THE SCHOOL BOY'S
HOLIDAY COMPANION;

OR,

TREASURY OF AMUSEMENT.

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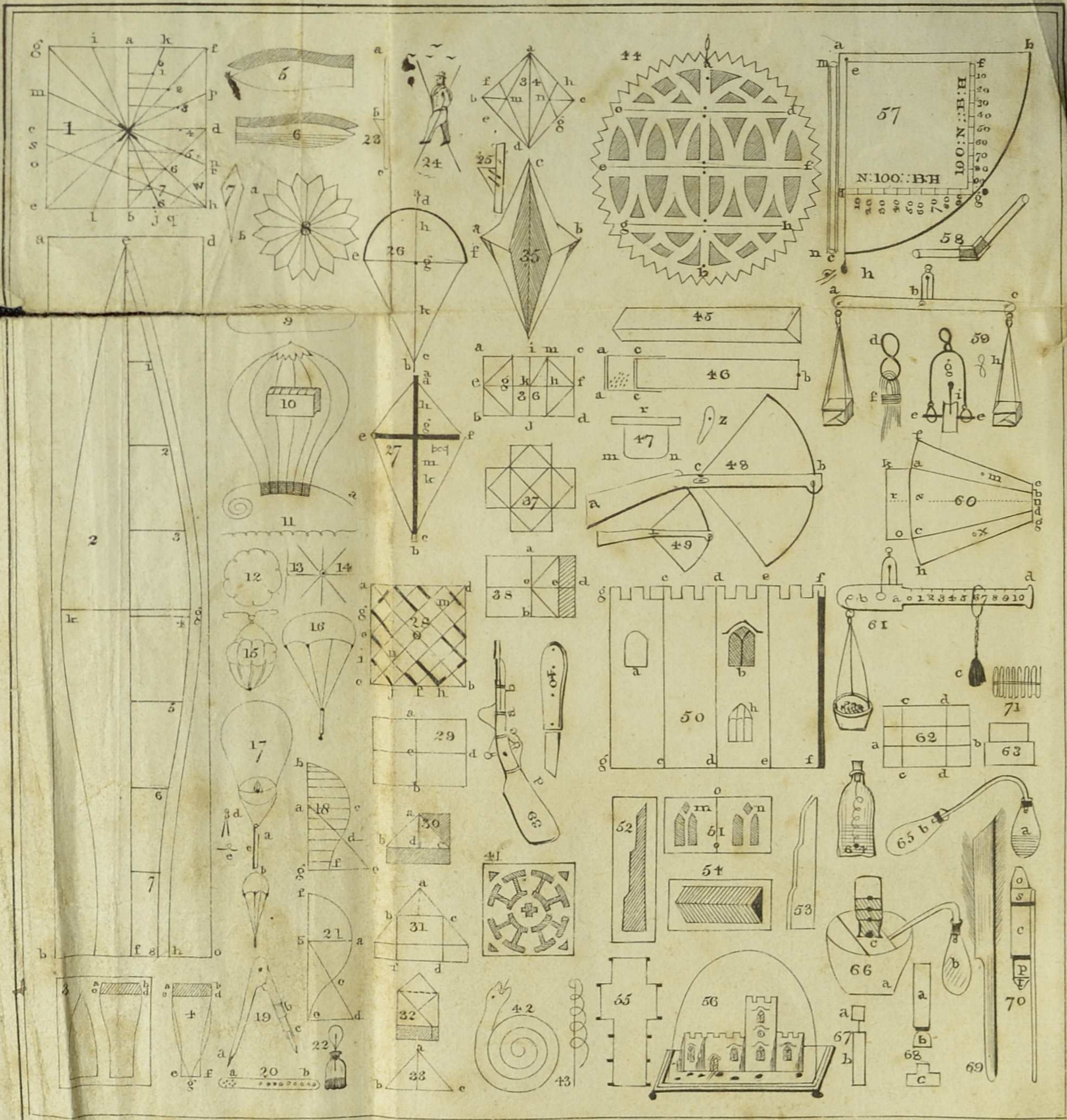
Ben Warner



The School Boy's Treasury of Amusement.

THE

SCHOOL BOY'S

HOLIDAY COMPANION;

OR,

TREASURY OF AMUSEMENT,

EXPLAINING

THE METHOD OF CONSTRUCTING

Air and Fire Balloons, Parachutes, Plain and Folding Kites, Stilts, Wire Baskets, Paper Globes, Stars, Caps, Bangs, Bellows, Boxes, Boats, Serpents, Pockets, Puzzle Notes, Fly Cages, Fly Guns, Stove Patterns, Cross Bows, Compasses, Kaleidoscopes, Models, and Instruments for Measuring Heights, Tubes, Scales, Steelyards, Funnels, Sieves, Looking Glasses, Egg Glasses, Hour Glasses, and Glass Inkstands.

TO WHICH ARE ADDED MANY CHEMICAL EXPERIMENTS,

Gasses, Metallic Trees, Chimney Ornaments, Crystallizing Tin, Silvering Copper, Distilling Spirits, and Freezing Water in Summer; Gunpowder, Fulminating Powders, Detonating Balls, Waterloo Crackers, Lucifer Matches, White, Blue, Lived, Crimson, Purple, and Instantaneous Fires; Squibs, Wheels, Crackers, Rockets, Blue Lights, Flower Pots, and Roman Candles.

