3

76. *A Quantity of Eggs being broken, to find how many there were, without remembering the Number.*

An old woman, carrying eggs to market in a basket, met an unruly fellow, who broke them; but, being taken before a magistrate, he was ordered to pay for them, provided the woman could tell how many she had; but she could only remember, that in counting them into the basket by two's, by three's, by four's, by five's, and by sixe's, there always remained one; but in counting them in by seven's, there were none remaining. Now, in this case, how was the number to be ascertained?

This is the same thing as to find a number, which being divided by 2, 3, 4, 5, and 6, there shall remain 1, but

being divided by 7, there shall remain nothing; and the least number which will answer the conditions of the question, is found to be 301, which was therefore the number of eggs the old woman had in her basket.

77. *To find the least Number of Weights that will weigh from One Pound to Forty.*

This problem may be resolved by means of the geometrical progression, 1, 3, 9, 27, 81, &c. the property of which is such, that the last number is twice the sum of all the rest, and one more; so that the number of pounds being forty, which is also the sum of 1, 3, 9, 27, these four weights will answer the purpose required.

Suppose it be required, for example, to weigh eleven pounds by those weights: you must put into one scale the one pound weight, and into the other the three and nine pound weights, which, in this case, will weigh only eleven pounds, in consequence of the one pound weight being in the other scale; and, therefore, if you put any substance into the first scale, along with the one pound weight, and it stand in equilibrio with the 3 and 9 in the other scale, you may conclude it weighs eleven pounds.

In like manner, to find a fourteen pound weight, put into one of the scales the one, three, and nine pound weights, and into the other that of twenty-seven pounds, and it will evidently outweigh the other three by fourteen pounds; and so on for any other weight.

78. *To break a Stick which rests upon two Wine Glasses, without injuring the Glasses.*

TAKE a stick (A B. FIG. 5.)of about the size of a common broomstick, and lay its two ends, (A B.) which ought to be pointed, upon the edge of two glasses, placed upon two tables of equal height, so that it may rest lightly upon the edge of each glass. Then take a kitchen poker, and give the stick a smart blow, near the middle point C, and the stick, A B, will be broken, without in the least injuring the glasses: and, even though the glasses be filled with wine, not a drop will be spilt, if the operation is properly performed.

But, on the contrary, if the stick were struck on the under side, so as to drive it up into the air, the glasses would be infallibly broken.

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79. *A Sheep Penn which contains a Hundred, may, by the addition of two more Hurdles, be made to hold double that Number.*

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

80. *Method of preparing the Composition, and applying it, so as to make Prints resemble Oil Paintings.*

TAKE of Canada balsam one ounce, spirit of turpentine two ounces, and mix them together. Prepare the print, or drawing with a wash made of a solution of isinglass in water, and when dry, apply the above varnish with a hair brush.

N.B. The deception will be greatly heightened by previously mounting the print on a canvas strainer.

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81. *A Method either to enlarge or diminish the size of a Picture or Print.*

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

To avoid the necessity of ruling across the original, which in some cases may injure it, take a square pane of crown glass and divide its sides, and also its top and bottom into equal parts; then from each division draw lines across the glass with lamp black ground with gum

water, and you will divide the glass into squares. Then lay the glass upon the original which you wish to copy, and having drawn the same number of squares upon your paper, proceed to copy into each square on your paper what appears behind each corresponding square of the glass. Instead of a glass, an open frame, with threads stretched across, will answer the same purpose, placing the picture in the middle, and taking care to number the extremity of each square. (See fig. 6.)

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

TAKE of linseed oil, and add to it for every pint, two ounces of sugar of lead, and three ounces of litharge; boil until these ingredients are dissolved. Then, to a half pint of the drying oil, (as we will now consider it), add a pound of bird-lime, and in an iron pot of a gallon measure, let it boil gently over a slow charcoal fire, until the bird-lime ceases to make a crackling noise. Then pour upon it two pints and a half of drying oil, and boil it about an hour longer, stirring it often with an iron or wooden *spatula*. As the varnish, in boiling, swells much, the pot should then be removed from the fire, and be again replaced when the swelling subsides. While boiling, it should be occasionally examined, in order to ascertain whether it has boiled enough: for this purpose, take some of the varnish upon the blade of a large knife, and after rubbing the blade of another knife upon it, separate the knives; and when, on their separation the varnish begins to form threads between the two knives, it has boiled enough, and should be removed from

the fire. When it is almost cold, add nearly about an equal quantity of spirits of turpentine; mix both well together, and let the mass rest till the next day. Then, having warmed it a little, strain and bottle it; if too thick, add more spirits of turpentine.

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

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83. *The Art of joining China-ware, so as to be fit for use in ten minutes.*

Mix some oyster-shell powder with the white of a fresh egg, to the thickness of white paint, lay it on thick at the two edges, and join them as exact and quick as possible, then put it before the fire till the china is quite hot, and it will cement in about two minutes. Pour boiling water into it directly, wipe it dry, scrape it clean on both sides with a penknife, and it will appear only as a crack. Mix no more than you can use for one or two things at a time; for if the cement grows hard it will be spoiled. The powder may be prepared as follows:—Choose a large deep oyster-shell, put it in the middle of a clear fire till red hot, then take it out, and scrape away the black parts; pound the rest in a mortar as fine as possible, sift and beat it a second time, till quite smooth and fine.

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84. *To prepare a Hortus Siccus.*

This is a Latin term, signifying "dry garden," inasmuch as specimens of all sorts of plants may be thus

preserved, in order to have recourse to them upon future occasions, when botany is pursued as a science in doors. The value of such a collection is evident, since a thousand minutiæ may be preserved in the well dried specimens of plants, which the most accurate engraver would have omitted.

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

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

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

The remainder of the plant is now to be treated in a similar manner.

The weights ought next to be gently removed, and the other leaf of the sheet of paper folded over the opposite one, so as to contain the loose pieces of paper and plants between them, a book or two is now to be applied to the outside of the paper, till the intended number of plants is thus prepared, when a box is to be filled with sand to the depth of an inch, one of the plants put in, and covered with sand sufficient to prevent the form of the plant from varying.—The other plants may then be

placed in succession, and likewise covered with a layer of sand, one inch thick between each, after which, the whole is to be gently pressed down in a greater or less degree, according to the tenderness or firmness of the plants.

The box is next to be carefully placed before a fire, one side being occasionally a little raised, as may be most convenient, the sides being alternately presented to the fire two or three times in the day, or the whole may be put into an oven gently heated, in the course of two or three days the plants will be perfectly dry, when the sand ought to be taken out and put into another box, the plants should likewise be removed to a sheet of writing paper.

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85. *Sea Plants, method of preserving.*

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

plant may be preserved within the leaves of a book. If you wish to free it from the slime and salt which adheres to it, it may be washed gently in fresh water, after being removed from the rock on which it grew.

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86. *An easy and expeditious Method of providing a substitute for Indian Ink.*

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

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87. *A Varnish which suits all sorts of Prints and Pictures, stands Water, and makes the Work appear as shining as Glass.*

Dilute one quarter of a pound of Venice turpentine, with a gill, or thereabouts, of spirit of wine, if too thick, add a little more of this last, if not enough, a little more of the former, so that you bring it to have no more thickness than the apparent one of milk; lay one coat of this on the right side of the print, and when dry, it

will shine like glass. If it be not to your liking, you need only lay another coat on it.

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88. *To make appear in Gold the Figures of a Print.*

After having laid on both sides of the print, one coat of the above described varnish in order to make it transparent, let it dry a little while, then before it is quite so, lay some gold in leaves on the wrong side of the print, pressing gently on it with the cotton you hold in your hand. By these means, all the parts, whereon you shall lay these gold leaves, will appear like true massive gold on the right side.

Now, when this is all thoroughly dry, lay on the right side of it, one coat of the varnish described above, and it will then be as good as any crown glass. You may also put a pasteboard behind the print to support it the better in its frame.

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89. *To make Artificial Pearls.*

The mode of obtaining real pearls, was shewn in a preceding article, (No. 9.) a good imitation is made by certain Jews in and about London, after the following process. That the scales of the fish, of which they are mainly formed, should be scarce and dear, is not to be wondered at, but that they should reach the enormous price of a guinea per quart, would almost exceed belief, but for the excellent imitation they afford of the real pearl, and the tedious, protracted, and illegal

means, made use of by the fishermen to obtain the scales.*

Take the bleak, or *blay*, as it is sometimes termed, which is a fish very common in the Thames, and having scraped off the fine silvery scales from the belly and sides while yet alive, wash and rub these in water; having suffered this water to settle, the sediment will be found of an oily consistence. A little of this is to be dropped into a hollow glass bead, of a bluish tint, and shaken about, so as to cover all the inner surface of the bead. After this, the bead is to be filled up with melted white wax, to give the pearl solidity and weight.

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90. *Method of Washing Chints, so as to preserve its Gloss and Beauty.*

Take two pounds of rice, and boil in two gallons of water till soft, when done pour the whole into a tub, let it stand till about the warmth you in general use for coloured linens; then put your chints in and use the rice instead of soap, wash it in this till the dirt appears to be out; then boil the same quantity as above, but strain the rice from the water and mix it in warm clear water; wash it in this till quite clean.

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* The fish being caught, the Thames fishermen assiduously seek after *the bleak*, seize them while yet struggling, and scrape off the larger scales from the sides, (which alone are valuable), and then cast them into the water again, under the vain hope of obtaining another harvest from the same individuals: in which, however, it is confidently believed, they are mistaken.

91. *Nuremberg Powder of Variegated Colour for strewing upon Writing.*

Mix together clean filings of copper, brass, iron, steel, and other metals; put each of them separately into an iron vessel; and heat them till they change colour. The degree of heat can only be regulated by trial. Take these to a good flatting-mill furnished with a funnel at top, and pass these filings through it, and you will procure a most beautiful sparkling powder of all sorts of lively colours.

92. *How to make a Drawing Desk.*

Let a frame be made of a reasonable size, so that a tolerably large piece of crown glass may rest upon it, supported by a ledge at the bottom part; where, by two hinges, it may be fastened to a drawer of the same dimension, which may be divided to serve for pen, ink, and paper, and other small utensils or instruments for drawing. To the top of the frame, fix two stays, by which the frame may be raised higher or lower, as occasion may require.

The manner of using this frame is thus:—lay the print or drawing you intend to copy on the glass, and fasten a sheet of fine white paper, with some wafers, or paste, upon it; if you work in the day-time, place the back, after you have raised the frame to a proper height, against the window; but if by night, put a *lamp* behind it, and you will see every stroke of the print or drawing, which, with your pen you may copy very accurately, and finish according to the manner you think proper. If it be a solid piece you intend to copy, then place it behind the desk, and having fastened your paper to the

frame, put the lamp so as to produce a strong shade on the objeet you have before you to draw, and you will plainly see to trace the outlines with black lead pencil: after which, fill up the *shades* in the manner it appears *without the desk.*

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93. *Improved Method of taking off Impressions of Leaves, Plants, &c.*

TAKE half a sheet of fine wove paper, and oil it well with sweet oil; after it has stood a minute or two to let it soak through, rub off the superfluous oil with a piece of paper, and let it hang in the air to dry; after the oil is pretty well dried in, take a lighted candle or lamp, and move the paper slowly over it in an horizontal direction, so as to touch the flame till it is perfectly black; when you wish to take off impressions of plants, lay your plant carefully on the oiled paper, and lay a piece of clean paper over it, and rub it with your finger equally in all parts for about half a minute; then take up your plant, and be careful not to disturb the order of the leaves, and place it on the book or paper, on which you wish to have the impression; then cover it with a piece of blotting paper, and rub it with your finger for a short time, and you will have an impression superior to the finest engraving. The same piece of black paper will serve to take off a great number of impressions, so that when you have once gone through the process of blacking it, you may make several impressions in a very short time.

The principal excellence of this method is, that the paper receives the impression of the most minute veins

and hairs, so that you may obtain the general character of most flowers much superior to any engraving. The impressions may afterwards be coloured according to nature.

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94. *To dye White Gloves a beautiful Purple.*

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

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95. *French Way of washing fine Lace or Linen.*

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

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96. *To make Flock Cloth Hangings, which at a distance look like Tapestry.*

Spread coarse canvass upon an even floor or table, and having flocks or shreds of woollen ground as small

as dust, and the cloth being sized over with good strong size, while it is wet, sift the flocks through a fine sieve, which, when you have done, run a roller of wood or iron over the piece to press them down close, and so suffer them to dry in the shade, lest the sun or fire parch them or make them crack, and when they are dry, brush them over lightly with alum water, and so draw your design with black and red lead, charcoal black, or any other colour, and it will at a distance look like tapestry, and be very lasting in a room where no great fires are made.

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

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

plicable to the purposes of painting both in oil and in water colours.

98. *To make Wax Candles.*

TIE a dozen of wicks on an iron circle, at equal distances, over a large copper vessel, tinned and full of melted wax, pour a ladle full of the wax on the tops of the wicks, one after another; what the wick does not take, will drop into the vessel, which must be kept warm by a pan of coals; so poured on till you have your candles as big as you chuse. If you want to have them of a pyramidical form, let the three first ladles be poured on at the top of the wick, the fourth at the height of $\frac{3}{4}$, the fifth at $\frac{1}{2}$, and the sixth at $\frac{1}{4}$; then take them down hot, and lay them aside of each other in a feather bed folded in two, to preserve their warmth and keep the wax soft; then take them down, and roll them one by one on a smooth table, and cut off the thick end as you please.

99. *To make Crocant or Ornamental Paste, for covering preserved Fruits.*

A CROCANT frame is made of copper, in the form of an egg cut through the middle, and about the size of two quarts; take about half a pound of flour and an ounce of fine grated sugar, which make up in a paste with the yolk of an egg or two, and a little water; roll it out very thin and even; butter the outside of your crocant, and lay the paste over it quite smooth, and with a sharp pointed penknife cut it in what figure you please; but it is only those who understand drawing can do it to perfection, as it ought to be done in coats of arms, flowers,

foliage, &c. when done set it in the oven to harden, and make it a cover for preserved fruits of any kind.

You may boil sugar till it be quite tough and ropy, and butter your frame, and with a small twig lay it on the frame in what figure you please: take it off when quite hard, and use it as the other.

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100. *Method of making Paper into Frames for Pictures, fine Embossed Work, and other parts of Furniture.*

Mr. Boyle tells us that paper besides its common uses, may be made into frames for pictures, fine embossed work, and other parts of furniture. For this purpose, a convenient quantity of the best white sort may be steeped for two or three days in water, till it becomes very soft, then reducing it by the mortar and hot water into a thin pulp, it is laid on a sieve to draw off its superfluous moisture, then putting it into warm water wherein a considerable quantity of fresh glue, or common size has been dissolved, it may afterwards be put into moulds, to acquire the designed figure, and when taken out, may be strengthened as occasion requires with plaster or moistened chalk, and when dry, painted or overlaid.

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101. *To make Liquid Gold and Silver for Vellum Painting, Fans, &c.*

Grind up gold or silver leaf with gum water, or honey, in a mortar, then wash away the gum or honey, and use the powder that remains with the gum water.

This may be applied to any article with a camel's hair pencil in the same way as any other colour.

102. *To Gild Sheets of Paper for ornamenting Ladies' Fancy Work, &c.*

TAKE yellow ochre, grind it with rain water, and lay a ground with it all over the paper, which should be fine wove, when dry, take the white of an egg, and about a quarter of an ounce of white sugar candy, and beat them together till the sugar candy is dissolved, then strike it all over the ground with a varnish brush, and immediately lay on the leaf gold, pressing it down with a piece of fine cotton, when dry, polish it with a dog's tooth, or agate.

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

TAKE two scruples of clear glue (Indian glue is the best) one scruple of alum, and half a pint of clear water, simmer the whole over a slow fire till it is nearly two-thirds evaporated, then your sheets of paper being laid on a smooth table, dip a varnishing brush in the preparation, and go quickly over the paper twice, sift powder of talc through a fine sieve made of gauze, hang it to dry, and when dry, rub off the superfluous talc, which serves again for the same purpose. The talc is to be prepared in the following manner:—Take one pound Muscovy talc, boil it in fair water four hours, then take it off the fire, and let it stand in the water two days, wash it well, beat it to pieces in a mortar, and add to it six ounces of alum, which when reduced to a fine powder, put again into clear water, and just give it a boil, pour off the water, and place the powder in the sun, or a warm place to dry, and it will become a hard consistence. This beat in a mortar to an impalpable powder, and it is fit

for use; keep it in a bottle to keep the dust from it, which is apt to make it appear dingy.

104. *Method of Painting on Silk or Satin.*

First make an outline according to your fancy, then lay on a wash of isinglass with great care, which will remove the glare and sleekiness of the silk, being necessary to make your colours work freely; melt the isinglass in clear water so as not to be very glutinous, otherwise it would spoil your colours and discolour your silk; observe your lights are to be made by a small tint mixed with flake white, of the colour of the intended flower, just sufficient to make a degree from the colour of the silk; for instance if a blue flower a very small quantity of bice or blue verditer mixed with the white, using less of the white in proportion as the shades grow darker, indigo may be used alone in the darkest shades. Take care never to lay your colours on the silk thick, as then they will be apt to crack, to prevent which it may be proper to mix a little white sugar candy with the gum water. If your flower is so deep as not to admit of a pure white in any part, lay on a priming of white, which being thoroughly dry proceed to the ground colour of the flower, advancing gradually with the shades as before directed.

105. *To make fine Blue Sealing Wax.*

Take an ounce of mountain blue, or blue ashes, an ounce of fine mastic, the fifth of an ounce of true Venice turpentine; then get a small iron pot or pan well cleaned, and made so as to have a little spout or beak, put the mastic in it first, which is to be melted on the fire, taking

care that it does not burn ; then mix the turpentine with it : this mixture being done, take the pan from the fire and put the blue ashes in it, then stir it all well with a little stick ; take care when you put in the blue ashes that the other ingredients are not too hot, as that would make the colour too black, when all is well mixed, and before it is quite cold, take two pieces of glass, which must be made wet with water, then pour on one of them this composition in order to roll it in sticks under your fingers, which must be wet.

In order to give this wax the necessary polish, pass the sticks over the flame of spirits of wine, which are to be lighted for this purpose.

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106. *Method of teaching Drawing or Writing to young Persons.*

An artist proposes to teach young persons the elements of drawing by making them first practise on a slate ; because it may be soon cleaned with a wet cloth or sponge. This method indeed would save the expense of paper, and afford the pupils an opportunity of easily correcting their faults, without being obliged to begin their drawing again entirely.

For my part, I think it would be more advantageous to employ, instead of a slate, a piece of Bohemian glass, which might be made rough on one side, by rubbing it with a pumice stone or a flat bit of freestone or fine sand well moistened. Whatever figures have been drawn on this glass, may be effaced by a wet cloth in the same manner as from a slate; and besides this advantage, as the glass is transparent, correct copies may be placed below it, which the scholars ought to follow till their hand is properly formed. What is here said of drawing may be applied also to writing.

107. *To write on Paper with Letters of Gold.*

Put some gum arabic into common writing ink, and write with it in the usual way. When the writing is dry breathe on it, the warmth and moisture softens the gum and will cause it to fasten on the gold leaf, which may be laid on in the usual way, and the superfluous part brushed off; or instead of this, any japanner's size may be used.

108. *Curious and simple manner of keeping Apricots, Peaches, Nectarines, Plums, &c. and even Figs, fresh all the year.*

For this small but excellent article we are indebted to no less a person than the celebrated Monsieur Lemery, one of the first chemists France ever produced. Beat well up together equal quantities of honey and common water, pour it into an earthen vessel, put in the fruits all freshly gathered and cover them up quite close. When any of the fruit is taken out, wash it in cold water and it is fit for immediate use.

109. *To remove Spots of Grease from Cloth.*

Spots of grease may be removed by a diluted solution of potash, but this must be cautiously applied, to prevent injury to the cloth. Stains of white wax, which sometimes fall upon the clothes from wax candles, are removed by spirits of turpentine, or sulphuric ether. The marks of white paint may also be discharged by the last mentioned agents.

110. *A very simple and Economical Method to take out every kind of spot occasioned by Fruits, such as Strawberries, Gooseberries, &c.*

Let the spotted part of the cloth imbibe a little water without dipping, and hold the part over a lighted common brimstone match at a proper distance. The sulphureous gas which is discharged soon causes the spot to disappear.

111. *To clean white Satins, and Flowered Silks, &c.*

Mix sifted stale bread crumbs with powder blue, and rub it very thoroughly all over, then shake it well, and dust it with clean soft cloths. Afterward, where there are any gold or silver flowers, take a piece of crimson in grain velvet, rub the flowers with it, which will restore them to their original lustre.

112. *To send Carp and Pike alive to any Distance.*

Steep the crumbs of new bread in brandy, and when it is sufficiently swollen, completely fill the mouth of the fish with it, and afterwards pour in a small quantity of brandy, wrap up the fish afterwards in fresh straw, sewed with packthread, and cover the whole with a linen cloth: when the fish reaches its destination, let it be unpacked, and thrown into a tub of water, where it will remain a quarter or half an hour without giving any signs of life, but at the expiration of that time it will disgorge itself copiously, and resume its ordinary motions.

113. *To make Size for Painting Scenes, and other Candle-light Pieces.*

STEEP a quarter of a pound of the cuttings of white glove leather in water for some time; then take them out, and boil them in three quarts of water till it wastes to a pint, and strain it through a cloth into an earthen pan; when the size is cold, if it feel firm under your hand, it is strong enough; you may prepare any colours in this size while it is warm, and it would take off the glare which would appear upon them by candle-light, if mixed with gum water.

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114. *To produce Fire by mixing together two cold Liquids.*

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

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

The same thing may be effected with the fuming acid

of nitre and oil of turpentine ; but the experiment should be performed with great caution, by fixing the vessel, containing the acid, at the end of a long pole, particularly if the quantity of ingredients be considerable.

115. *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.

116. *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 upon the other, and manage so as 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 edges, by a composition of lime, slacked by exposure to the air, mixed with the 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 may be added 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 again gradually disappear.

117. *Artificial Thunder.*

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

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

We gave an account at a preceding page (No. 27.) of a more mechanical method of producing those sounds, which seems better adapted to a large in-door area, though certainly not so ingenious as the above, nor the following method.

118. *Another way of producing Claps of Thunder.*

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

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

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

119. *Money augmented by an Optical Illusion.*

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

This phenomenon is occasioned by your seeing the piece through the conical surface of the water, at the side of the glass, and through the flat surface at the top

of the water, at the same time; for the *conical surface* dilates the rays, and makes the piece appear larger, whilst the *flat surface* only *refracts* them, and occasions the piece to be seen higher up in the glass, but still of its natural size.

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

120. *Three Objects, discernible only by the use of 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.

121. *How to construct a Camera Obscura.*

Make a circular hole in the shutter of a window, from whence there is a prospect of some distance; in this hole place a magnifying glass, either double or single, whose focus is at the distance of five or six feet; no

light must enter the room but through this glass. At a distance from it, equal to its focus, place a very white pasteboard, (what is called a Bristol board, if you can procure one large enough, will answer extremely well); this board must be two feet and a half long, and eighteen or twenty inches high, with a black border round it: bend the length of it inward to the form of part of a circle, whose diameter is equal to double the focal distance of the glass. Fix it on a frame of the same figure, and put it on a moveable foot, that it may be easily placed at that distance from the glass, where the objects appear to the greatest perfection. When it is thus placed, all the objects in front of the window will be painted on the paper in an inverted position, with the greatest regularity, and in the most natural colours. If you place a swing looking-glass outside the window, by turning it more or less, you will have on the paper all the objects on each side the window.

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

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

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122. *Another pleasing Experiment with the Camera Obscura.*

LET the rays of light that pass through the magnifying glass in the shutter be thrown on a large concave mirror, properly fixed in a frame. Then take a thin strip of glass, and stick any small object on it; hold it

in the intervening rays at a little more than the focal distance from the mirror, and you will see on the opposite wall, amidst the reflected rays, the image of that object, very large, and beautifully clear and bright.

123. *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 on 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 makes 20. B then tells A to count 20 on the dial, beginning at the next hour 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

124. *A Person having an even number of Shillings in one hand, and an odd number in the other, to tell in which hand the odd or even number is.*

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

Example I.

Number in the right hand is *even*.....	18	In the left hand *odd*..	7
Multiply by.....	3	Multiply by.....	2
Product....	54	Product....	14
Add the product of the left hand....	14		
Which produces a total of.....	68		

Example II.

Number in the right hand is *odd*.....	7	In the left hand *even*..	18
Multiply by	3	Multiply by	2
Product.....	21	Product.....	36
Add the Product of the left hand....	36		
Which produces a total of.....	57		

125. *Buff-coloured Cloth may be cleaned,*

By taking a small quantity of "pipe-clay," and soaking it in water until it is homogeneous, and of the thickness of cream. Let this be spread over all the cloth, and when dry rub it off with a brush, and the dirt or dust comes off with it.

White kerseymere may be dyed of a buff colour, by dipping the same in a solution made of iron filings, warm, or made hot, while the cloth is yet soaking in it. Dry it, and a dingy or blackish hue is produced; at the termination of two days, dip it in almost any vegetable decoction, as "tea," *i. e.* extract of old tea-leaves, and a handsome light buff colour will come off.

126. *Art of Dyeing or Staining Gloves, so as to resemble the "York Tan," the "Limerick Dye," &c.*

These different pleasing hues of yellow, brown, or tan colour, are readily imparted to leather gloves, by the following simple process. Steep saffron in boiling hot soft water for about twelve hours; then having slightly sewed up the tops of the gloves to prevent the dye staining the insides, wet them over with a sponge or soft brush dipped into the liquid. The quantity of saffron, as well as of water, will of course depend on how much dye may be wanted, and their relative proportions on the depth of colour required. A common tea-cup will contain sufficient in quantity for a single pair of gloves.

127. *A Person, having fixed on a Number, in his Mind, to tell him what Number it is.*

Bid him multiply the number thought on by 4; having done this, desire him to add 6, 8, 10, or any number, at pleasure, to the product; then let him take away the half of this sum, and tell you how much it is. From which, if you take away half the number you desired him at first to add to it, there will then remain double the number thought on.

For Example:

Suppose the number thought on is.....5
The *quadruple* of it is.....20
8 added to the product is.....28
And the half of this sum is.....14
4 taken from this leaves.....10
therefore 5 was the number thought on.

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128. *Another Method of discovering a Number thought on.*

After the person has fixed on a number, bid him double it, and add 4 to that sum; then let him multiply the whole by 5, and to that product add 12; desire him, also, to multiply this sum by 10, and after having deducted 320 from the product, to tell you the remainder, from which, if you cut off the *two last figures*, the number that remains will be the one thought on.

For Example:

Let the number thought on be.....7
Then the double of this is.....14
And 4 added to it makes.....18
This multiplied by 5 is.....90
And 12 added to it is.....102
And this multiplied by 10 is.....1020
From which deducting.....320
There remains.....700
which by striking off the two cyphers gives 7 the number thought on.

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129. *To tell the Number a Person has fixed upon, without asking him any Question.*

The person having chosen any number in his mind, from 1 to 15, bid him add 1 to it, and triple the amount. Then,

1. If it be an *even* number, let him take the half of it, and triple that half; but if it be an *odd* number, he must add 1 to it, and then halve it, and triple that half.
2. In like manner let him take the half of this number, if it be *even*, or the half of the next greater, if it be *odd*, and triple that half.
3. Again, bid him take the half of this last number, if *even*, or of the next greater, if *odd;* and the half of that half in the same way; and by observing at what

steps he is obliged to add 1 in the halving, the following table will shew the number thought on :

1—0—0	.....	4— 8
2—0—0	.....	13— 5
3—0—0	.....	3—11
1—2—0	.....	2—10
1—3—0	.....	8— 0
1—2—3	.....	6—14
2—3—0	.....	1— 9
0—0—0	.....	15— 7

Thus, if he is obliged to add 1 only at the first step, or halving, either 4 or 8 was the number thought on ; if there was a necessity to add 1 both at the first and second steps, either 2 or 10 were the numbers thought on, &c.

And which of the two numbers is the true one, may always be known from the last step of the operation ; for if 1 must be added before the last half can be taken, the number is in the second column, or otherwise in the first, as will appear from the following Examples :

Suppose the number chosen to be.....9
To which if we add.....1
The sum is.....10
Then the triple of that number is.....30
1. The half of which is.....15
The triple of 15 is.....45
2. And the *half* of that (adding 1) is.....23
The triple of 23 is.....69
3. The *half* of that is.....35
And the *half* of that is.....18

From which it appears that it was necessary to add 1 both at the second and third steps, or halvings, and

therefore by the foregoing table, the number thought on is either 1 or 9.

And as the last number was obliged to be augmented by 1 before the half could be taken, it follows also, by the above rule, that the number must be in the second column; and consequently it is 9.

Again, Suppose the number thought on to be.....6
To which if we add.....1
The sum is.....7
Then the triple of that number is.....21
1. The half of which is.....11
The triple of 11 is.....33
2. And the half of that is.....17
The triple of 17 is.....51
3. The half of that is.....26
And the half of that half is.....13

From which it appears, that it was necessary to add 1 at all the steps, or halvings, 1, 2, 3, therefore, by the table, the number thought on is either 6 or 14.

And as the last number required no augmentation before its half could be taken, it follows also, by the above rule, that the number must be in the *first column;* and consequently the person thought on a 6.

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130. *Thirty Soldiers having deserted, so to place them in a Ring, that you may save any Fifteen you please, and it shall seem the Effect of Chance.*

This Recreation is usually proposed in these terms: 'It once happened that fifteen Christians and fifteen Turks being in a ship at sea, in a violent tempest, it was deemed necessary to throw *half* the number of persons

overboard, in order to disburthen the ship, and save the rest. To effect this, with some *appearance* of equity, it was agreed to be done by *lot*, in such a manner, that the persons being placed in a ring, every ninth man should be cast into the sea, until one half of them were thrown overboard. Now the Pilot, being a Christian, was desirous of saving those of his own *persuasion;* how ought he therefore to dispose of the crew, so that the lot might always fall upon the Turks?

This question may be resolved, by placing the men according to the *numbers* annexed to the *vowels* in the words of the following verse;

Po-pu-le-am jir-gam Ma-ter Re-gi-na fe-re-bat.
4 5 2 1 3 1 1 2 2 3 1 2 2 1

from which it appears, that you must place four of those you would save first; then five of those you would have perish. After this, *two* of those to be saved, and then one who is to perish, and so on. When this is done, you must enter the ring formed by the men, and beginning with the first of the *four* men you intend to save, count on to the ninth man, and turn him out to be punished; then, counting on, in like manner, to the next *ninth* man, turn him out to be punished in like manner, and so on for the rest, until the fifteen are turned out.'

It is reported of Josephus, the author of the Jewish History, that he escaped death by practically working this problem; for, being governor of Joppa, at the time it was taken by the Roman emperor Vespasian, he was obliged to secrete himself with thirty or forty of his soldiers in a cave, where they made a firm resolution to perish by famine rather than fall into the hands of the conqueror. But being at length driven to great distress, they would have destroyed each other for sustenance, had not Josephus persuaded them to die by *lot;* which he

so ordered, that all of them were killed except himself and another, whom he might easily destroy, or persuade to yield to the Romans.

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131. *Three Persons having each chosen privately one out of three Things, to tell them which they have chosen.*

Let the three things, for instance, be a ring, a guinea, and a shilling, and let them be known privately to yourself by the vowels *a*, *e*, *i;* of which the first, *a*, signifies one, the second, *e*, two, and the third, *i*, three.

Then take 24 counters, and give the first person 1, which signifies *a*, the second two, which represents *e*, and the third 3, which stands for *i*; then, leaving the other counters upon the table, retire into another room, and bid him who has the ring take as many counters from the table as you gave him; he that has the guinea, twice as many, and he that has the shilling four times as many.

This being done, consider to whom you gave one counter, to whom two, and to whom three; and as there was only twenty-four counters at first, there must necessarily remain either 1, 2, 3, 5, 6, or 7, on the table; for we will not suppose they have failed to observe the directions you gave them.

But if either of these numbers remain, as they ought, the question may be resolved by retaining in your memory the six following words:

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

As, for instance, suppose the number that remained was 5; then the word belonging to it is *semita*; and as the

vowels in the first two syllables of this word, are *e* and *i*, it shews, according to the former directions, that he to whom you gave two counters has the ring, he to whom you gave three counters the gold, and the other person, of course, the silver, it being the *second* vowel which represents 2, and the *third* which represents 3.