APPENDED IS

A LIST OF PRICES OF EVERY ARTICLE REQUIRED
FOR THE EXPERIMENTS.

BY T. KENTISH.

Non prius
Audita, pueris canto.—Hor.

LONDON;
RELFE & FLETCHER, SCHOOL LIBRARY, 17, CORNHILL.
1840.

PREFACE.

The following little work has been written solely for the amusement of youth; and for this purpose, the experiments have been reduced to as small and economical a scale as possible: every little expedient has been resorted to likely to diminish expense and promote the learners ingenuity; and the apparatus throughout so simplified as to fall within the reach of the humblest of our purchasers. A list of prices is annexed at the end, for enabling the learner to compare the state of his funds with the experiments he feels desirous of trying; many of these he will find entirely new, and if we mistake not, among the most entertaining parts of the work.

THE SCHOOL BOY'S

HOLIDAY COMPANION.

To Project a Balloon.

Take a piece of cartridge paper. fig 1, exactly square, and measuring $13\frac{1}{2}$ inches each way. Mark the letters on the paper the first time for a guide. Fold it along *a b*. Unfold it. Fold *cd*. Unfold. Do the same with *ef* and *gh*. Fold it along *ix* and *xj* by making *ax* fall upon *xg*; and *bx* upon *xh*. Fold *kx*, *xl*, *mx*, *xn*, *ox*, *xp*. Fold *bd* by bringing *h* up to the centre *x*. Fold *qr* by bringing *h* up to 6. Fold *sh* by bringing *eh* up to *hg*. Take a slip of paper, and measure the distance from *x* to 6. Set this distance from *x* to 5, *x* to 4 *x* to 3, *x* to 2, *x* to 1, *x* to 0. Then set it from the corner *h* along the line *sh* to 7, and along the bottom to 8. Make a square with another piece of paper, by folding it down *ab*, and without unfolding it, folding *xd*. The folded sides will be square. Draw 8 perpendiculars, or ordinates, with it through the dots 1, 2, 3, &c. to the line *ab*, which should be made plainer by drawing a line down it with a black lead pencil.

To Form the Pattern Gore.

Take a piece of cartridge paper *abcd* fig.2, 13½ inches broad, and 60 long. Fold it down *ef*. With a slip of paper measure the distance from *x* to *w*, fig. 1, and lay it down 8 times from *f* fig. 2, towards *e*. Draw ordinates, or perpendiculars, through these points, and make the 1st equal to the 1st, of fig. 1; the 2d equal to the 2d; the 3rd to the 3rd; and so on. Trace a curve line through the extremities, and round this another *egh*, a quarter of an inch distant, to allow for pasting. Cut through both sides with a pair of scissors.

To Cut Out the Gores.

Cut the pattern gore across the middle in the line *kg* fig. 2, and having laid 12 sheets of tissue paper smooth upon each other, place the two pieces of the pattern on the top, as in fig. 3. Mark round the edges, allowing a quarter of an inch at the broad end of the bottom part for pasting, as shown by the shaded portion *acdb*, and with a strong pair of scissors cut through the whole 12 sheets at once.

To Paste.

Pasting is the most difficult part, but a careful attention to the following directions will soon render the learner expert.

To Paste the two Pieces Together

Lay the bottom part of the gore *aefb* fig. 4, smooth upon the desk, and the top part *cgd* upon it, so as to leave about a quarter of an inch along the edge, as shown by the shaded part *acdb*. Paste this shaded part; and, without removing either piece, bend the pasted part of the lower half gore over upon the top, and press it smoothly down with a handkerchief. When dry, smooth with a hot iron if thought proper.

To Paste two Gores Together.

Lay one gore with the pointed part towards the *left hand*, and another upon it a quarter of an inch back, as in fig. 5. Paste the shaded part of the lower gore, bend over and press as before. Observe that one of the gores having been drawn in, by pasting, is now narrower than the other. Finish the six pairs and lay them by to dry.

To Paste the Pairs Together.

Lay one pair with the pointed part towards the *right hand*, keeping the widest gore upwards, and another upon it in the same manner as in fig. 6. Bend the top gore back upon itself, as shown by the bottom shaded portion, and lay a book upon it to keep it out of the way. Paste and double as before, and so proceed till the whole twelve are finished, and lying upon each other. Be careful to disturb none of the gores.

To Make the Last Joining.

Get the assistance of a second person. Turn the points towards the *left hand*. Lift up the top, and bend the ten inner gores back upon themselves. Draw the top gore over so as to make it lie upon the bottom. Paste as before.

To Cut out a Star, fig. 8.

Take a piece of tissue paper 4 inches square, as *gehf* fig. 1. Fold it along *ab*. Without unfolding it, fold it along *xd*, then along *xf*, then *xk*. With a pair of scissors cut it to the shape of fig. 7. Unfold it.

To close the Aperture at the Top of the Balloon.