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132. *To find the Number of Deals a Person may play at the Game of Whist, without holding the same Cards twice.*

THE number of cards played with at *whist*, being 52, and the number dealt to each person 13; if this be taken from the whole pack, the number of cards remaining will be 39, any 13 of which may be those the person takes in; and therefore we are to find in how many ways 13 cards may be taken out of 39, which is done as foliows:

Multiply 52 severally by 51, 50, 49, and *so forth*, backwards to 41, which will give 3954242643911239680000 for the product. Then divide this number, separately, by 1, 2, 3, &c. to 13, and the quotient will be 6227020800; which is the number of different ways 13 cards may be taken out of 52, and consequently the number required.

A question, somewhat similar to this, though more difficult to be resolved, is, to determine the number of *fifteens* that may be made, as in the game of Cribbage, out of a common pack of 52 cards, which is found, by computation, to be no less than 17264, each counting two holes on the *board*.

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133. *The Magic Vessel.*

ON the bottom of a vessel, (see Fig. 7,) lay three pieces of money, the first at A, the second at B, and the third

at C. Then place a person at D, where he can see no farther into the vessel than E. You tell him, that by pouring water in the vessel you will make him see three different pieces of money; and bid him observe, that you do not convey any money in with the water. But be careful that you pour the water in very gently, or the pieces will move out of their places, and thereby destroy the experiment.

When the water rises up to F, the piece at A will be visible; when it reaches G, both A and B will be visible; and when it comes up to H, all three pieces will be visible.

134. *Artificial Earthquake and Volcano.*

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

135. *Artificial Illuminations.*

A PLEASING exhibition may be made with little trouble or expence, in the following manner: Provide a box, fitted up with architectural designs, cut out on pasteboard; prick small holes in those parts of the building where you wish the illuminations to appear, observing, that in proportion to the distant perspective, the holes are to be made smaller; and on the *near objects* the holes

are to be made larger. Behind these designs thus perforated, you fix a lamp or candle, but in such a manner, that the reflection of the light shall only shine through the holes; then placing a light of just sufficient brilliance to shew the design of the buildings before it, and making a hole for the sight at the front end of the box, you will have a very tolerable representation of illuminated buildings.

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

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

N. B. It would be an improvement, if paper of various colours, as red, yellow, green, dyed in the colours described in Articles 142, 143, 144, below; and rendered transparent by oil, were placed between the lights behind, and the apertures in the buildings, as they would then resemble lamps of different colours.

136. *The Cameleon Spirit.*

Put into a decanter, volatile spirit, in which copper filings have been dissolved, and it will produce a fine blue. If the bottle is stopped, the colour will disappear;

but, when unstopped, it returns. This experiment may be often repeated, and the interest occasioned by the changes much increased, if you ascribe the change to the *material* with which the bottle may be stopped, or to some mysterious words pronounced at such changes.

137. *Invisible Ink.*

Put litharge into very strong vinegar, and let it stand twenty-four hours. Strain it off, and let it remain till quite settled; then put the liquor in a bottle.

Next dissolve orpiment in lime water, by setting the water in the sun for two or three days, and turning it five or six times a day. Keep the bottle containing this liquor well corked, and handle it at arm's length, as the vapour is highly pernicious if received into the mouth.

Write what you wish with a pen dipped in the *first* liquor; and to make it visible, expose it to the *vapour* of the *second* liquor. If you wish the writing to disappear again, draw a sponge or pencil, dipped in aqua-fortis, or spirit of nitre, over the paper; and if you wish it to re-appear, let the paper be quite dry, and then pass the solution of orpiment over it, as before.

138. *Another Ink for Secret Correspondence.*

Dissolve bismuth in nitrous acid. When the writing with this fluid is exposed to the vapour of liver of sulphur, it will become quite black.

139. *Another Invisible Ink.*

Dissolve green vitriol and a little nitrous acid in common water. Write your characters with a new pen.

Next infuse small Aleppo galls, slightly bruised, in water. In two or three days, pour the liquor off.

By drawing a pencil dipped in this second solution over the characters written with the first, they will appear a beautiful black.

140. *Invisible Gold Ink.*

Put as much gold in a small quantity of aqua regia as will dissolve in it, and dilute it with two or three times the quantity of distilled water.

Next dissolve, in a separate vessel, fine pewter in aqua regia, and when it is well impregnated, add an equal quantity of distilled water.

Write your characters with the first solution; and let it dry in the shade. To make them appear, draw a pencil or sponge, dipped in the second solution, over the paper, and the characters will appear of a purple colour.

141. *Invisible Silver Ink.*

Dissolve fine silver in aqua-fortis; and after the dissolution is complete, add some distilled water, after the same manner as in the gold ink process.

What is written with the above ink, will remain invisible for three or four months if kept from the air; but may be easily read in an hour, if exposed to the fire, air, or sun.

142. *Invisible Yellow Ink.*

STEEP marygold flowers, seven or eight days in clear distilled vinegar. Press the flowers, and strain the liquor, which is to be kept in a bottle well corked. If you would have it still more clear, add, when you use it, some pure water.

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

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

143. *Invisible Red Ink.*

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

Use the preceding infusion of violets, to make visible the characters written with this ink.

144. *Invisible Green Ink.*

DISSOLVE zaffre in powder, in aqua regia, for twenty-fours hours. Pour the liquor off, add the same quantity of common water, and keep it in a bottle well corked.

This ink will not be visible till exposed to the fire or the sun; and will again be invisible when it becomes cold.

145. *Invisible Violet Ink.*

EXPRESS the juice of lemons, and keep it in a bottle, well corked. Use the violet infusion to make the writing visible.

146. *Invisible Grey Ink.*

MIX alum with lemon juice. The letters written with this ink will be invisible till dipped in the water.

147. *A Secret Correspondence by means of Invisible Ink.*

A PERSON wishing to carry on a correspondence with another, and who is fearful of having his letter opened or intercepted, can adopt the following plan:

Write any unimportant matter with common ink, and let the lines be very wide apart: then between these lines, write the communication you wish to make, with any of the above invisible inks you can most readily procure.

Your correspondent is to be previously apprized of the method of making the characters visible; and writing in common ink will serve to lull the suspicions of those who might intercept the letter; and who not finding any thing important in it, will either forward or keep it. In either case there can be no danger, as the writing will not be visible without the proper application.

148. *The Restored Flowers.*

MAKE a bouquet of artificial flowers; the leaves should be formed of parchment. Dip the roses in the *Red invisible Ink*, the jonquils in the yellow, the pinks in the violet, and the leaves in the green ink. They will all appear white; and you shew them to the company, observing, that you will restore them to their natural colours, and desiring any person to fix any private mark on them he pleases that he may be sure there is no deception. You then, unperceived by the company, dip them in the revivifying liquor, used to make the yellow ink visible, and drawing them gently out, that the liquor may drop, and the flowers have time to acquire their colours, you present them to the company, who will see, with surprise, that they each appear in their natural colours.

TRICKS ON CARDS.

THE *cards* consist of fifty-two, as is well known, in four suits, each containing thirteen. They are distinguished by different marks, being from one to ten, and three *court cards* (or pictures.) Many and curious are the combinations of which they are susceptible, and immense are the sums of money that have been lost and won by playing at them, since the time of their first invention; nor is the passion for card playing at all abated in our day. Hence the interest every one feels for the turn-up of a card, all present being interested in what it may chance to be. And then, the change in the game which a favourable turn-up produces! The desire to know what it may be, and the doubt that the *secret* may be known to the adversary, raises our curiosity at the *back* of a card

which is wholly dissipated upon viewing its face. Further, 'Is there no knowing *before-hand*, where, or how to come at certain cards?' The very thought begets an idea of magic; and he who should be capable of atchieving such a purpose, would be literally said to deal with Satan! And a very good application of such a power it would be; for the bare attempt to come at such a knowledge, would subject the *knowing person* to all the pains and penalties of *a cheat:* the bare *thought*, and the *penetration* thereof, are not so far distant, as some persons would imagine. There is no magic, then, in the arrangement of the *cards*, so as to know where, or how to find certain of them that are desirable to our purpose; nor is he a conjuror who so contrives as to delude us in this respect, or any other, most of the tricks upon the fifty-two, being performed by dexterity of the hands, by combination, or previous contrivance; but the far greater number, and the most ingenious, being brought about by dint of calculation and previous arrangement, therefore become rational and scientific exercises of the mind. Still is it the reflection how many games and what sums of money, may be won by this apparent power over the cards, that keeps curiosity upon the stretch, while the performance of the following tricks may be going on; and the broad stare of wonder that accompanies the *denouement* of each, proves that best of the senses (common sense) still slumbers; and in fact, it seems necessary to prevent its becoming broad awake, by means of a kind of *side-play*. For this purpose 'the *conjuror*,' (if our readers will allow the word) must excite attention to his performance, by a certain action, and an accompanying conversation; telling his hearers what he intends to do, he may make appplications thereof to existing circumstances, and induce a belief that he really has the power he pretends to, in order to heighten the *gusto* that follows every atchievement of his purpose. He may subsequently ex-

plain away this impression upon rational grounds, or not, as seems to him good; or he may heighten it by the assumption of a dress, the choice of a certain situation for the performance of his tricks, or some other equally apparent matter of importance. Turning the coat sleeves inside out; wearing another's hat awry; or prefering the east side, or north of the room, mainly contribute to make this kind of impression, and to carry on the delusion from trick to trick, upon younger minds especially

Finesse of a similar nature will be found necessary to carrying on tricks of every description with the requisite success, particularly such as may be deemed magical.

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149. *To tell the Amount of the Numbers upon any two Cards, which a Person has drawn from a whole Pack.*

Let the person who draws the cards add as many more cards to each of those he has drawn as will make each of their numbers twenty-five, counting as before mentioned. Then take the remaining cards in your hand, and, seeming to search for some card among them, count them over to yourself, and their number will be the amount of the two cards drawn.

For Example:

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

Secondly.—You may perform this amusement without touching the cards, thus:

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

EXAMPLE:

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

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150. *To tell the Amount of the Numbers of any Three Cards that a Person shall draw from the Pack.*

AFTER the person has drawn his three cards, draw one yourself, and lay it aside, for it is neeessary that the number of the remaining cards be divisible by three, which they will not be in a pack of fifty-two cards, if only three be drawn. The card you draw, you may call the confederate, and pretend it is by the aid of that card you discover the amount of the others. Then tell the party to add as many more to each of his cards, as will make its number sixteen, which is the third part of the remaining forty-eight cards; therefore, suppose he has drawn a ten, a seven, and a six; then, to the first he

must add six cards,—to the second, nine,—and to the third, ten, which together make twenty-five, and the four cards drawn being added to them, make twenty-nine. You then take the remaining cards, and telling them over, as in the last amusement, you find their number to be twenty-three, the amount of the three cards the person drew.

This amusement may also be performed without touching the cards, thus:—When the party has drawn his three cards, and you have drawn one, let him deduct the number of each of the cards he has drawn from seventeen, which is one-third of the pack after you have drawn your card; and let him tell you the amount of the several remainders, to which you privately add one to the card you drew, and deducting that amount from fifty-two, (the whole number of the cards), the remainder will be the amount of the three cards drawn.

EXAMPLE:

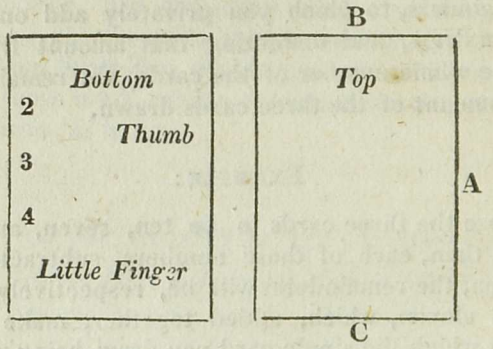
Suppose the three cards to be ten, seven, and six, as before; then, each of those numbers, subtracted from seventeen, the remainders will be, respectively, seven, ten, and eleven, which, added together, make twenty-eight, to which the single card you drew being reckoned as one, and added, makes twenty-nine; and that number deducted from fifty-two, leaves twenty-three, which is the amount of the three cards the party drew.

151. *How to make the Pass.*

THE following amusements principally depend on dexterity of hand; and, as what is termed *making the pass*,

will be necessary to be acquired, to enable the operator to perform many of them, we subjoin the following explanation of this term :

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



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

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

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

152. *The Divining Card.*

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

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

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

Let a person draw any card, and replace it in the pack. You then *make the pass*, (see above), and bring that card to the top of the pack, and shuffle them, without losing sight of that card. Then offer the same card to a second person, that he may draw it, and put it

in the middle of the pack. You *make the pass*, and shuffle the cards a second time in the same manner, and offer the card to a third person, and so again to a fourth or fifth.

153. *The Four Confederate Cards.*

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

154. *The Numerical Card.*

LET the *long card* be the sixteenth in a pack of picquet cards. Take ten or twelve cards from the top of the pack, and, spreading them on the table, desire a person to think on any one of them, and to observe the number it is from the first card. Make *the pass* at the long card, which will then be at the bottom. Then ask the party

the number his card was at, and counting to yourself from that number to sixteen, turn the cards up, one by one, from the bottom. Then stop at the seventeenth card, and ask the person if he has seen his card, when he will say *no*. You then ask him how many more cards you shall draw before his card appears; and when he has named the number, you draw the card aside with your finger, turn up the number of cards he proposed, and throw down the card he fixed on.

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155. *The Card found out by the Point of a Sword.*

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

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156. *The Card hit upon by Guess.*

Spread part of a pack before a person, in such a way, that only one court card is visible; and to arrange it, that it shall appear the most prominent and striking card. You desire him to think on one; and observe if

he fix his eye on the court card. When he tells you he has determined on one, shuffle the card, and turning them up one by one, when you come to the court card, tell him that is the one.

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

157. *The Card changed by Word of Command.*

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

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

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

158. *A number of Names being Written on several Cards, how to tell the particular Name which any Person has thought on.*

TAKE eight cards, and write eight different names *on each* of them, taking care that the last on each card begins with one of the letters of the word DISCOVER, which letters, in the order they stand, answer to the Nos. 1, 2, 3, 4, 5, 6, 7, 8.

On eight other cards, write the same names, with this restriction, that the first name, on each of them, must be taken from that card of the other parcel, whose last name begins with D, the second name from that whose last name begins with I, and so on.

Then let any one choose a card out of the first eight, and, after he has fixed on a name, give it to you again; when you must carefully note the last name on it, and retain the number answering to the letter it begins with in your mind.

You then take the other eight cards, and, after shuffling them, shew them to the person, one by one, and desire him to look for the name he has chosen.

When he says he has found it, you must look for that name which is the same in number from the top with the number of the card he took from the other parcel, and it will be the name he fixed on

Thus, for example, suppose he took out the card that had the word Orpheus at the bottom of it, which, according to the order of the letters in the word DISCOVER, is the fifth ; then whatever word he fixed upon (Hebe for instance) must necessarily be the fifth upon the card on which it is found in the other parcel.

Order of the Words in the first Eight Cards.

Corydon	Pomona	Arachne	Pyramus
Andromeda	Ariadne	Deucalion	Polyhymnia
Silenus	Danae	Galatea	Circe
Acis	Narcissus	Thetis	Psyche
Proteus	Hercules	Nisus	Cassandra
Thyrsis	Philomela	Ganymede	Adonis
Flora	Calista	Cephalus	Icarus
Daphnis	Jason	Semele	Ceres
Iphigenia	Acteon	Homer	Virgil
Procris	Sappho	Polypheme	Priam
Thysbe	Alcinous	Æneas	Andromache
Diana	Ulysses	Hesiod	Euryalus
Hebe	Atys	Cupid	Helen
Endimion	Proserpine	Telemachus	Pandora
Medusa	Dryope	Venus	Troilus
Orpheus	Virtumnus	Eson	Rhadamanthus

Order of the Words in the last Eight Cards.

Corydon	Andromeda	Silenus	Acis
Pomona	Ariadne	Danae	Narcissus
Arachne	Deucalion	Galatea	Thetis
Pyramus	Polyhymnia	Circe	Psyche
Iphigenia	Procris	Thysbe	Diana
Acteon	Sappho	Alcinous	Ulysses
Homer	Polypheme	Æneas	Hesiod
Virgil	Priam	Andromache	Euryalus

Proteus	Thyrsis	Flora	Daphnis
Hercules	Philomela	Calista	Jason
Nisus	Ganymede	Cephalus	Semele
Cassandra	Adonis	Icarus	Ceres
Hebe	Endimion	Medusa	Orpheus
Atys	Proserpine	Dryope	Virtumnus
Cupid	Telemachus	Venus	Eson
Helen	Pandora	Troilus	Rhadamanthus

Instead of eight cards, you may, by adding duplicates to each, have sixteen in each parcel, which will make the recreation appear the more mysterious, without in the least embarrassing it, as you have nothing to remember but the last name on each card. Or instead of names, you may write questions on one parcel, and answers on the other.