Open the balloon carefully. Pass a book up the inside to reach the aperture. Spread the top of the balloon flat upon the lid; paste the star, and press it upon it. Letters, half-moons, crowns, &c., may be pasted on for ornament. Of course balloons may be made of any size, but the tissue paper cannot be adapted to some without many joinings. The following will be found to answer. To project a balloon of 4 sheets, make the cartridge paper, fig. 1, $7\frac{3}{4}$ inches square, for 5 sheets 9 inches square, for 12 sheets $13\frac{1}{2}$ inches, and for 48 sheets, $27\frac{1}{2}$ inches. There must always be 12 gores,

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To Wire the Balloon.

For a 12 sheet balloon, select a coil of wire a little thicker than a pin; and, with a pair of tongs, hang it over the flame of a fire till red hot. Remove it, and let it cool gradually; this will deprive it of its elasticity. Before applying it to the balloon, practise the method of making a joining, as shown in fig. 9. simply bringing the ends together, crossing them about an inch from the extremity, and winding them tight round each other, the one under, and the other over. Try if they are firm, and cannot be pulled asunder. Having become perfect in this, lay the balloon as in fig. 10, with a book upon it to keep it down. Curve the wire to the shape of the bottom of the balloon, and lay it about half an inch from the edge, as shown by the shaded part, leaving a piece at the end *a* of 5 or 6 inches. Notch the paper at the joinings of the gores; paste and fold back. When perfectly dry, not before, turn the balloon over; cut the wire to a sufficient length, bend the ends together, and make the joining. Paste over the remaining half, and shape the wire to a circle. Across the opening fasten a rod of wire, having in the middle a piece of sponge, cotton, or tow. Saturate it with spirit of naphtha, or spirit of wine. Hold the balloon over some burning paper. When inflated, set fire to the spirit, and as soon as the balloon becomes buoyant, let it go. A 12 sheet balloon will require an ounce of spirit, and as much sponge as will absorb it.

To Construct a Wire Basket.

Take a very thin piece of wire about 8 inches long, and twisting it round a pin, make 8 loops in it, about three quarters of an inch distant from each other, as in fig. 11. Twist it into a round as in fig. 12. Next take 4 pieces, each 4 inches long, and making a loop in the middle of one, as fig. 13, fasten the others into it, as fig. 14. Bend these up and hook them into fig. 12, till they become a basket, as fig. 15, which is to be furnished with a handle, and hung across the wire at the mouth of the balloon. For tow, cotton, pieces of linen rag, or calico, these will be found convenient. Every joining must be made firm, otherwise the weight of the burning materials will cause it to fall as the wires become red hot. Take the elasticity out of the wire before using it.

To Construct a Parachute.

Take a sheet of tissue paper, and cut it square. Fasten threads, about two feet in length, to each of the four corners, and draw the ends together. Pass them through a piece of tobacco pipe, about two inches in length, and tie a knot beneath to prevent them from slipping out, as in fig. 16. Fly this in a windy day against the corners of a building, by holding the pipe, and swinging the paper upwards, till the wind catches it; then loose it, and let it rise.

To Cause a Parachute to Fall from a Balloon at a Height in the air.

Paste a piece of touch paper *ab* fig. 17, round a wire *c*, in such a manner that the bottom of the paper *b*, shall reach an inch or two lower than the bottom of the wire, *c*. Suspend the wire from a balloon, and fasten the parachute to the bottom of the touch paper, by passing it through a little wire ring inserted into the parachute for the purpose. The form of the ring is shown at *d*. Push it through, and spread out the ends as at *e*. When the balloon is just ready to rise, light the touch paper at *a*, and let it go. The length of the touch paper must be determined by experiment before hand. As much as will burn three minutes will be sufficient.

If the learner is acquainted with the use of the compasses, he may project the balloon, as in fig. 18. The curve will consist of the quadrant *bc*, the octant *cd*, and the reverse octant *df*: *de* the radius being equal to *da*. The whole curve may then be divided into 12 equal parts, from which to draw the ordinates; and the radius *ac* is to be laid down 12 times along *ef* fig. 2, in forming the pattern gore. For the readiest way of performing this see the Author's Treatise on a Box of Instruments and the Slide rule, Relfe & Fletcher, 17 Cornhill, Price 3s.

To Make a Pair of Compasses.

Cut the wood as in fig. 19. A piece of wire, or a pin, is to be inserted into the leg *a*, and filed to a point. The other leg is to have a quill fastened upon it at *b*, for the purpose of holding a black lead pencil, *c*. A simpler method is to have a long slip of deal, half an inch broad, and an eighth thick, as in fig. 20. At the end *a*, with a red hot pin, make a number of holes very close together; and towards the other end *b*, with a thick wire burn a row of large holes. By adjusting a pin to one of the holes at *a*, and a pencil to one of the others at *b*, the learner may obtain any radius sufficiently exact for amusement.

Air Balloons.