159. *To discover any Card in the Pack by its Weight or Smell.*

DESIRE any person in company to draw a card from the pack, and when he has looked at it, to return it you with the face downwards; then, pretending to weigh it nicely take noticc of any particular mark on the back of the card, which having done, put it among the rest of the cards, and desire the person to shuffle them as much as he pleases; then, giving you the pack, you pretend to weigh each card as before, and proceed in this manner till you have discovered the card he has chosen.

160. *To make a Person choose any Card you please, and to tell him the Card he has chosen.*

SPREAD a pack of cards before any person in company in such a manner, that one of the pictured cards, or some other remarkable one, only shall be completely visible; then desire him to think of any card he pleases; and when he has made his choice, you may safely tell him, that the pictured card is the one he thought on; for as no other could strike his eye, it was scarcely possible for him to make a different choice; but if he should, you may pretend to have made some mistake, and, after a time, try the experiment with some other person in company.

161. *The convertible Aces—two neat Legerdemain Tricks.*

I. HAVING by means of a little soap, caused the cards to stick together,—suppose an ace of hearts upon the ace of spades, and an ace of spades upon the ace of hearts. The trick may be commenced by declaring an intention of making the spade and the heart change places. For this purpose, one of the double cards is to be placed ceremoniously underneath the foot of a person, or in his pocket, and the other double card seemingly in the pocket of another person, but in so doing, the *upper card* of either is to be secretly withdrawn, in the palm of the hand, lengthwise. A piece of *conjuration*, which is easily managed by going behind the person to put the card under his foot, or by fumbling in his coat pocket. Mr. Jonas usually dropped the *double card* in to the person's pocket, and then, as if to see that all

was safe, he would feel for, and subtract the card necessary to the trick. Having now the adverse cards planted upon the persons, with a wand, touch the shoulder of each, and with a ' Presto,' ' fly,' or ' change quick,' they may be directed to exhibit the card which each has in his pocket, or under his foot, as the case may be.

II. As before, having stuck the aces together, you show the uppermost to the person to be played upon; then slap it on the table, pick it up, bid him blow on it, and while amusing him with discourse, slide off the card he has seen, conceal it in the sleeve of the coat, and place the other, face downwards, upon the table. Then, with one hand underneath, order the card on the table to change ' Presto,' which upon his picking it up will appear to have taken place, whilst you add to the surprise of all the beholders, by producing, from under the table, the very card he had before noted.

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162. *To discover the Number of Points on any three Cards, which a Person has taken privately from a whole Pack.*

You begin with premising, arbitrarily, that *the ace*, in this case, shall count for *eleven*, but the court cards (as 10) and others, to be counted as usual. Then propose to any person to choose three cards out of the pack, and to place over each of them as many other cards as will make the whole number of points 15.

After this take the remainder of the pack in your hand; and under pretence of looking for some particular card among them, count how many there are, and by adding *sixteen* to that number, you will have the number of pips on the three bottom cards.

For Example:

Suppose the person had chosen a 7, a 10, and an ace.

Then over the 7, he must place 8 cards; over the 10, 5; and over the ace 4.

After this he gives you the remaining part of the pack, which you find consists of 32 cards.

From this 32, therefore, you deduct 4, and the remainder, 28, is the number of pips upon all the bottom cards.

163. *Several Cards being shewn to different Persons, in order that each of them may choose one, to name that which each Person has fixed on.*

There must be as many different cards shewn to each person as there are persons to choose; so that if there be three persons, you must shew to each of them three cards; and, telling the first to retain one of them in his memory, you then lay those three cards down, and shew three others to the second person; and so to the third.

This being done, take up the first person's cards, and lay them down one by one, separately, with their faces uppermost. You next place the second person's cards over those of the first; and, in like manner, the third person's cards over those of the second; so that in each parcel, there may be one card belonging to each person.

Having done this, ask each of them in which parcel his card is, and when he has informed you, you may immediately know which card it is; for the first person's card will always be the bottom one, the second person's the middle card, and the third person's the uppermost one, in that parcel where they each say their card is.

This recreation may be performed with a single person, by letting him fix on three, four, or more cards; in which

case you must shew him as many parcels as he is to choose cards, and every parcel must consist of that number, out of which he must fix on one; the rest of the process being then as above.

164. *The Three Magical Parties.*

Offer the *long card* to a person, that he may draw it, and replace it in any part of the pack he pleases. Make the *pass*. Take a pack of twenty-seven cards; give them to a person, bid him fix on one, shuffle them, and return them to you. Arrange the twenty-seven cards in three parcels, by laying one down, alternately, on each parcel; but before you lay each card down, shew it to the person, without seeing it yourself. When you have completed the three parcels, ask him at what number, from one to twenty-seven, he will have his card appear, and in which heap it then is? You then look at the heap through your glass; and if the first of the three numbers, which stands against the number it is to appear at, be one, put that heap at top; if the number be two, put it in the middle, and if it be three, put it at bottom. Next divide the cards into three heaps in the same manner, a second and third time, and his card will be at the number he chose.

Example:

Suppose the person wishes his card to be the twentieth from the top; and the first time of making the heaps, he says it is in the third heap; you then look at the table in the perspective, and you see that the first figure is two; you, therefore, put that heap in the middle of the pack. The second and third times, you in like manner put the heap in which he says it is, at bottom; the number each time being three. Then looking at the pack with your

glass, as if to discover which the card was, you lay the cards down, one by one, and the twentieth will be the card fixed on.

165. *The Card in the Ring.*

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

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

166. *The Card in the Mirror.*

PROVIDE a mirror, either round or oval, the frame of which must at least be as wide as a card, and the glass must be wider than the distance between the frame, by at least the width of a card. The glass in the middle must be made to move in two grooves; and so much of the quicksilver must be scraped off, as is equal to the size of a common card. You then paste over the part where the quicksilver is rubbed off, a piece of pasteboard, on which is a card, that must exactly fit the space, and it must at first be placed behind the frame.

Fix this mirror against a partition, through which two strings are to go, by which an assistant in an adjoining room can easily move the glass in the grooves, and make the card appear or disappear at pleasure. Or it may be done without an assistant, if a table be placed against the partition, and a string from the glass be made to pass through a leg of it, and communicate with a small trigger, which you may easily push down with your foot, and at the same time wiping the glass with your handkerchief, under the pretence that the card may appear more conspicuous, which will also serve most effectually to disguise the operation.

Having every thing thus arranged, you contrive to make a person draw the same sort of card as that fixed to the mirror; if you do not succeed in this with a stranger, make some pretence for shuffling the cards again, and present the pack to a confederate, who, of course, will draw the card you wish, and who is to shew it to two or three persons next to him, under the pretence that it might slip his memory. This card you place in the middle of the pack, then *make the pass*, and bring it to the bottom. Direct the person to look for his card in the mirror, when the confederate behind the partition is to draw it slowly forward; or if you perform the operation yourself, press the trigger with your foot, and the card will appear as if placed between the glass and the quicksilver. While the glass is drawing forward, you slide off the card from the bottom of the pack, and convey it away.

167. *The Card in the Opera Glass.*

Procure an opera glass, two inches and a half long; the tube to be made of ivory, so thin that it may appear transparent. Place in it a magnifying glass, of such power,

and at such a distance, that a card, three quarters of an inch long, may appear like a common-sized card. At the bottom of the tube lay a circle of black pasteboard, to which fasten a small card, with the pips, or figures, on both sides, and in such a manner that by turning the tube either side of the glass may be visible.

You then offer two cards to two persons, similar to the double card in the glass. You put them in the pack again, or convey them in your pocket; and after a few flourishing motions, you tell the persons you have conveyed their cards into the glass; then you shew each person his card in the glass, by turning it in the proper position.

You may easily induce the parties to draw the two cards you wish, by placing them first on the top of the pack, and then, by making the *pass*, bringing them to the middle. When you can make the pass in a dexterous manner, it is preferable to the long card, which obliges the operator to change the pack frequently, as, if the same card is always drawn, it may excite suspicion.

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168. *To separate the Two Colours of a Pack of Cards by One Cut.*

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

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169. *The Metamorphosed Cards.*

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

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

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

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

monds, which is at the top of the pack, to the opening, you bid him look at his card again, when he will see it is that he drew. You may do the same with all the other painted cards, either with the same person, or with him who drew the ten of clubs.

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

170. *The Magic Vase.*

CONSTRUCT a vase of wood, or pasteboard. (See Fig. 8.) On the inside let there be five divisions; two to them, *c*, *d*, to be large enough to admit a pack of cards each; and the other three, *e f g*, only large enough to contain a single card. Place this vase on a bracket, L, which is fastened to the partition M. Fix a silken thread at H, the other end of which passes down the division *d*, and over the pulley I, runs along the bracket L, and goes out behind the partition M.

Take three cards from a picquet pack, and place one of them in each of the divisions, *e f g*, making the silk thread or line go under each of them. In the division *c* put the remainder of the pack.

You then get another pack of cards, at the top of which are to be three cards, the same as those in the three small divisions; and, making the pass, bring them to the middle of the pack. Let them be drawn by three persons; let them shuffle all the cards; after which place the pack in the division *d*, and tell the parties that the cards they drew will rise at their command, separately, from the vase.

A confederate behind the partition then gently drawing the line, the three cards will gradually appear from

the vase; then taking the cards from *c*, you shew that those three are gone from the pack.

The vase must be placed so high that the company cannot see the inside.

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171. *To discover the Card that is drawn by the Throw of a Die.*

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

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

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172. *To tell the Number of the Cards by their Weight.*

TAKE a parcel of cards, suppose forty, among which insert two long cards; let the first be, for example, the fifteenth, and the other the twenty-sixth from the top. Pretend to shuffle the cards, and then cutting them at the first long card, poise those you have cut off in your left hand, and say, "there should be here fifteen cards."

Cut them again at the second long card, and say, "there are here only eleven cards." Then poising the remainder you say, "here are fourteen cards."

173. *The Four inseparable Kings.*

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

174. *To change the Cards that several Persons have drawn from the Pack.*

ON the top of the pack put any card you please, suppose the queen of clubs; make *the pass*, and bring that card to the middle of the pack, and offer it to a person to draw. Then, by cutting the cards, bring the queen again to the middle of the pack. Make *the pass* a second time, and bring it to the top, and shuffle the cards without displacing those on the top. Make *the pass* a third time, and bring it to the middle of the pack, and offer it to a second person to draw, who must be at a proper distance from the first person, that he may not perceive it is the same card. After the like manner let five persons draw the same card.

Shuffle the pack without losing sight of the queen of

clubs, and laying down four other cards with the queen, ask each person if he sees his card there: they will all reply "yes," as they all drew the queen of clubs. Place four of those cards to the pack, and drawing the queen privately away, you approach the first person, and shewing him that card, so that the others cannot see it, ask if that be his card; then putting it on the top of the pack, blow on it, or give it a stroke with your hand, and shew it in the same manner to the second person, and so of the rest.

175. *The Card discovered under the Handkerchief.*

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

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

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

THIS trick is to be performed by *confederacy*. You previously agree with your confederate on certain signs, by which he is to denote *the suite*, and the particular card of each *suite;* as thus: if he touch the first button of his coat, it signifies an ace; if the second, a king, &c.

and then again, if he take out his handkerchief, it denotes the suite to be hearts; if he take snuff,—diamonds, &c. These preliminaries being settled, you give the pack to a person who is near your confederate, and tell him to separate any one card from the rest, while you are absent, and draw his finger once over it. He is then to return you the pack, and while you are shuffling the cards you carefully note the signals made by your confederate; then turning the cards over one by one, you directly fix on the card he touched.

177. *The Card in the Pocket Book.*

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

178. *The Card in the Egg.*

TAKE, a card, the same as your long card, and rolling it up very close, put it in an egg-shell, by making a hole as small as possible, and which you are to fill up carefully with white wax. You then offer the *long card* to be drawn, and when it is replaced in the pack you shuffle

the cards several times, giving the egg to the person who drew the card, and while he is breaking it, you privately withdraw the long card, that it may appear upon examining the cards, to have gone from the pack into the egg. This may be rendered more surprising by having several eggs, in each of which is placed a card of the same sort, and then giving the person the liberty to choose which egg he thinks fit.

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

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179. *A Card discovered by the Touch or Smell.*

You offer the *long card*, or any other that you know how to find, and as the person who has drawn it holds it in his hand, you pretend to feel the pips or figure on the under side with your fore finger; or you sagaciously smell to it, and then pronounce what card it is.

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

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180. *The Inverted Cards.*

Prepare a pack of cards, by cutting one end of them about one-tenth of an inch narrower than the other. Then having offered the pack to some one, that he may draw a

card, place the pack on the table, and observe carefully if he turn the card while he is looking at it; if he does not, when you take the pack from the table, offer the other end of it for him to insert that card; but if he turn tne card, then offer him the same end of the pack. You afterwards offer the cards to a second or third person, for them to draw and replace a card in the same manner: then let any one shuffle the cards, and taking them again into your own hand, as you turn them up one by one, you easily perceive by the touch which those cards are that have been inverted, and laying the first of them down on the table, you ask the person if that card be his. If he say *no*, you ask the same of the second person, and if he say *no*, you tell the third person it is his card; and so of the second and their cards. You should lay the pack on the table after each person has drawn his card, and turn it dexterously in taking it up, when it is to be turned, that the trick may not appear to depend on the cards being inverted.

181. *The Transmutable Cards.*

In a common pack of cards let the ace of hearts and nine of spades be something larger than the rest. With *juice of lemon* draw over the ace of hearts a spade, large enough to cover it entirely, and on each side draw four other spades.

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

person who put the card in it, take it off, and take out the card, which he will see is turned into the nine of spades.

182. *Several Different Cards being fixed on by different Persons, to name that on which each Person fixed.*

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

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

183. *To name the Rank of a Card that a Person has drawn from a Piquet Pack.*

THE rank of the card means whether it be an ace, king, queen, &c. You therefore first fix a certain number to each card; thus, call the king *four*, the queen *three*, the knave *two*, the ace *one*, and the others according to the numbers of their pips.

Then shuffle the cards, and let a person draw any one of them; then turning up the remaining cards, add the number of the first to that of the second, the second to the third, and so on, till it amount to ten; which you then reject, and begin again; or if it be more, reject the ten, and carry the remainder to the next card, and so on to the last. To the last amount add four, and subtract that sum from ten if it be less, or from twenty, if it be more than ten, and the remainder will be the number of the card that was drawn; as for example, if the remainder be two, the card drawn was a knave, if three a queen, and so on.

184. *The Ten Duplicates.*

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

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

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

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

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

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

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

and that every card be of a different suit, following each other in this order: spades, clubs, hearts, and diamonds.

Then the eight first cards will be the seven of spades, ace of clubs, eight of hearts, king of diamonds, nine of spades, queen of clubs, ten of hearts, and knave of diamonds, and so of the rest.

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

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

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

OPTICS,

Considered as a science, explains the nature of vision, by investigating the causes of the various phenomena that arise from the *refraction* and *reflection* of light ; upon one or the other whereof, or both combined, most of the *illusions* (for they are no other) in the following experiments depend. The *camera obscura* and *magic lantern*, inventions that may be considered modern, though popular notions have assigned them a distinct place, yet

equally depend upon the same laws of vision, but upon a more elaborate scale.

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186. *Optical Illusion:—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 seem empty, and the water appear to be at the top. (See Fig. 9).

If the bottle be suspended with the neck downwards, it will be *reflected* in its natural position, with 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 of three parts full, and that no other liquid is used but water, as in either of these cases, the illusion ceases.

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187. *Another Optical Illusion:—Refracted Motion.*

If you place yourself before a concave mirror, at a proper distance, your figure will appear inverted; and if you stretch out your hand towards the mirror, you will perceive another hand stretched out to join and meet it, though not perceptible to the touch. But if a sword be substituted for the hand, and your mirror is a

foot or more in diameter, another sword will appear, and seem to encounter with that in your hand. The larger the mirror is, the more perfect will be the illusion.