The method of projecting these is shown at fig 21. The arc *ac* is a sextant, and *ce* the same reversed. Divide *ac* and *ce* each into 4 equal parts, and the quadrant *af* into 6. Draw 14 ordinates, and lay down the distance *ab* 14 times in forming the pattern gore. Cover the gores with a varnish of india rubber dissolved in a mixture of spirits of turpentine and naphtha. The balloon is to be inflated with hydrogen gas, which may be procured as follows. Melt some pieces of zinc in the bowl of a tobacco pipe, and pour it from a height into a pan of water to granulate it. Place these grains in a pint and a half wine bottle, and pour upon them a vial-ful of sulphuric acid, and 5 of water. Through the cork insert one end of a tube, and pass the other end into the neck of the balloon, as in fig. 22. When inflated, tie with silk riband, and suspend a bung for ballast. Globes are to be cut out in a similar manner, and blown full of air.

Stilts.

Take two pieces of light deal, an inch and a half square, and from 6 to 8 feet long; and another piece an inch in thickness 3 inches broad, and 6 long. Saw this across from corner to corner, for the tread boards. Screw them firmly on, as in fig. 23, with 2 screws, 3 inches long. The distance *ab* should always be 4 feet *bc* may vary. Begin with 2 feet, and increase to 4. The method of constructing them with leather treads or binding them to the leg, is extremely dangerous. These are not so in the least, as the feet being left at perfect liberty, the practiser can leap off in an instant. When the weather permits they afford a very healthful exercise. Hold them *behind* the arms as in fig. 24 and to mount them, run forwards with them extended to get momentum; then, suddenly stopping, pitch them upon the ground, and leap up; lean the body forwards, and begin to step directly. To stand perfectly still upon them is very difficult. Fig. 25 shows the best way of placing the screws.

Kites.

The strip of deal *ab* fig. 26, 4 feet 3 inches long, $\frac{3}{4}$ of an inch broad, and half as thick. *ad* an inch and a half, *cb* the same; of course *dc* 4 feet. Divide this into 3 equal parts, in *g* and *k*. The cane *edf* the same length as *dc*, 4 feet. The cross string *ef* equal to *gc*, 2 feet 8 inches. The side strings *ec*, *cf*, a yard each. *dh* one-third of *dg*. *h* and *k* are the holes for the band; the length of which is equal to *ak*. The loop about a foot from the top. And so of all others in proportion. Cover with paper, glazed cambric, or book muslin with tissue paper pasted on the back.

Folding Kites.

The measures the same as before; but *ef* is a strip of deal 2 feet 8 inches long, half an inch broad, and the thickness of the other. Fasten a wire ring at each end *e* and *f* and run a strong rivet through *g*. Make this by twisting two pieces of wire round each other; then, having passed them through the hole spread them out on each side in the manner shown at *m*. Strings are to be fastened at *d* to run to *e* and *f*; and others from *c* to meet them; the ends of which, after being secured with a knot, should be left loose to allow of their being tied to the rings. When not in use, the slip turns round upon the rivet, and the kite folds up.

To Make a Paper Box.

Cut a piece of writing paper, fig. 28, perfectly square Fold *ab*, unfold it; fold *cd*, unfold it; fold *ef*, bringing the point *c* to the centre *o*; do the same all round; fold *gh*, bringing *c* to *m*, and do the same all round; fold *ij* bringing *c* to *n*, and do the same all round. With a penknife, or a pair of scissors, cut through the parts shown by the thick marks. Button the end *c* into *d*; and pushing in the sides, loop *b* into *a*. The learner should pencil the lines to be cut, the first time of performing the operation.

To Make a Paper Cap.

Take an oblong sheet of brown paper, fig.29, and fold it from *a* to *b*: without unfolding it fold it from *c* to *d*. Lay it flat, so as that the edge containing one fold shall be on the left hand, and the double fold at the top. Lift up the top, open it and press it flat, as shown in fig. 30. Bend the corner *c* over to the corner *b*. Do the same with the other side. It will then assume the form of fig. 31. Make the fold *bc*, and with the upper half of the paper the folds *cd*, and *bf*. Turn over, and do the same with the other side, except the top part. Turn it over again, unfold the top, and it will be of the form fig. 32. Roll up the top portion of the shaded part as far as possible, beginning with a narrow fold. Turn over and roll up the remaining half in the same way. Pinch the sides together with the left hand, and with the right pull out the middles towards the ends. Open it and roll the rim all the way round, once more taking care that the corners do not get torn, and it is finished.

To Make a Pair of Bellows.

Take a square piece of brown paper fig. 1. Fold *ab.* Without unfolding it fold *xd.* Lay it flat, so as that the edge containing one fold shall be on the left hand, and the double fold at the top. Lift up the top, open it and press it flat, and bend the right hand corner over to the left. Do the same with the other side. It will now assume the form of fig. 33. Bend *b* and *c* up to *a.* Do the other side the same. This will bring it to a diamond shape, as shown at fig. 34. Fold *ae*, *ag*, by bringing the sides *ab*, *ac*, up to the middle line *ad.* Unfold. Fold *df*, *dh.* Unfold. Fold *bm*, *cn.* Turn over, and do the same. Turn back, and fold along *am*, *md*, and *bm* at once. Do the same with the rest, till it assumes the form of fig. 35. *a* and *b* are the handles, and the wind issues from *c.*

To Make a Paper Bang.

Take an oblong piece of brown paper fig. 36. Fold *ef*, Unfold, Bend *a* and *b* to *g*; and *c* and *d* to *h*. Bend *e* to *f*, making the fold *ij*. Fold *kf*. It will now be of the shape *ikfm*. Fold *km*; unfold it, and push the part inwards. Do the same with the other side. To use it lay hold of the point *f*, and swing it through the air downwards. The paper should be half as long again as broad.

To Fold a Puzzle-Note.

Take a square piece of paper fig. 1. Fold *ef*. Unfold. Fold *gh*. Unfold. Bend all the corners to the centre. Without unfolding it, turn it over, and bend all the corners to the centre again. Repeat this as often as thought proper. At last turn over, open the corners, and press them flat, till of the form in fig. 37.

To Make a Boat.

Take an oblong piece of paper fig. 38. Fold *ab*.

Without unfolding it, fold *cd*. Unfold *cd*, and bend *a* and *b* up to *e*. Fold the top shaded part over upon these, and the bottom piece under. Open, and press the sides together the contrary way. Bend the top back upon itself. Turn over, and do the same. Open, and press as before. Repeat this as often as thought proper. At last set it upright, and pull out the middles towards the sides, right and left.

To Make a Fly Gun.

Cut out the stock, as in fig. 39. with a groove in it for the reception of a quill. Lay the quill in, and bind it tight on with waxed thread, at *a* and *b*. Burn a hole, and insert a wooden trigger. Under this bind a piece of main spring at *c* and *d*; and to the top of it fasten another piece for propelling shot or pins. A notch must be cut in the bottom of the quill, for the main spring to catch in. They are best made with double barrels.

To Cut out a Stove Pattern.

Grind a knife to the form shown in fig. 40. A knife that has been broken is the best. Bend a sheet of Tissue Paper across the middle, and fold it backwards and forwards till it becomes a small square, with 30 or 40 thicknesses. Upon the top lay a piece of writing paper, upon which design any fanciful pattern, as in fig. 41. Cut out all the dark parts and unfold it.

To Make a Serpent.

Draw it on pasteboard, as in fig. 42, and cut through the marks. Suspend it upon a pointed stick, as in fig. 43, and set it in a draught, over a candle, by the side of a fire, or against a sash window, partly opened. As long as the draught continues, the serpent will revolve.

To Make a Fly Cage.

Take 4 sheets of writing paper, and with a pair of compasses draw circles upon the top one, as in fig. 44. Draw the upright pillar *ab* and the three horizontal slips *cd*, *ef*, *gh*. Fill up the rest with any fanciful pattern, and cut out all the shaded parts. Pass a needle and thread through each of the dots; bring the thread through the middle slits, and tie it in knots. There will thus be 8 separate knots. Cut out three stars, as in fig. 8. The distance from *a* to *b*, fig. 7, for two of the stars, is to be equal to half *cd* fig. 44. For the other star equal to half *ef*. Pass these horizontally through the slits *cd*, *ef*, *gh*, in the manner of shelves, and draw the parts round them, one into each notch, in the shape of a globe. Suspend them by a loop from the top at *a*.

To Make a Kaleidoscope.

Procure from the glazier's 3 slips of glass, an inch broad, and 6 inches long. Paste them upon a piece of black paper, and join them into a triangular prism, as in fig. 45. Next roll up a round stout paper case to fit it, and furnish this with a lid *aacc* fig 46. At the end *aa* fix a round piece of ground glass, and at *cc* a piece of common glass. Fill up the space between with beads, fragments of coloured glass, bent pins, &c. If ground glass cannot be easily procured, rub a piece of common glass on a hone or flag-stone. For the prism, three pieces cut from a looking glass are by far the best. Stop up the end at *b*, and make a sight hole through the middle. If the ruler is not thick enough to roll the case upon, make it so by pasting paper round it.

To Make an Hour Glass.

Procure a cork that will fit the necks of two oil flasks, and make a neat hole through it with a round file. In the middle of this hole fasten a bead, or piece of tobacco pipe a quarter of an inch long. Dry some common house sand in a ladle over the fire, and shake it through a fine sieve or muslin bag. Fill one of the flasks with it, fit in the cork, and invert it over a jug or the neck of a wine bottle. Let it run for an hour. Collect the sand that has passed through, pour the rest away; return the sand to the flask, and fit on the other. Place the whole in a wooden frame for support. Egg glasses are to be made with two small vials, furnished with sand to run for three minutes. The flasks should be well dried by the fire, and the cork sealed in. If oily, they may be cleaned with a little hot water, sand, and salf of tartar.

To Make a Cross Bow.

Cut the stock as shown in fig. 48, or 49, from a piece of deal, an inch thick, 3 inches broad at *a*, and an inch and a half broad from *c* to *b*. A foot long from *a* to *c*, and a foot and a half from *c* to *b*. The bow a yard long,of lancewood, yew, nut, hazel, ash, or briar. From *c* to *b* is a groove. This is most readily made by fixing an iron wire, the thickness of a black lead pencil, into a wooden handle, as *r*, fig. 47. The part *mn*, being heated in the fire, will burn the groove required. A slight notch at *c* receives the string, and below it is a button, which being pressed down, liberates the cord, and launches the pipe. A better way is by making a hole through the middle and inserting an iron trigger of the form shown at *z*. To do execution with birds, the pieces of pipe should be about an inch and a half long.