188. *The Solar Magic Lantern.*

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

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

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

189. *The Artificial Rainbow.*

1*st*, OPPOSITE a window facing the sun, suspend a glass globe, filled with clean water, by means of a string that runs over a pulley, so that the sun's rays may fall on it. Then, drawing the globe gradually up, you will

observe, when it comes to a certain height, (*i. e.* 40 degrees), by placing yourself in a proper situation, a purple colour in the glass ; and by drawing it up gradually higher, the other prismatic colours, blue, green, yellow, and red, will successively appear ; but after this, the colours will disappear, till the globe is raised to about fifty degrees, when they will again appear, but in an inverted order, the red appearing *first*, and the blue or violet *last*. On raising the globe a little higher, (*i. e.* above 54 degrees), they will totally vanish. These appearances serve to illustrate the phenomena of natural rainbows, of which there are generally two, the one being about eight degrees above the other, and the order of their colours are inverted, as in this experiment ; the red being the uppermost colour in the lower bow, and the violet in the other. 2*nd*, Take some water in your mouth, and turn your back to the sun ; then, if the water be blown forcibly out against some dark or shady place, you will see the drops formed by the beams of the sun, into an apparent rainbow, which, however, soon vanishes.

190. *To make Pictures of Birds with their natural Colours.*

First take thin board or pannel, of deal or wainscot, well seasoned that it may not shrink ; then paste white paper smoothly on it, and let it dry ; if the colour of the wood shew through, paste a second paper over it. When the paper is dry, get ready any bird that you would represent, and draw the outline as exact as you can on the papered pannel. You then paint the ground work, stump of a tree, the bill and legs, their proper colour, with water colours, leaving the body to be covered with its own natural feathers. In the space you have left for

the body, you lay on very thick gum water, letting each coat dry before you lay on another, and so continuing till the gum is as thick as a shilling. Then take the feathers off the bird; and, as you proceed, draw a camel's hair pencil, dipped in gum water, over the coat of gum that you have laid on the paper, that it may more readily adhere. As you strip the bird, you must fix the feathers in their proper places on the board, and you shave the shafts or stems of the larger feathers, that they may lay flat. The part where the eye is, must be supplied by a small piece of paper, coloured and shaped like one.

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191. *The Globular Fountain.*

MAKE a hollow globe, of copper or lead, and of a size adapted to the quantity of water that comes from a pipe (hereafter mentioned), to which it is to be placed, and which may be fastened to any kind of pump; provided it is so constructed, that the water shall have no other means of escape than through the pipe. Pierce a number of small holes through the globe, that all tend towards its centre, and annex it to the pipe that communicates with the pump.

The water that comes from the pump, rushing with violence into the globe, will be forced out at the holes, and form a very pleasing sphere of water.

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192. *The Hydraulic Dancer.*

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

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

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

193. *Curious Hydraulic Experiment, called the Magical Bottle.*

TAKE a small bottle, the neck whereof is not more than the sixth of an inch in diameter. By means of a funnel fill the bottle quite full of red wine corked, and place it in a glass vessel similar to a *show-glass*, whose height exceeds that of the bottle two inches, and fill the outer glass with water. Then if the wine be uncorked, it will rise up in the form of a small column, as high as the surface of the water, while the water entering the bottle, will supply the place of the wine. The natural reason for this phenomenon is that water being specifically heavier than wine, it must consequently subside to the lowest place of the two, and the wine rises to the top.

An effect nearly similar may be produced by filling the bottle with water, and the vessel with wine; when having placed the bottle in the vessel in an inverted position, the water will descend out of its neck to the bottom of the vessel, and the wine rise into the bottle. Any other two liquors, whose specific gravities differ in as great a degree, will undergo the like change of situation.

194. *Hydraulic Experiment, called the Miraculous Vessel.*

PROVIDE a tin vessel five or six inches in height, and two or three in diameter, having a mouth of only a quarter of an inch wide; and in the bottom of the vessel make a number of small holes, of a size sufficient to admit a common sewing needle

Plunge the vessel in water, with its mouth open, and when full, cork it while in the water, and take it out again. Then, as long as the vessel remains corked, no water will come out of it; but as soon as it is uncorked, the water will immediately issue from the small holes at the bottom.

It must be observed, however, that if the holes at the bottom of the vessel be more than one-sixth of an inch in diameter, or if they be too numerous, the experiment will not succeed; for, in this case, the pressure of the air against the bottom of the vessel will not be sufficient to confine the water.

A recreation similar to this, is made with a wide-mouthed glass, filled with water, over which a piece of paper is placed; for if the glass be then inverted, and the paper drawn dexterously away, the water, by the pressure of the air under it, will remain in the glass.

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195. *Hydraulic Experiment, called Tantalus's Cup.*

TAKE a glass, or any other vessel, A B C D, Fig. 10, which has a small bent pipe, E F G, open at each end, running through the middle of it. Then, if water, or wine, be poured into the glass, it will continue in it till the tube is full up to the bend F, which should be a little

lower than the upper edge of the glass; but if, after this, you continue to pour more liquor into it, it will endeavour, as usual, to rise higher in the glass, but not finding room for a farther ascent in the tube, it will descend through the part E G, and run out at the end G, as long as you continue to put it in. To those who are unacquainted with the nature of the *syphon*, the effect may perhaps appear more extraordinary, if the longest branch of the tube be concealed in the handle of the cup.

This is called 'The Cup of Tantalus,' from its resemblance to an experiment of the same kind, which is sometimes made, by placing an upright image in the cup, and disposing of the syphon in such a manner, that, as soon as the water rises to the chin of the image, it will begin to run out through the longest leg, in the same manner as from the cup above-mentioned.

196. *A curious Chemical Experiment, called the Tree of Diana.*

TAKE half an ounce of fine silver, either in filings or cut into small pieces, and dissolve them, with two drams of mercury, in three or four ounces of *aqua-fortis*. When the solution is perfect, pour it into a pint of common water, after stirring it about, that the whole may mix together, and keep the preparation in a bottle well corked.

Put a quantity of the size of a pea, of the amalgam of silver and mercury, into a small phial, and pour an ounce of the above liquor over it. Then, from this little globular amalgam, there will presently rise small branches, which, by increasing, will form a kind of shrub, or bushy tree, of a silver colour.

Another way of producing the same effect is, by dissolving an ounce of fine silver in three ounces of strong

aqua-fortis, in a glass or earthen vessel, and when the silver is quite dissolved, pour the *aqua-fortis* into another glass vessel, with seven or eight ounces of mercury, and a quart of common water, and to the whole add your dissolved silver.

Then, if the vessel remain untouched, the mercury, in a few days, will appear to be covered with a multitude of little branches, resembling slender shrubs, and of a silver colour; and this appearance will remain after the mercury is entirely dissolved.

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197. *A remarkable Experiment, called Prince Rupert's Drop.*

With a tube take up a small quantity of the melted glass, and let a drop of it fall into a vessel of water, by which it will retain its form, and appear solid throughout, except that it contains a few air bubbles. This drop will have a small tail, which being broken, the whole substance of the drop will burst with great violence, into a fine powder, and give a little pain to the hand, but do no hurt to it.

It is a remarkable circumstance in this experiment, that the bulb, or body, will bear the stroke of a hammer, without breaking; but when the tail is broken, the above-mentioned effect is produced. If the drop be cooled in the air, the same effect will not take place; and if it be ground away on a stone, nothing extraordinary appears; but if it be put into the receiver of an air-pump, and then broken, the effect will be so violent as to produce light.

This phenomenon is supposed to be produced from the particles of the glass being in a state of repulsion when melted, but by being dropt into cold water, the external particles are condensed, and hold the internal ones, which are still in a state of repulsion, as it were in a case; but

when an opening is made in this case, by breaking off the tail, the confined particles rush forth, and burst the drop with great violence.

198. *Pyrotechnical Experiment, with Liquid Phosphorus.*

TAKE a piece of common phosphorus, of about the size of a pea, and cutting it very small, put it into a glass of clear water, and boil it in a little earthen vessel over a moderate fire. Then take a phial with a narrow neck, and having plunged it into boiling water, take it out again, and put the boiling mixture immediately into it, stopping the phial instantly with a glass stopper, and covering it with a cement, that the air may in no degree enter.

Then, if this mixture be put in a dark room, it will shine for several months, though the phial be not touched; but if it be shook, especially in warm dry weather, very strong corruscations, like lightning, will dart from the middle of the water; and if the phial be sufficiently long, or broad, and a piece of paper be pasted over it, any letters or figures which may be written on it, will appear strongly illuminated.

Note. If any letters or figures be drawn with it on a white wall, in a dark room, they will likewise appear luminous.

199. *Another Pyrotechnical Experiment, by Means of Fulminating Gold.*

PLACE a small *mattrass* in a sand heat, and put into it one part of filings of pure gold, and three parts of *aqua*

regia; and when the liquor has completely dissolved the gold, put the mixture in a phial, and add to it five or six times as much common water.

This being done, take spirit of sal ammoniac, or tartar, and pour it, drop by drop, into the solution, till the ebullition ceases; then let the mixture rest till the gold be precipitated to the bottom of the phial; and when this is done, pour the water, that swims at the top, gently off. After washing the gold dust, several times, in common water, put it on a piece of clean paper, and dry it, with a moderate heat, till the moisture be all absorbed.

Then, if a grain of this powder be put into a copper spoon, over the flame of a candle, as soon as it is well heated, it will go off with a loud report, like a pistol; but if the spoon be not sufficiently strong, the mixture will run through it, and make an explosion underneath, with great violence.

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200. *Experiments made by M. Symmer, on the Electricity of Silk Stockings.*

This gentleman relates, that having frequently observed, on putting off his stockings in the evening they made a crackling or snapping noise, and that in the dark they emitted sparks of fire, was induced to ascertain on what circumstances these electrical appearances depended. After a considerable number of observations, directed to this point, he found that it was *the combination* of *white* and *black* which produced the electricity, and that the appearances were the strongest when he wore a white and black stocking upon the same leg.

These, however, evinced no signs of electricity while they were upon the leg, though they were drawn backwards and forwards upon it several times; but the mo-

ment they were separated, they were both of them found to be highly electrified, the white positively, and the black negatively : and when they were held at a distance from each other, they appeared inflated to such a degree, that they exhibited the entire shape of the leg.

When two black or two white stockings were held together, they would repel one another to a considerable distance ; but when a white and black stocking were presented to each other, they would be mutually attracted, and rush together with great violence, joining as close as if they had been so many folds of silk ; and in this case their electricity did not seem to have been in the least impaired by the shock of meeting, for they would be again inflated, attract, repel, and rush together as before.

When this experiment was performed with two black stockings in one hand, and two white ones in the other, it exhibited a still more curious spectacle. The repulsion of those of the *same colour*, and the attraction of those of *different* colours, threw them into an agitation, and made each of them catch at the opposite colour in a way that was most entertaining.

What was also very remarkable in these experiments, was the power of electrical cohesion which they exhibited. M. Symmer having found that, when they were electrified, and allowed to come together, they frequently stuck so close to each other, that it required a weight of sixteen or seventeen ounces to separate them, and this in a direction parallel to their surfaces.

When one of the stockings was turned inside out, it required twenty ounces to separate them; and by having the black stockings new dyed, and the white ones washed and whitened in the fumes of sulphur, and then putting them one within the other, it required three pounds three ounces to separate them.

Trying this experiment with stockings of a more substantial make, he found that, when the white stocking was put within the black one, so that its outside was contiguous to the inside of the other, they raised near nine pounds; and when the white stocking was turned inside out, and put within the black one, so that their rough surfaces were contiguous, they raised fifteen pounds, which was ninety-two times the weight of the stockings. And in all these cases, he found that pressing them together with his hands, contributed much to strengthen the cohesion.

When the white and black stockings were in a state of cohesion, and another pair, more highly electrified, were separated from each other, and presented to the former, their cohesion would be dissolved, and each stocking of the second pair would catch hold of and carry away with it that of its opposite colour; but if the degree of electricity of both pairs were equal, the cohesion of the former would be weakened, but not dissolved, and all the four would cohere together in one mass.

M. Symmer also observed, that white and black silk, when electrified, not only cohered with each other, but would also adhere to bodies with broad, and even polished surfaces, though those bodies were not electrified. This he discovered, by throwing accidentally a stocking out of his hand, which stuck to the paper-hangings of the room, and continued hanging there nearly an hour.

Having stuck up the black and white stockings in this manner, he came with another pair of stockings, highly electrified, and applying the white to the black, and the black to the white, he carried them off from the wall, each of them hanging to that which had been brought to it. The same experiment also held with the painted boards of the room, and likewise with the looking-glass, to the smooth surface of which, the white and black stockings

appeared to adhere more tenaciously than to either of the former.

201. *Iron transformed into Silver.*

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

It is hardly necessary to say, that these transmutations are only *apparent*, though to the credulous it would seem that they were actually transformed. They are also extremely evanescent, passing away in a few hours.

202. *Chemical Illuminations.*

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

203. *The Philosophical Candle.*

Provide a bladder, into the orifice of which is inserted a metal tube, some inches in length, that can be adapted to the neck of a bottle, containing the same mixture as in the last experiment. Having suffered the atmospheric air to escape from the bottle, by the action

of the elastic vapour produced by the solution, apply the orifice of the bladder to the mouth of the bottle, after carefully squeezing the common air out of it, (which you must not fail to do or the bladder will violently explode.) The bladder will thus become filled with the inflammable air, which when forced out against the flame of a candle, by pressing the sides of the bladder, will form a beautiful green flame.

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

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

205. *To melt Iron in a moment, and cause it run into drops.*

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

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

206. *Never-yielding Cement.*

POUND calcined oyster-shells, sift the powder through a silk sieve, and grind it on porphyry, till reduced to the finest powder. Then take the whites of several eggs, according to the quantity of the powder; beat them well, and having mixed them with the powder, form the whole into a kind of paste. With this paste, join the pieces of china, or glass, and press them together for seven or eight minutes. This cement will stand both heat and water, and will never give way, even if the article should, by accident, fall to the ground.

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207. *So to fill a Glass with Water, that it cannot be removed without spilling the whole.*

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

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

MAKE two figures, of any shape or materials you please. Insert in the mouth of one a small tube at the end of which is a piece of phoshporus, and in the mouth

of the other a tube containing at the end a few grains of gunpowder; taking care that each be retained in the tube by a piece of paper. If the second figure be applied to the flame of a taper, it will extinguish it; and the first will light it again.

209. *A Powder which catches Fire when exposed to the Air.*

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

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

210. *Fulminating Gold.*

Put into a small long necked bottle, resting on a little sand, one part of fine gold filings and three parts of aqua

regia, (nitro-muriatic acid.) When the gold is dissolved, pour the solution into a glass, and add five or six times the quantity of water. Then take spirit of sal ammoniac, or oil of tartar, and pour it drop by drop into the solution, until the gold is entirely precipitated to the bottom of the glass. Decant the liquor that swims at the top, by inclining the glass; and having washed it several times in warm water, dry it at a moderate heat, placing it on paper capable of absorbing all the moisture.

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

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211. *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.

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212. *A Liquor that shines in the Dark.*

TAKE a bit of phosphorus, about the size of a pea; break it into small parts, which you are to put into half a glass full of very pure water, and boil it in a small earthen vessel, over a very moderate fire. Have in readi-

ness a long narrow bottle, with a well fitted glass stopper, and immerse it, with its mouth open, into boiling water. On taking it out, empty the water, and immediately pour in the mixture in a boiling state; then put in the stopper, and cover it with mastich, to prevent the entrance of the external air.

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

213. *Luminous Liquor.*

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

214. *Golden Ink.*

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

215. *Another way.*

Reduce gum ammoniac into powder, and dissolve it in gum arabic water, to which a little garlic juice has been added. This water will not dissolve the ammoniac so as to form a transparent liquid; for the result will be a milky liquor. With this liquor form your letters or ornaments on paper or vellum, with a pen or fine camel's hair brush; then let them dry, and afterwards breathe on them some time, till they become moist; then apply a few bits of leaf-gold to the letters, which is to be pressed down gently with cotton-wool. When the whole is dry, brush off the superfluous gold with a large camel's hair brush, and to make it brilliant, burnish with a dog's tooth.

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216. *Retentive nature of the Visual Organs.*

1. When we look attentively at a well-marked object, in *bright weather*, the impression thereof is left upon the sight after the lids are closed, as perfectly, as if they were still open. If you then read intensely till your eyelids fall, the letter still seems before your sight; but an experiment suggested upon a larger scale, is that of looking at a window-frame, and having shut your eyes, the figure of the window, and even the number of the panes, will still remain. But it is worthy of remark, that the panes assume a dark appearance, whilst the frame-work seems white and bright; this phenomenon must arise from the semi-transparency of the eye-lids; for, when the hand, or any substance, is placed between the object and the eyes, this illusion vanishes, but, remove the substance, and it returns again.