It is to be presumed that the learner has already derived amusement from the different articles we have described: the following, if executed neatly, and set upon a handsome frame, covered with a blown glass, is really a very chaste and elegant ornament for the drawing-room.

To Construct the Model of a Church.

Measure the church, its height, length, and breadth, the size of the windows, and every thing necessary. Lay the whole down accurately on bristol board or card-board; cut out the various parts, and set them up. Thus, for the tower: lay it down as in fig. 50, 6 inches high. Mark the size of the window at *a*, and cut it clean out. Place a strip of Bristol board behind it. fig. 51, and with the point of a needle (not a pencil, as it soils,) mark out the shape of the window upon it, *m*. Draw the bars very fine and cut out the shaded parts. Cut the line *oo* half through, bend it under the window *m*, and mark out the bars a little wider than before. Do the same a third time, if thought proper. Gum them together, one behind the other, and behind the last a piece of quilling net; behind the net gum a piece of glass, and stick the whole behind *a*, fig. 50. Gum a rim or arch round this, as shown at *b*. Another form of window is shown at *h*. The gum should be prepared two or three days beforehand, by putting it into a phial, and pouring over it as much cold water as will just cover it. Select the whitest gum arabic. Buttresses are to be cut out of deal, as shown at fig.52. Gum them upon a slip of Bristol board, with a camel's hair pencil, and when dry, cut round the edges of the wood. Do the other side in the same manner, and afterwards face them, as in fig. 53. Imitate the lubber boards of the bell-loft windows, by gumming on separately, instead of net, narrow slips of writing paper, cut with the scissors. Make the doors in the same manner as the windows, but much deeper. Six thicknesses will give them a very massive appearance. The lines *cc*, *dd*, *ee*, fig. 50, are to be cut half through, and bent back; and in order to keep the side *gg* firm to the side *ff*—behind *ff* gum a long slip of deal, the eighth of an inch thick, close to the edge, as shown by the black mark. Stick slips of deal near the top, to support the roof; and along the bottom to keep it firm upon the velvet. Have the gum as stiff as possible. The manner of constructing the roof is shown at fig. 54. A flat piece is laid on first, and the sloping roof is fixed upon this. When the whole is ready to be put together, procure a deal board, covered with green cotton velvet, if it can be obtained, if not, with black, and having a mahogany, rosewood, or maple rim, and brass feet, if thought proper. Cut out the ground plan, fig. 55, in tissue paper and stick it upon the velvet. Set up the church, fig. 56; and, from the door, gum a line along the velvet for a path, and cover it with fine sand or road grit. Represent graves by little rolls of velvet, headed with Bristol-board grave-stones. Rails and tombs in the same manner, with faintly dotted lines drawn across for epitaphs and inscriptions. Yew trees by gumming unravelled velvet upon twigs of blackthorn. In making the clock, the hands and figures must be left white upon a black ground. If the learner should not be able to get upon the tower, he may obtain its altitude by the following

Instrument to Measure Heights.

Procure from the carpenter's a piece of deal, of the shape shown in fig. 57, half an inch thick, and measuring 8 or 10 inches from *a* to *b*; and in one of the sides *ac* let there be a groove. Cut out a square piece of writing paper *defg*, to fit the board; and divide the sides *dg*, *gf*, each into 100 equal parts, only 10 of which are shown in the plate, for want of room. Paste this carefully upon the board, so that the side *ef* shall lie parallel to the side *ab*, and the side *ed* to *ac*. At *e* make a fine hole, and through it pass a piece of silk, having a plummet at the other end, *h*. Roll up a piece of paper *mn* round a fine wire, or procure a tin tube, and gum or glue it firmly into the groove *ac*. In using it place the eye at *c*. Direct the tube to the top of the tower; when properly adjusted, incline the point *a* slightly to the left hand, and observe the number cut by the silk line, *eh*. Measure from the place of observation to the bottom of the tower. If the thread falls exactly upon the corner *g*, the height of the tower is the same as the distance of the person from the bottom. If it cut the side *dg*, state, as the number is to 100, so is the base to the height; if it cut *gf*, as 100 is to the number, so is the base to the height.

The learner may now construct himself some tubes of paper, a pair of scales, a pair of steelyards, a funnel, a sieve, and a few paper pockets.

Tubes.

Roll writing paper round a black lead pencil, and paste the edges. If liquids or gases are to be passed through them, oil the paper first, and press it between blotting paper. For bent ones join two together, as in fig. 58, pasting the joining over with several folds of tissue paper.

Scales.

Procure a strip of deal, 2 feet long, $\frac{3}{4}$ of an inch broad, and $\frac{1}{4}$ thick, from the extremities of which suspend two paper caps, as in fig. 59, taking care that the fulcrum *b* be exactly in the middle between *a* and *c*, and that they balance each other, both before and after attaching the scales. Through *b* pass a smooth round peg or pivot, as shown at *ee*, and suspend this in a wire bent to the form at *g*, under which stick a common pin upright as at *i*. Twist another piece of wire round two black lead pencils to the form shown at *h*; clip off the ends, as at *d*, loop the threads into it, and tie them round, as at *f*. Pass them through *a* and *c*. For weights use beans, marbles, bullets, half-pence, or pieces of wire or tobacco pipe, filed to an equal length. The adjusting of these will form a suitable amusement for a wet afternoon, or winter's evening. A wooden handle will serve still better than a wire one if the learner can construct it.

Another Sort.

On a slip of Bristol board, fig. 60, draw the straight line *rn*, 4 inches long, of which make *rs* one inch; make *nb* and *nd* each half an inch; *sa*, *sc*, each one inch. Draw *ak* and *co* parallel to *rs*. Make *af* perpendicular to *ab*, and equal to *ak*. *eb* equal to *bn*. Cut half through the three lines *ab*, *cd*, and *ac*. Bend them up, and paste the corners with writing paper. Holes are to be made at *m*, *r*, and *x*, to receive the strings. Suspend it as before.

Instead of these the learner may use two circular pieces of tin, about 5 or 6 inches in diameter, which he will be able to cut for himself with a strong pair of scissors. Another method, and which will answer for liquids at the same time, is by suspending two gallipots. Scratch off the glaze in three places, round the outside, with a file, and work a hole through with the point of a penknife. Pattypans make excellent scales.

Steelyards.

Procure a slip of deal as for the scales, see fig. 61. Fix in a pivot somewhere, as at *a*, and hook in the scale, say a pattypan, as at *b*. Provide a weight *c*, with a wire inserted through it, and loop it on the beam. Move it along till it exactly balances the scale hanging from *b*, make a notch at the point, and write under it *o*. Then set off any equal distance towards *d*; number it, and the instrument is complete. It is requisite that the fulcrum should be in a line with the top of the beam rammed hard. Thrust a thimble into it, to make an impression; remove the thimble, and stick a wire upright in the middle. Pour in melted lead. When cold draw out the wire, and a hole will be left through the middle of the weight, by which to suspend it. If it be desired to make the steelyards weigh ounces, lay a pound weight in the scale, and counterbalance it, then divide the distance into sixteen equal parts.

Funnels.

Roll up paper to the proper shape, pin the edges, and cut a circular hole at the bottom, instead of the sloping aperture which naturally presents itself.

Sieves.

Nail together four pieces of deal, each about 5 inches long, and three broad. Form the bottom of net, or stiff muslin, and secure it neatly at the corners.

Paper Pockets.

These will be found convenient for holding many little articles, as church windows, touch paper, &c. Fold a piece of paper, fig. 62, along *ab*, upwards in front, and bend the sides back along *cc* and *dd*, to the shape shown in fig. 63. Pin the back, or paste it.

In the following pages, the weights are not given in ounces and pounds, but the proportions simply are indicated, to enable the learner to adapt them to his own constructed scales. Thus if it be said 1 nitre, 2 sulphur; take one bullet or one bean, for the weight of the nitre: and 2 bullets or 2 beans for the sulphur: and so of others. In one or two instances the real weight is given, as it will be more convenient, since the articles will be purchased ready weighed.—The learner will find his little steelyards the most handy.

To Cut off the Neck of a Vial.

Fasten a piece of whipcord to a post, and twist it round the neck of a vial. Pull the cord tight, with the left hand, and with the right rub the bottle swiftly backwards and forwards. When hot, plunge it suddenly into cold water, and the neck will fall off. Fill this partly with water and hang it from the ceiling with the mouth downwards. At the approach of wet weather it will drip. Colour the water with a drop of red ink.

To Make a Glass Inkstand.

Take a vial, and with a pen and ink, make a mark round it about two inches from the bottom. Just below and above this, wind pieces of string, similar to that upon a bat handle, leaving a groove between; bind whipcord round this groove, and proceed as for cutting off the neck. Set it in a wooden block with a hole in it. These will be found useful for schools.

To Break a Glass Tube at any Particular Part.

File a notch at the place, and snap it asunder. Tobaccopipes the same. Or by friction, as for the neck of a vial.

To Bend a Glass Tube.

Lay it in the middle of a clear fire, and, when red hot, bend it. Let it cool as slowly as possible.

To Crack Glass in a Particular Direction.

Bind it with thread soaked in spirit of wine. Set fire to the thread, and plunge the glass into cold water.

To Make a Sand Bath.

Place some dry sand in an iron ladle, and heat it over the fire. This is useful for boiling liquids in glass vessels.

Instantaneous Crystallization.

Dissolve an ounce and a half of Sulphate of Soda, in an ounce of water. Pour it into a vial, and cork it while hot. When perfectly cold remove the cork, and in an instant the whole will become solid, as a mass of ice. The same will serve for many times. Place the vial in boiling water to re-dissolve it. Cork and proceed as before.

Crystallized Chimney Ornaments.

Select a crooked twig of white or black thorn; wrap some loose wool or cotton round the branches, and tie it on with worsted. Suspend this in a basin, or which is better, in a deep jar. Dissolve two pounds of alum in a quart of boiling rain water, and pour it over the twig. Allow it to stand 12 hours. Wire Baskets may be covered in the same way.