2. If the object be globular, small moving subjects, conjured up by the fancy, (if they do not arise from

specks in the *optic lens*, or probably, the circulation of the blood in the eye-lid, where the vessels are finer than any hair of the head), may be seen to move in the centre of the glass, provided a liquid be in the glass—which we will suppose to be a goblet. A deception of this kind, is that which deluded the once celebrated Joanna Southcott, (as described by herself,) to imagine something *miraculous* in the affair; for it is not too much to believe, that she herself was as sincere as she was certainly credulous, and ignorant of natural effects.

3. After looking through *green* spectacles, the white paper of a book will, on first taking them off, appear as if it had a blush of red; and after looking at the same paper through *red* glasses, it assumes a greenish hue. This opposition of colours, is only *comparative*, red being connected with *heat*, and green conveying the idea of *coolness*.

4. Of the same nature is the phenomenon noticed by the Count de Buffon, of a *border* or *accidental* colour, showing itself round another wholly different, thus—if a *red* square spot be looked at intensely, a cool *greenish* border surrounds it; but upon taking away the eye, the *square* will assume an imaginary green, while the border will seem blue. In this series of experiments, as in the preceding, red and green change places; it is to be supposed, from the same cause.

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217. *Fulminating Mercury.*

Dissolve 100 grains of mercury by heat, in an ounce and a half of nitrous acid. This solution being poured cold upon two measured ounces of alcohol, previously introduced into any convenient glass vessel, a moderate heat is to be applied, till effervescence is excited. A white fume then begins to appear on the surface of the

liquor, and the powder will be gradually precipitated when the action ceases. The precipitate is to be immediately collected on a filtre, well washed with distilled water, and cautiously dried in a heat not exceeding that of a water bath. Washing the powder immediately is material, because it is liable to the re-action of the nitrous acid ; and while any of the acid adheres to it, it is very subject to the action of light. From 100 grains of mercury, about 130 of the powder are obtained.

This powder, when struck on an anvil with a hammer, explodes with a sharp stunning noise, and with such force as to indent both hammer and anvil. Three or four grains are sufficient for one experiment.

218. *The two 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 eighten inches square : and all the space between them must be enclosed with pasteboard painted black, and well closed, that no light may enter ; let there be also

* If a person, after placing himself close to a wall, elevates his stick straight up, and makes a sweep with it, thence to the ground, he will have described 90 degrees ; of course 45 degrees is one-half way from the ground.

two curtains to cover them, which you may draw aside at pleasure.

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

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

219. *To cause a brilliant Explosion under Water.*

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

220. *The Iron Tree.*

Dissolve iron filings in *aqua-fortis*, moderately concentrated, till the acid is saturated; then add to it, gradually, a solution of fixed alkali, (commonly called oil of tartar *per deliquum.)* A strong effervescence will ensue, and the iron, instead of falling to the bottom of the vessel, will afterwards rise so as to cover the sides, forming a multitude of ramifications heaped one upon the other, which will sometimes pass over the edge of the vessel, and extend themselves on the outside, with all the appearance of a plant.

221. *The Magic Mirror.*

TAKE a square box, about six inches long and twelve high, or of any other proportionate dimensions. Cover the inside with four flat pieces of looking-glass, placed perpendicular to the bottom of the box. Place at the bottom any objects you please, as a piece of fortification, a castle, tents, soldiers, &c. On the top place a frame of glass shaped like the bottom of a pyramid, and so formed as to fit on the box like a cover, (see Fig. 11.) The four sides of this cover are to be composed of ground glass or covered inside with gauze, so that the light may enter, and yet the inside be invisible, except at the top, which must be covered with transparent glass ; when you look through this glass, the inside will present a pleasing prospect of boundless extent ; and if managed with care, will afford a good deal of amusement.

222. *To set Fire to a combustible Body by Reflection.*

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

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

223. *The Silver Tree.*

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

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

224. *Lead Tree.*

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

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

225. *Fire Works in Miniature.*

Put half a drachm of solid phosphorus into a large pint Florence flask; holding it slanting, that the phosphorus may not break the glass. Pour upon it a gill and a half of water, and place the whole over a tea-kettle lamp, or

any common tin lamp, filled with spirit of wine. Light the wick, which should be almost half an inch from the flask; and as soon as the water is heated, streams of fire will issue from the water by starts, resembling sky-rockets; some particles will adhere to the sides of the glass, representing stars; and will frequently display brilliant rays. These appearances will continue at times till the water begins to simmer, when immediately a curious aurora borealis begins, and gradually ascends, till it collects to a pointed flame; when it has continued half a minute, blow out the flame of the lamp, and the point that was formed will rush down; forming beautiful illuminated clouds of fire, rolling over each other for some time, which, disappearing, a splendid hemisphere of stars presents itself: after waiting a minute or two, light the lamp again, and nearly the same phenomena will be displayed as from the beginning. Let a repetition of lighting and blowing out the lamp be made for three or four times at least, that the stars may be increased. After the third or fourth time of blowing out the lamp, in a few minutes after the internal surface of the flask is dry, many of the stars will shoot with great splendour from side to side, and some of them will fire off with brilliant rays; these appearances will continue several minutes. What remains in the flask will serve for the same experiment several times, and without adding any more water. Care should be taken, after the operation is over, to lay the flask and water in a cool secure place.

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226. *Illuminated Writing.*

It is well known that if any words are written on a wall with solid phosphorus, the writing will appear as if

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

227. *The Mysterious Writing.*

WRITE on a piece of paper with common ink any question; then underneath it write the answer either in invisible silver ink, or the invisible green ink, made with zaffre and aqua ragia, described in pages 90 and 91.

Give this paper to your friend, and tell him to place it against the wall, or on his dressing table, keeping the door locked, that he may be sure no person has entered his room: he will next day find the answer written on it.

228. *White Ink for writing on Black Paper.*

HAVING carefully washed some egg-shells, remove the internal skin, and grind them on a piece of porphyry. Then put the powder into a small vessel of pure water, and when it has settled at the bottom, draw off the water, and dry the powder in the sun. This powder must be preserved in a bottle; when you want to use it, put a small quantity of gum ammoniac into distilled vinegar, and leave it to dissolve during the night. Next morning the solution will appear exceedingly white; and if you then strain it through a piece of linen cloth, and add to

it the powder of egg-shells, in sufficient quantity, you will obtain a very white ink.

229. *To construct Paper Balloons.*

TAKE several sheets of tissue paper; cut them in the shape of a spindle; or, to speak more familiarly, like the coverings of the sections of an orange; join these pieces together, and they will form one spherical or globular body. Border the aperture with a ribbon, leaving the ends, that you may suspend them.

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

230. *Water-Gilding upon Silver.*

TAKE copper-flakes, on which pour strong vinegar: add alum and salt in equal quantities; set them on a fire, and when the vinegar is boiled till it becomes one-fourth part of its original quantity, throw into it the metal you design to gild, and it will assume a copper colour. Continue boiling it, and it will change into a fine gold colour.

231. *A Water, which gives Silver a Gold Colour.*

TAKE sulphur and nitre, of each an equal quantity; grind them together very fine, and put them into an

unglazed vessel; cover and lute it well; then set it over a slow fire for twenty-four hours, put what remains into a strong crucible, and let it dissolve; put it into a phial, and whatever silver you anoint with it, will have a gold colour.

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232. *To make an old Gold Chain appear like new.*

Dissolve sal ammoniac in urine, boil the chain in it, and it will have a fine gold colour.

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233. *To give Silver the Colour of Gold.*

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

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234. *A Water, to give any Metal a Gold Colour.*

Take fine sulphur and pulverize it; then boil some stale spring water; pour it hot upon the powder, and stir it well together; boil it, and pour into it an ounce of dragon's blood. After it is well boiled, take it off, and filter it through a fine cloth; pour this water into a mattrass (a chemical vessel), after you have put in what you design to colour; close it well, and boil it, and the metal will be a fine gold colour

235. *Another way.*

TAKE hepatic aloes, nitre and Roman vitriol, of each equal quantities; and distil them with water, in an alembic, till all the spirits are extracted; it will at last yield a yellowish water, which will tinge any sort of metal of a gold colour.

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236. *To give Silver-Plate a Lustre.*

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

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237. *The Fiery Fountain.*

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

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238. *To take Impressions of Coins, Medals, &c.*

CUT fish-glue or isinglass, into small pieces, immerse it in clear water, and set it on a slow fire; when gradually dissolved, let it boil slowly, stirring it with a wooden spoon, and taking off the scum. When the liquor is found to be sufficiently adhesive, take it off the

fire, let it cool a little, and then pour it on the medal or coin you wish to copy, having first rubbed the coin over with oil. Let the composition lie about the thickness of a crown-piece on the medal. Then set it in a moderate air, neither too hot nor too cold, to let it cool and dry. When dry, it will loosen itself; you will find the impression correct, and the finest strokes expressed with the greatest accuracy.

You may give a more pleasing effect to the composition, by mixing any colour with it, red, yellow, blue, green, &c. and if you add a little parchment size to it, it will make it harder and better. This size is made by gently simmering the cuttings of clear white parchment in a pipkin, with a little water, till it becomes adhesive.

239. *A Lamp that will burn Twelve Months without replenishing.*

Take a stick of phosphorus, and put it into a large dry phial, not corked, and it will afford a light sufficient to discern any object in a room when held near it. The phials should be kept in a cool place, where there is no great current of air, and it will continue its luminous appearance for more than twelve months.

240. *Curious Transcolourations.*

Put half a table spoonful of syrup of violets, and three table-spoonfuls of water into a glass; stir them well together with a stick, and put half the mixture into another glass. If you add a few drops of acid of vitriol into one of the glasses and stir it, it will be changed into a crimson; put a few drops of fixed alkali dissolved into the other glass, and when you stir it, it will change to green.

If you drop slowly into the green liquor, from the side of the glass, a few drops of acid of vitriol, you will perceive crimson at the bottom, purple in the middle, and green at the top; and by adding a little fixed alkali dissolved to the other glass, the same colours will appear in different order.

241. *Another.*

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

242. *Another.*

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

243. *The Lamp Chronometer.*

Refer to (Fig. 12.) It represents a chamber-lamp, A, consisting of a cylindrical vessel made of tin, in the shape of a candle, and is to be filled with oil. This vessel should be about three inches high and one inch diameter, placed in a stand, B. The whole apparatus, of lamp and stand, can be purchased ready made, at any tin-shop in London. To the stand B, is fixed the handle C, which

supports the frame D, about 12 inches high, and four inches wide. This frame is to be covered with oiled paper, and divided into 12 equal parts by horizontal lines, at the end of which are written the numbers for the hours, from 1 to 12, and between the horizontal lines and diagonals, divided into halves, quarters, &c. On the handle C, and close to the glass, is fixed the style or hand, E.

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

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

244. *The Water Sun.*

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

245. *The Magical Cascade.*

PROCURE a tin vessel, shaped like (FIG. 13.) about five inches high, and four in diameter, with a cover C closed at top. To the bottom of this vessel, let the pipe D E be soldered. This pipe is to be ten inches long, and half an inch in diameter, open at each end, and the upper end must be above the water in the vessel. To the bottom also fix five or six small tubes, F, about one-eighth of an inch in diameter. By these pipes, the water in the vessel is to run slowly out.

Place this machine in a tin basin, GH, with a hole in the middle, about a quarter of an inch in diameter. Fix to the tube, DE, any sort of ornament that will keep the machine firm on the basin; taking care that these supports be sufficiently long to leave about a quarter of an inch between the end of the tube and the orifice in the basin; and let there be a vessel under the basin to catch the water that runs out.

As the small pipes discharge more water into the basin than can run out of the central orifice, the water will rise in the basin above the lower end of the pipe, and prevent the air from getting into the vessel, by which means the water will cease to flow from the small pipes. But, as the water continues to flow from the basin, the air will have liberty again to enter the vessel by the tube; and the water will again flow from the small pipes, and alternately stop and flow, while any water remains in the vessel.

As you can guess when the pipes will flow, and when they will stop; you may so manage it, that they will appear to act by word of command.

246. *The illuminated Fountain, that plays when the Candles are lighted, and stops when they are extinguished.*

PROVIDE two cylindrical vessels, AB and CD, (see FIG. 14.) Connect them by four tubes open at each end, as HI, &c. so that the air may descend out of the higher into the lower vessel. To these tubes fix candlesticks, and to the hollow cover, EF, of the lower vessel, fit a tube, K, reaching almost to the bottom of the vessel. At G let there be an aperture with a screw, whereby water may be poured into CD, which, when filled, must be closed by the screw.

When the candles are lighted, the air in the upper cover and contiguous pipes will be thereby rarified, and the jet from the small tube, K, will begin to play: as the air becomes more rarified, the force of the jet will increase, and it will continue to play till the water in the lower vessel is exhausted. As the motion of the jet is caused by the heat of the candles, when they are extinguished, the fountain will stop.

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247. *A Fountain which acts by the Heat of the Sun.*

GNS is a thin hollow globe of copper, (see FIG. 15.) eighteen inches diameter, supported by a small inverted basin, placed on a stand with four legs, ABCD, which have between them, at the bottom, a basin of two feet diameter. Through the leg C passes a concealed pipe, which comes from G, the bottom of the inside of the globe. This pipe goes by HV, and joins the upright pipe

u I, to make a jet as I. The short pipe, *u* I, which goes to the bottom, has a valve at *u*, under the horizontal pipe HV, and another valve at V, above that horizontal pipe, under the cock at K. The use of this cock is to keep the fountain from playing in the day, if you think proper. The north pole N, of the globe has a screw that opens a hole, whereby water is poured into the globe.

The machine being thus prepared, and the globe half filled with water, put it in an open place, when the heat of the sun, rarifying the air as it heats the copper, the air will press strongly against the water, which coming down the pipe, will lift up the valve at V, and shut the valve at *u*. The cock being opened, the water will spout out at I, and continue to play a long while, if the sun shine.

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248. *Inflammable Phosphorus.*

TAKE the meal or flower of any vegetable, put it into an iron pan over a moderate fire, and keep it stirring with an iron spoon till it changes to a black powder; to one part of this add four parts of raw alum. Make the whole into a fine powder, put it again into the iron pan, and keep stirring it till it almost catches fire, to prevent its forming into lumps, as it is apt to do when the alum melts, in which case it must be broke again, stirred about, and accurately mixed with the flower, till it emit no more fumes, and the whole appears a fine dry black powder.

Put this powder in a clean dry phial with a narrow neck, filling it to about one-third of the top. Then stop the mouth of the phial with loose paper, so as to let the air pass freely through it, and leave room for fumes to come through the neck. Place the phial in a crucible,

encompassed on all sides with sand, so that it may not touch any part of the crucible, but a considerable space every where left between. The phial must be covered up with sand, leaving only a small part bare, by which you can discern whether the powder is ignited. In this state, the crucible is to be surrounded with coals, kindled slowly till it is well heated on all sides, and then the fire is to be raised, till the crucible and every thing in it is red hot; keep it in this state an hour; after this, the fire still burning as fiercely, close up to the orifice of the phial with wax, to exclude the air. Leave it to cool, and you will find in it a black dusty coal formed of the flour and alum.

Shake a small quantity of this out of the phial into the cool air, and it will immediately take fire, but will not burn any thing. Keep the bottle dry, as even the air will spoil it effectually.

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249. *Magic Lantern.*

Of all the deceptions and tricks, the experiments and devices, we have taken the pleasure of putting in practice and of recording here, none ever excited more surprise and actual wonder, at a first exhibition, than did the magic lantern, the invention of a German, (P. Kircher.) The manufacture of the instrument itself still remains chiefly in the hands of his countrymen, or their pupils; and they are now to be purchased of every instrument shop-keeper, at very moderate prices, agreeable to the manner of *getting up*, (being from one guinea to five pounds and upwards.) But we are not thence to be deterred from observing, that the principles on which its operation is founded, rests upon the simplest laws of optics. M. Guyot a Frenchman, and our countryman Dr. Hooper, fifty years ago, took great pains to instruct

their readers on the construction of this pleasing instrument of domestic entertainment, and the improvements made thereon; yet, notwithstanding the publicity of their works, so little was it practised among us long after the period indicated, that the attention of our wonder-hunting metropolis was frequently called to exhibitions of the effects produced by various modifications of the common magic lantern of its first inventor. Nor did the ingenuity of these wonder-working foreigners, who so catered to our whim, ascend so high in the scale, as to show us the effects to be produced by the nebulous (or smoke-lighted), or the ogre (or smoke-refracted) lantern; and it remained for a M. de Philipsthal and Mr. Bartley, a comedian, in the year 1801, to represent the recently deceased great characters in the drama of Europe, to crowded audiences at the Strand Theatre, by commixing in the same representation the two latter kinds of contrivance.

Every one may see, at the first glance, that the original lantern was constructed upon the principle of concentering the focus of the metal *mirror* at its back, and that of *glass* in front, (next the opening), in the *lamp or light*, in the middle, whereby any object applied farther in front of the latter, will be thrown out to a considerable distance, and much increased in dimension. Darkness in the theatre, is essential to the exhibition of *the scene*, which alone occupies the area of light issuing from the lantern: these scenes are painted or coloured on the glass, and come off, when well managed and *played* appropriately, in an astonishingly natural manner. Thus, clouds should *descend* from *above*, the sea *ascend*, from the lower part of the opening; moving scenes, as men, horses, &c. enter *gently agitated*; a storm should be *tossed about*. Those *subjects*, and a thousand others, may be bought ready made; but occasions may arise, or may be

necessary for your recreation, to render it desirable that you should know how to paint particular subjects. Instructions to this end will follow the present article.

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250. *Construction of the Ogre (or smoke refracted) Magic Lantern.*

In a box, sufficiently large to contain a dressing-glass, place a small magic lantern. (See Fig. 16.) The glass *f* to be placed in a sloping position opposite the *sight-glass* of the lantern, whereby the rays thrown upon it by this latter will be refracted through an oval aperture made in the sloping lid of the box, of the exact size of the cone of light so refracted. There should be a flap with hinges, to cover the opening, that the inside of the box may not be seen.

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

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

When you have lighted the lamp in the lantern, and placed the mirror in a proper direction, put the box on a table, and setting the chaffing-dish in it, throw some

incense in powder on the coals. You then open the trap door, and let down the glass in the groove slowly, and when you perceive the smoke diminish, draw up the glass that the figure may disappear, and shut the trap door.

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

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251. *Of Painting the Glasses.*

First draw on paper, the size of the glass, the subject you mean to paint on it; fasten this at each end of the glass with paste, or any other cement, to prevent it from slipping. Then with some very black paint mixed with varnish, draw with a fine camel's hair pencil, very lightly, the outlines sketched on the paper, which, of course, are reflected through the glass. Some persons affirm that these outlines can be more readily traced with japan writing ink, and a common pen with a fine nib; but this, even if it succeeds in making a delicate black outline, is likely to be effaced by damp or wet.

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

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

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252. *A Storm at Sea, on Glass, for the Magic Lantern.*

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

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

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

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

253. *The Boundless Prospect.*

PROCURE a box (see Fig. 17.) of about a foot long, eight inches wide, and six inches high ; or any other dimensions you please, so as they do not greatly vary from these proportions. At each of its opposite ends, *inside*, fit thereto, a piece of looking-glass ; but at that end where the sight-hole A is, scrape the quicksilver off the glass, through which the eye can view the objects.

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

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

When viewed through the sight-hole, it will present an unlimited prospect of rural scenery, gradually losing itself in the distance, and be found well worth the pains bestowed on its construction.

254. *The art of Drawing a Landscape or other object, without an acquaintance with the Laws of Perspective, or the aid of the Camera Obscura.*

MAKE a pasteboard box, ABCD, (see Fig. 18.) about a foot and a half long, and made in the shape of a truncated pyramid, whose base B, D, F, G is eight inches wide, and six inches high. Fix to the other end of it a tube of four or five inches long, and which you can draw out from the box, more or less. Line the inside of the box with *black paper*, and place it upon a leg or stand of wood, H, and on which it may be elevated or depressed by the hinge, I.

Take a small frame of wood, and divide it at every inch by lines of black silk drawn across it, forming forty-eight equal parts; divide these into still smaller equal parts, by lines of finer silk*: Fix this frame at the end of BD, as the base of the pyramid.

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

Place this instrument opposite a landscape, or any other object you want to draw, and fix its leg firmly on, or in the ground, that it may not shake: then, turning it to the side you choose, raise or incline it, and put the tube further in or out, till you have obtained a desirable view of the object intended to be drawn.

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* The different thicknesses of the silk serve to distinguish more readily the corresponding divisions.

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

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

255. *Illuminated Prospects.*

PROVIDE yourself with some of those prints that are commonly used in optical machines, printed on very thin white paper; taking care to make choice of such as have the greatest effect from the manner in which the objects are placed in perspective. Paste one of these on the borders of a frame, and paint it carefully with the most lively colours, making use of none that are terrestial. Carefully retouch those parts several times where the engraving is strongest,* then cut off the upper part or sky, and fix that on another frame.

The prints being thus prepared, place them in a box, ABCD, (Figs. 19. and 20.) the opening to which, EFGH, should be a little less than the print. Cover this opening with a glass and paint all the space between that and the

* *Both sides* of the print may be coloured with increased effect, and it should be placed against a pane of glass, in a position nearly erect, so that the light (of the *sun*) may pass through it.

prints, which should be about two or three inches, black. The frame that contains the sky should be about an inch behind the other. In the back part of this box, which is behind the prints, and which may be about four inches deep, place four or five small candlesticks to hold wax lights, and cover that part entirely with tin, that it may be the more luminous.

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

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

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

256. *Experiment with a Viper.*

NATURAL philosophers, in their eagerness to display the powers of science, are said to have overlooked one of the first duties of life, humanity; and, with this view, torture and kill many harmless animals, to exemplify the amazing effects of the air-pump. We, however, will not stain our pages by recommending such cruelties, which

in many instances merely gratify curiosity; but, as our readers may like to read the effect produced by the operation of the air-pump on reptiles, we extract from the works of the learned Boyle, an account of his experiment on a viper.

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

It is thus with *animals* of every kind; even the most minute insects cannot live without air.

ELECTRICITY,

Is defined to be, the power of attraction bodies have for each other, *naturally*, or that may be induced upon them by friction or heat; whereby it shows itself in a luminous effluvium, with a snapping noise, and a faint

phosphoric smell. In a former page, (134.) we gave an account of the natural electricity, observable in stockings, copied from the communications of M. Symmer. Some bodies, however, resist the effects of electricity, and are therefore termed *non-conductors*, *Wax*, for instance, which is consequently employed upon occasions when the electric shock is to be stayed, or, as it is termed, *insulated*. When glass, or any other *non-conductor* body, is excited or *charged* with electric matter, this may be discharged at intervals, each discharge (or shock) being less and less ; but *conductor* bodies—as metal, charcoal, water—upon being touched, discharge their electric matter all at once. There is a proneness of the electric matter towards the earth ; it constantly resides in the air, and may be brought down from the upper regions by means of an *iron rod*, erected on the top of a building, but brought down and terminating in a pit, or in water. A *kite*, made of silk, and furnished with wire, will perform the same office, but much precaution is necessary and even then, danger is to be apprehended from the *lightning* hitting the person who holds the string. Jars, however, may safely be *charged* with electric matter by this means, when no commotion exists in the air ; for lightning and the electric matter are the same.—*(Dr. B. Franklin.)*

The machine and *apparatus*, for exciting electric matter, may be bought at the instrument manufacturers' shops, in London, at prices, varying from 10*l.* 10*s.* to 15*l.* 15*s.* with six-inch cylinders, increasing to double that price, as the diameter of the cylinder may be larger, or the demonstrating apparatus more complete. A magic electric bottle, capable of giving slight shocks, may be purchased for half a guinea.

257. *Artificial Earthquake.*

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

258. *The Magic Dance.*

From the middle of the brass arch suspend three small bells. Hang the two outer bells by chains, and the middle one by a silk string, while a chain connects it with the floor. Two small knobs of brass, which serve as clappers, hang by silk strings, one between each two bells. Therefore, when the two outer bells, communicating with *the conductor*, are electrified, they will attract the clappers and be struck by them. The clappers being thus loaded with electricity will be repelled, and fly to discharge themselves upon the middle bell, after which they will again be attracted by the outer bells ; and thus, by striking the bells alternately, the ringing may be continued as long as the operator pleases.

Next suspend a plate of metal from the same part of the arch to which the bells are connected ; then, at the distance of a few inches from the arch, and exactly under it, place a metal stand *of the same size.* On the stand, place several figures of men, animals, or what you

please, cut in paper, and pretty sharply pointed at each extremity. When the plate that hangs from the arch is electrified, the figures will dance with astonishing rapidity, and the bells will keep ringing, to the no small amusement of the spectators.

259. *The Electrical Fountain.*

SUSPEND a vessel of water from the middle of the brass *arch*, and place in the vessel a small tube. The water will at first issue by drops only from the lower part of the tube; but when the wheel is put in motion, there will be one continued stream of water; and if the electrification be strong, a number of streams will issue, in form of a cone, the top of which will be at the extremity of the tube. This experiment may be stopped, and renewed almost instantaneously, as if at the word of command.

260. *The Self-moving Wheel.*

THIS wheel is formed of a thin round plate of window-glass, 17 inches diameter, well gilt on both sides, except two inches next the edge. Fix two small hemispheres of wood, with cement, to the middle of the upper and under sides, centrally opposite, and in each of them a thick strong wire, eight or ten inches long, which together form the axis of the wheel. It turns horizontally, on a point, at the lower end of its axis, which rests on a bit of brass, cemented within a glass salt-cellar. The upper end of its axis passes through a hole in a thin brass plate, cemented to a long and strong piece of glass, which keeps it six or eight inches distant from any non-

electric body, and has a small ball of wax or metal on the top to keep in the fire.

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

When well charged, it begins to move. The bullet nearest to a pillar moves towards the thimble on that pillar, and passing by, eletrifies it, and then pushes itself from it. The succeeding bullet, which communicates with the other surface of the glass, more strongly attracts that thimble, on account of its being electrified before by the other bullet, and thus the wheel increases its motion, till it is regulated by the resistance of the air. It will go half an hour, and make, one minute with another, 20 turns in a minute, which are 600 turns in the whole. The bullet of the upper surface gives, in each turn, 12 sparks to the thimbles, those bullets moving 2,500 feet in the same time. The thimbles are to be well fixed, and in so exact a circle, that the bullets may pass within a very small distance of them. The number of rotations may be increased by adding to the number of the bullets.

261. *The Magician's Chase.*

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

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262. *The Unconscious Incendiary.*

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

If the electrified person puts his finger, or a rod of iron, into a dish containing warm spirits of wine, it will immediately blaze; and if there be a wick or thread in the spirit, that communicates with a train of gunpowder, he may be made to blow up a magazine, or set a city on fire, with a piece of *cold iron*, and at the same time know nothing of the mischief he is doing.

This experiment admits of a good number of modifications, that must naturally suggest themselves to the practitioner.

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263. *The Inconceivable Shock.*

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

Care should be taken, that the shock be not too strong; and regard should be had to the constitution and disposition of the party, as a shock that would hardly affect one person, might be productive of very serious consequences to another. A *small shock*, however, is more pungent than a large one.

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

The whole company may be made to partake of the shock, by joining hands, and forming a circle. The experiment may also be varied if they tread upon each other's toes, or lay their hands on each other's heads. It might happen, by the latter method, that the whole company would be struck to the ground; but it will be productive of no danger, and very little inconvenience;

on the contrary, it has happened that they have neither heard nor felt this shock. Mr. Walker electrified three entire regiments of soldiers, at one shock, thus exceeding the experiments of the Abbe Nollett, ten-fold.

264. *The Animated Feather.*

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

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

265. *The Artificial Spider.*

CUT a piece of burnt cork, about the size of a pea, into the shape of a spider; make its legs of linen thread, and put a grain or two of lead in it to give it more weight. Suspend it by fine silk thread, between an electrified arch and an *excited* stick of wax;

and it will jump continually from one body to the other, moving its legs at the same time, as if animated, to the great surprise of those who may be unacquainted with the influence of electric fire.

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266. *The Miraculous Portrait.*

GET a large print (of any known personage) with a frame and glass. Cut the print out at about two inches from the frame all round; then with thin paste fix the border that is left on the inside of the glass, pressing it smooth and close; fill up the vacancy, by covering the glass well with leaf-gold or thin tin-foil, so that it may lie close. Cover likewise the inner edge of the bottom part of the back of the frame with the same tin-foil, and make a communication between that and the tin-foil in the middle of the glass; then put in the board, and that side is finished. Next turn up the glass, and cover the fore side with tin-foil, exactly over that on the back part; and when it is dry, paste over it the pannel of the print that was cut out, observing to bring the corresponding parts of the border and pannel together, so that the picture will appear as at first, only part of it behind the glass, and part before. Lastly, hold the print horizontally by the top, and place a little moveable gilt crown on the portrait—suppose that of the reigning monarch.

Now, if the tin-foil on both sides of the glass be moderately electrified, and another person take hold of the bottom of the frame with one hand, so that his fingers touch the tin-foil, and with the other hand attempt to take off the crown, he will receive a very smart blow, and fail in the attempt. The operator, who

holds the frame by the upper end, where there is no tin-foil, feels nothing of the shock, and can touch the face of the monarch without danger, which he pretends is a test of his loyalty.—(*Mr. Kinnersly.*)

267. *The Tantalian Cup.*

PLACE a cup of any sort of metal on a stool of baked wood, or a cake of wax. Fill it to the brim with any kind of liquor; let it communicate with the branch by a small chain, and when it is moderately electrified, desire a person to taste the liquor, without touching the cup with his hands, and he will instantly receive a shock on his lips, which should not be too strong. The motion of the wheel being stopped, you affect to taste the liquor yourself, and desire the rest of the company to do the same; then give your operator (who is concealed in an adjoining room) the signal, and while you amuse the company with discourse, he again charges the cup; you desire the same person to taste the liquor a second time, and he will receive a second shock, to the no small diversion of the company.

268. *Magical Explosion.*

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

DARK-CHAMBER EXPERIMENTS.

To exhibit a great number of pleasing and surprising recreations *in the dark*, as well as in the light is the peculiar province of electricity; for, although a good number of beautiful representations may be obtained by the aid of the *camera obscura*, it is indebted to the sun's rays for its effects, or more ignobly to the light of a candle or lamp; whereas the electric apparatus contains within itself those properties, whence the fire may be obtained with which experiments may be made. Here follows five of those that require the room to be darkened.

269. *The Miraculous Luminaries.*

You must previously prepare *phosphorus*, thus: — Calcine common oyster-shells, by burning them in the fire for half an hour; then reduce them to powder; of the clearest of which take three parts, and of *flowers of sulphur* one part; put the mixture into a crucible, about an inch and a half deep. Let it burn in a strong open fire for an hour; when cool, turn it out and break it in pieces, and taking those pieces into a dark place, scrape off those parts that shine brightest, which, if good, will be a white powder.

Then construct a circular board of three or four feet diameter, on the centre of which draw, in gum water, or any adhesive liquid, a half moon, of three or four inches diameter, and draw a number of stars round it, at different distances, and of various magnitudes. Strew the phosphorus over the figures, to the thickness of about a quarter of an inch, laying one coat over the other. Place this board behind a curtain, and when you draw the curtain up or back, discharge one electrifying jar or phial

over each figure, at the distance of about an inch, and they will become illuminated, exhibiting a very striking resemblance of the moon and stars; and will continue to shine for about half an hour, the light, however, becoming gradually more faint.

270. *The Luminous Shower.*

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

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

271. *The Illuminated Vacuum.*

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

If a jar be discharged through this vacuum, it presents

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

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

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

272. *The Illuminated Cylinder.*

PROVIDE a glass cylinder, three feet long, and three inches diameter ; near the bottom of it fix a brass plate,

and have another brass plate, so contrived that you may let it down the cylinder, and bring it as near the first plate as you desire. Let this cylinder be exhausted and insulated, and when the upper part is electrified, the electric matter will pass from one plate to the other, when they are at the greatest distance from each other that the cylinder will admit of. The brass plate at the bottom of the cylinder will, moreover, be as strongly electrified as if it was connected by a wire to the prime conductor.

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

273. *The Electric Aurora Borealis.*

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

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

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

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

274. *The Illuminated Room.*

THE company, who have been kept in *the dark*, during the *five* preceding experiments, should now be restored to the light, in order to which, introduce the self-moving wheel (Article 260.) To the upper axis whereof, let there be fixed a number of *radii*, made of baked wood, at the end of which must hang a small globular lamp filled with spirits, and let that of each lamp be tinged with a different colour. The wheel, having previously acquired its greatest velocity, is to be placed on the table, and a chain depending from the branch, is to dip into each lamp as it passes by; so that all of them will become illuminated in a very short time. These lamps will not only light the room, but, by their variegated colours, and continued revolution, afford a very pleasing *phenomenon.*

Facts connected with Magnetism.

1. This pleasing study, like its sister science, Electricity, depends entirely on attraction: it has also a negative quality, that of repulsion under certain circumstances, out of which arises the gusto of many curious experiments or tricks, of which it is susceptable. Steel and iron contain much positive attraction, which may be brought into action, and imparted from one bar to another by *friction* alone; the upper ends of all bars or rods being the south pole in this northern Hemisphere, whilst in the southern Hemisphere the upper pole is north. But it is a fact worth recording that, those poles do sometimes greatly change, and much alteration has been observable from time to time, not only in the degree, quantity, or strength of magnets, but the polarity of entire countries is known to have differed many degrees, in the course of the two centuries and a half, that have elapsed since the discovery of the *load-stone*. (See Galvanism, Vol. 2.)

2. Our domestic *poker and tongues* offer the readiest means of manufacturing *magnets*, on account of their constant vertical position; though smiths' files, augers and other tools which are used in friction, always in the same direction, might be employed with advantage, Take a piece of *soft steel* of the requisite size for a magnet, and fastening it with silk thread to the upper part of a poker, suspend both in the left hand, and grasping the tongues by the middle in the right hand, stroke the poker with the point ten times upwards: let the poker now turn half round, and repeat this on the opposite side, and your *steel* will have acquired magnetic power, in a small degree, but which may be increased by further friction of several such steel bars together.

3. Having previously marked the north pole of your steel, and impregnated several such bars, place any two side by side, but with their poles transversed, the north of the

one being next the south of the other, but having a space between. At each end place a piece of iron in contact with both, and then rubbing, or rather stroking, the sides of this pair with the ends of another pair, and so on *vice versa*, two pair, or more, of good magnets may be produced. When the ends are being rubbed it must be a north and south one together, and at the *lower end* they must be kept apart with a *pin*.

4. Such are the principles upon which magnetical power is given to steel, which may be further increased by certain observances of a similar nature, that are easily acquired by practice. The price of those instruments, however, is so trivial, that no other consideration probably than practical curiosity would induce you to undertake the task. As is said, the two ends of a magnet are called its poles, so of a touched needle; and when placed with just equipoise upon a pivot, the end which turns towards the north, is called its north pole, the other is consequently south. When the north pole of one magnet is presented to the south pole of another, attraction equal to its powers takes place; and if the substance so attracted be afloat upon liquid, or in any other situation capable of changing places, they approach towards, or come in contact with each other: upon this principle several of the following tricks are founded. But, generally disregarded is the circumstance, that the north pole being presented to another north pole, repulsion takes places, as in the affair of "the wonderful Swan," described below.

5. Those facts may be illustrated by placing on a board, two magnets, (lying transposed always), and being provided with a quantity of steel or iron filings, strew them about upon the board, and according to the quantity of attraction and *non-resistance* of the finer filings, will be the *radii* described. None, whatever,

will approach the extreme of the south poles, and the quantity attracted by, or towards, each magnet, shall be greater and greater as you come nearer to the north pole.

6. The power of attraction is sometimes impaired, at others lost, no one can tell how, with any certainty of being correct. A hard blow with a bar on the stones will sometimes impart the magnetic power; a blow upon an anvil with a hammer discharges it. *Fire heat* totally destroys it; whilst electricity (and *lightning* of course) is known to communicate it; and, when either prevails, is most likely to affect the degree of polarity in the compass, (*at sea* particularly, I humbly suggest) when storms assail, and every sudden variation in these our dumb guides is replete with danger and ruin. In aid of this hypothesis, we have the well known fact, that the declination of the compass is greater at one time than at another, even varying at the same place. This may be partly owing to the *magnetic pole* of our earth being fifteen degrees from the arctic pole, and far to the westward; as was ascertained in 1820, by the ships (Griper and Hecla), sent out by the British Government to explore those regions. On that occasion, the needles of both ships became perfectly useless, veering about at random, when the vessels were fourteen leagues from the coast. Immense piles of ice, at one season, and a clear sea at others, on the place of attraction, (wherever that may be) is one apparent cause of the variations just noticed. From these premises, it is evident, much still remains to be discovered regarding the power of the magnet.

276. *Magnetic Wand.*

Bore a hole, three-tenths of an inch diameter, through a round stick of wood, (as ebony), or get a hollow cane,

about eight inches long, and half an inch thick. Provide a small steel bar, and let it be very strongly impregnated with a good magnet; this rod is to be put in the hole you have bored through the wand, and close at each end by two small ends of ivory that screw on, different in their shapes, that you may better distinguish the *poles* of the magnetic bar.

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

277. *The Mysterious Watch.*

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

This experiment cannot be effected, unless you take the precaution to use a very strongly impregnated magnetic bar, and that *the balance wheel* of the watch be of steel, which may be ascertained by previously opening it, and looking at *the works.*

278. *The Magnetical Table.*

UNDER the *top* of a common table, place a magnet that turns on a point, and fix a board to cover it, so that it may not be discovered. There may also be a drawer under the table, which you may pull out to show that nothing is there concealed. At one end of the table, secretly place a pin, that communicates with the magnet, and by which it may be placed in several different positions. Stew some steel filings, or very small nails, over that part of the table where the magnet is; and having requested the loan of a knife or key of some one, apply it to the steel filings, and it will have the same effect on the larger ends of these as a magnet would. Then placing your hand as if carelessly on the pin at the end of the table, alter the position of the magnet, and giving the key or knife to any one you would disappoint, he will be unable to perfom the experiment as you have done, but you may change the pin's influence once more, and show the company how these matters may be managed by word of command.

279. *The Magnetic Cards.*

DRAW a pasteboard circle; then provide yourself with two needles, similar to those used in the foregoing experiment, (which you must distinguish by some private mark), with their opposite points touched with the magnet. When you place that needle, whose pointed end is touched, on the pivot described in the centre of the circle, it will stop on one of the four pips, against which you have placed the pin in the frame; then take off that needle, and placing the other, it will stop at the opposite point.

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

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280. *The wonderful Swan.*

Not many years ago, one of our principal conjurors—for credulity was at its heighth towards the end of the last century—and many of those sagacious persons flocked to the capital of our empire to exhibit their tricks, for the amusement, and at the expense of the *Bull Family*—made it one of his principal feats, to command a swan, placed in a *basin of water*, to perform any evolution at will. Did he present to this bird the herbage known to be most agreeable to its taste, he would approach at the apparent sight thereof; but if a person supposed to be disagreeable to it, came near the basin, he would hasten to the *other side of the water;* and the facetious conjuror proceeded so far as to embody one of his own personal realities in the shapes of a bailiff and his followers—from whose approach the sagacious swan would invariably fly. This was the contrivance—

The *figure* of a swan, cut out in cork, and covered with a coat of white wax, the eyes made of glass beads, having concealed in its body a well-impregnated magnetic bar, is to be set afloat in a capacious basin of water. Round the edge of the basin, may be placed various devices, and among others, a *swan-house*, such as is seen on *the river*, may hang over and touch the water; here the swan may take shelter occasionally, and in it he may be made to *turn round*, in order to heighthen the wonderment of the spectators.

In the management and adaptation of the magnetic bar, placed within the swan, and that in the *wand*, (before described), consists the whole of the tricks to be elicited from the approaching or receding of the figure, by presenting to the edge of the basin, now the north pole, now the south; and an expert performer may still further diversify his exhibition by using two wands of strength and force somewhat different.

This contrivance is applicable to several other kinds of floating figures, as *ships*, &c. and adapting the *palaver* usual on such occasions to the thing before you.

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281. *Concealed Money,*

MAY be discovered by means of the magnetic compass, if it be previously loaded with a *touched needle*. This may be effected by boring a hole in the *edge* of the money, (as a *dollar* or *crown*), and having driven in the needle, let the hole be filled with a bit of pewter, or silver, to hide the head of it. Next take a needle that is balanced on a *pivot*, in the same manner as the mariner's compass, and this will turn towards the needle inclosed in the money.

Desire any person to lend you a crown, or other piece of money, similar to the first mentioned; and having dexterously changed them, let him, at his option, secretly place *the piece* in a snuff-box, or not, as he thinks fit, and it then becomes your task to say whether he has or has not done so, without touching the snuff-box. Your own compass, or needle upon a pivot, offers the ready means of doing this, by placing it near the box: if the needle maintains its northerly direction, unalterably, be assured the money is not concealed in the box, unless the *north pole* of the needle, (which lies hid within the money) happens to be placed in a northerly direction—a thing not very likely to happen. Howsoever, to be quite sure, find you fault with the position of the snuff-box—seem as if hard to please—and unless your needle vibrates one way or the other, the loaded money is not at that time in the snuff-box.

Two points remain, upon which you may deceive yourself, viz. 1*st*, Your needle must be very *sensible* or the influence will be too inconsiderable to effect any change in it; 2*nd*, Take good care that your *adversary* (or person acted upon) does not change *your piece* for another, and thus defeat the purpose you have in view.

282. *Method of taking the Impression of Butterflies on Paper.*

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

are to be drawn in the space which you leave between the wings.

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283. *To cast Figures in Imitation of Ivory.*

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

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284. *To soften Horn.*

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

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285. *To make Moulds of Horn.*

If you wish to take the impression of any coin, medal, &c. previously anoint it with oil; then lay the horn shavings over it in its softened state. When dry, the impression will be sunk into the horn; and this will serve

as a mould to re-produce, either by plaster of Paris, putty and glue, or isinglass and ground egg-shells, the exact resemblance of the coin or medal.

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286. *To extract the Silver out of a Ring, that is thickly gilded, so that the Gold may remain entire.*

TAKE a silver ring that is thickly 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.

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287. *To soften Iron or Steel.*

EITHER of the following simple methods will make iron or steel as soft as lead:

1. Anoint it all over with tallow; temper it in a gentle charcoal fire, and let it cool of itself.
2. Take a little clay, cover your iron with it, temper it in a charcoal fire.
3. When the iron or steel is red hot, strew hellebore on it.
4. Quench the iron or steel in the juice or water of common beans.

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288. *To take a Plaster of Paris Cast from a Person's Face.*

THE person must lie on his back, and his hair be tied behind Into each nostril put a conical piece of paper

open at each end to allow of breathing. The face is to be lightly oiled over, and the plaster being properly prepared, is to be poured over the face, taking care that the eyes are shut, till it is covered a quarter of an inch thick. In a few minutes, the plaster may be removed. In this a mould is to be formed, from which a second cast is to be taken, that will furnish casts exactly like the original.

THE ART OF MAKING FIRE-WORKS.

Above all things it is necessary to have good materials, and that these be prepared in a proper manner, in order to execute any task combining so many ingenious contrivances as the making of Fire-works undoubtedly require. The manufacture of your own gunpowder is not desirable, and therefore postpone the description of that art—you will no doubt buy the best; but as the admixture of charcoal is necessary, and much of your success depends upon having it good—observe that the less of *sap* there may be in the wood before it is made into charcoal the better will be the gunpowder that is made with such charcoal. Dr. Watson made the discovery, and communicated the fact to his Majesty's Government, but the French and Germans were in the secret many years before, and always beat us at *long shot*. The wood is to be dried in an oven or *iron boiler*, with a slow fire, and the charcoal kept in close boxes from the influence of atmosphoric air, until the moment of being brought into use

289. *How to meal Gunpowder, Brimstone, and Charcoal.*

THERE have been many methods used to grind these ingredients to a powder for fireworks, such as large mortars and pestles made of ebony, and other hard woods; but none of those methods have proved so effectual and speedy as the new invention, of the *mealing table.* It is made of elm, with a rim round its edge, four or five inches high; and one end is a slider, which runs in a groove and forms part of the rim; so that when you have taken out of the table as much powder as you wish, with a copper shovel, you may sweep all clean out at the slider. When you are going to meal a quantity of powder, do not put too much on the table at once; but when you have put in a good proportion, take a muller and rub it therewith till all the grains are broke; then sift it in a lawn sieve, that has a receiver and top to it; and that which does not pass through the sieve, return again to the table and grind it more, till you have brought it all fine enough to go through the sieve. Brimstone and charcoal are ground in the same manner as gunpowder, only the muller must be made of ebony, for these ingredients being harder than powder, would stick in the grain of the elm, and be very difficult to grind; and as the brimstone is apt to stick and clog to the table, it would be best to keep one for that purpose only, by which means you will always have your brimstone clean and well ground.

290. *To make Touch-paper.*

DISSOLVE in some spirits of wine or vinegar, a little saltpetre; then take some purple or blue paper, wet it with the above liquor, and when dry it will be fit for use.

When you paste this paper on any of your works, take care that the paste does not touch that part which is to burn. The method of using this paper is, by cutting it into slips, long enough to go once round the mouth of the serpent, cracker, &c. When you paste on these slips, leave a little above the mouth of the case not pasted; then prime the case with *meal powder*, and twist the paper to a point.

291. *Of the vertical Scrole Wheel.*

THIS wheel may be made of any diameter, but must be constructed thus:—Have a block of a moderate size, into which fix four flat spokes, and on them fix a flat circular fell of wood. Round the front of this fell place port-fires; then, on the front of the spokes form a scrole either with a hoop or strong iron wire; on this scrole tie cases of brilliant fire, in proportion to the wheel, head to tail. When you fire this wheel, light the first case near the fell; then, as the cases fire successively, you will see the circle of fire gradually diminish; but whether the illuminations on the fell begin with the scrole or not, is immaterial.

292. *A slow Fire for Wheels.*

MUST be composed of saltpetre, four ounces; brimstone, two ounces; and meal powder, one ounce and a half.

293. *A dead Fire for Wheels.*

SALTPETRE, one ounce and a quarter; brimstone, a quarter of an ounce; lapis-calaminaris, a quarter of an ounce; and antimony two drachms.

294. *A brilliant Fire.*

MEAL powder, six pounds; saltpetre, half a pound brimstone, two ounces; and steel-dust, twelve ounces.

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295. *For a Blue Flame.*

MEAL powder, saltpetre, and sulphur vivum; the sulphur must be the chief part. Or, meal powder, saltpetre, brimstone, spirit of wine, and oil of spike; but let the powder be the principal part.

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296. *Of Port or Wild Fires.*

SALTPETRE, one pound two ounces: meal powder, one pound and a half; and brimstone, ten ounces. This composition must be moistened with one gill of linseed oil.

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297. *Of such Ingredients as show themselves in Sparks when rammed into choaked Cases.*

THE set colours of fire produced by sparks are divided into four sorts, viz. the black, white, grey, and red; the black charges are composed of two ingredients, which are meal powder and charcoal; the white of three, viz. saltpetre, sulphur, and charcoal; the grey of four, viz. meal powder, saltpetre, brimstone, and charcoal; and the red of three, viz. meal powder, charcoal, and sawdust.

There are, besides these four regular or set charges, two others, which are distinguished by the names of

compound and brilliant charges; the compound charge being made of many ingredients, such as meal powder, saltpetre, brimstone, charcoal, saw-dust, sea-coal, antimony, glass-dust, brass-dust, steel-filings, cast-iron, tanners' dust, &c. or any thing that will yield sparks; all which must be managed with discretion. The brilliant fires are composed of meal powder, saltpetre, brimstone, and steel-dust; or with meal powder and steel-filings only.

298. *Of Saltpetre.*

SALTPETRE being the principal ingredient in fire works, and a volatile body, by reason of its inflammable and ærial parts, is easily rarified by fire; but not so soon when foul and gross, as when purified from its crude and earthy parts, which greatly retard its velocity: therefore, when any quantity of fire-works is intended to be made, it would be necessary first to examine the saltpetre; for if it be not well cleansed from all impurities, and of a good sort, your works will not have their proper effect.

299. *To pulverize Saltpetre.*

TAKE a copper kettle the bottom being spherical, and put into it fourteen pounds of refined saltpetre, with two quarts or five pints of clean water; then put the kettle on a slow fire, and when the saltpetre is dissolved, if any impurities arise, skim them off, and keep constantly stirring it with two large sticks till all the water exhales. When done enough, it will appear like white sand, and as fine as flour; but if it should boil too fast, take the kettle off the fire, and set it on some wet sand, which

will prevent the saltpetre from sticking to the kettle. When you have pulverized a quantity, be careful to keep it in a dry place, not exposed to the air.

300. *To make Crackers.*

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

301. *To make Squibs and Serpents.*

First make the cases, of about six inches in length, by rolling slips of stout cartridge paper three times round

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

FINIS.

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