Imitation Coral Ornaments.

1 vermilion, 8 rosin, for Red.

1 white lead, 6 rosin, for White.

1 lamp black, 10 rosin, for Black

Melt any of them together, according to the colour required; and, with a camel's hair pencil, paint the mixture upon some pieces of black thorn. Nests of Chaffinches and other birds, smeared over with them, have a pleasing appearance. To render them smooth hold them by the fire, and turn them round.

Beautiful Lead or Silver Tree.

Dissolve half an ounce of Acetate of Lead in a pint and a half of water. Shake it well, and let it stand till clear. Pour off the liquid, and throw away the sediment. Partly fill a vial with the former, and fix a wire through the cork as in fig. 64, having, at the bottom, a piece of Zinc, the size of a horse bean. Set it carefully by, where it will not get disturbed. In a few hours the lead will crystallize round the zinc in the form of moss, and soon after will branch out into silvery leaves running up the wire, and spreading in every direction. To obtain the zinc of a convenient form, melt it in a tobacco pipe, and run it into sand, flour, or powdered chalk in holes made with a black lead pencil. Stick a wire in the middle, as directed for the steel-yard weight. If sand be used, be careful to have it dry, otherwise, steam will be formed, and the hot metal will be driven, perhaps, into the face. The zinc may be re-melted and used again.

Copper Tree.

Place a farthing in a cup or tumbler, and pour upon it a small quantity of nitric acid. A violent efferves-cence will take place, and the surface of the coin will be dissolved, staining the liquid of a bright blue colour. As soon as the effervescence has subsided, pour it off, and dilute it with 8 times its quantity of water. Half fill a vial with this, and suspend a piece of zinc in it, as for the lead or silver tree. In a little time the copper will be precipitated upon the zinc, wearing the appear-ance of green moss, which in a few days will change to a copper colour. If the end of a feather be dipped into the solution, and rubbed upon a knife blade, it will im-mediately cover it with a film of copper. One drop of nitric acid to twenty of water makes an excellent wash for the teeth, but it should not be used continually. About 3 or 4 mornings will be sufficient to make them perfectly white.

Beautiful Medals.

Lay a sovereign, half-crown, farthing, &c. upon a slate, and form a little border round it with clay, or putty. Melt some glue thoroughly over the fire, and stir in it a small quantity of treacle. Pour this over the coin, and suffer it to cool. When cold, remove it, and a beautiful impression will be found beneath. Lay this now with its face uppermost, aud form round it a border as before. Mix some plaster of paris and water in a cup to the consistency of cream, not thicker, and pour it over the impression. When firm, remove the glue, and a perfect copy will be found transferred to the cast. To take copies from sealing wax, the glue must be removed from the fire, and kept stirred till nearly cold, otherwise the wax will be melted, and the lines effaced. Impressions may be taken from leaves of trees, embossed lids of books, shells, fish bones, geological specimens, &c. in the same manner. To prevent cohesion they should be oiled, or smeared with tallow. Seals are to be taken in plaster at once, and well oiled. Letters, or drawings scratched upon slate, may be transferred in the same way. A little red lead mixed with the plaster will form excellent marbles, and very hard when perfectly dry. A gloss may be given them by dipping them into milk, and drying them. A glass inkstand, and a half pint tin pot will furnish the learner with a glue-kettle. Putty is made of linseed oil and whiting. Chalk will answer the purpose.

To Show the Refraction of Light.

Lay a shilling in the bottom of a basin, and walk back till you just lose sight of it. Let some one now carefully pour water upon it. The shilling will become visible.

Another Method.

Plunge a straight stick into water; it will appear bent.

To Show the Pressure of the Atmosphere.

Float a bung in water, with a small piece of candle upon it. Place a glass tumbler over it to reach the water. As the pressure under the glass becomes diminished, the water will be driven up.

To Show the Elasticity of the Air.

Fit a piece of tobacco pipe through a cork. Fasten the cork into a vial half filled with water, and make the pipe long enough to reach beneath the surface. Blow into it, and remove the mouth suddenly. The water will be driven up as in a fountain.

Perhaps the following receipts may be useful.

Ginger Beer.

$\frac{1}{2}$ lb Sugar, $\frac{1}{2}$ oz cream of Tartar, 1 oz ginger, 1 gallon of boiling water. Ferment 24 hours. Bottle.

Another.

3 lb. Sugar, 2 oz. Ginger, 1 oz. cream of tartar, 4 lemons sliced, 4 gallons boiling water. Ferment 4 days with a pint and a half of yeast. Bottle.

Ink.

1 Sulphate of Iron; 1 logwood; 1 gum arabic; 3 nut galls; 20 water; 20 vinegar.

Ink Powder.

1 Gum arabic; 2 sulphate of iron; 4 nut-galls. For use, pour on it ten times its weight of water.

Red Ink.

1 Cochineal, 8 gum arabic, 16 ground brazil wood, 16 alum, 160 sour ale.

Indian Ink.

1 borax, 5 seed lac, 96 water, and lamp black enough to make it hard.

Blacking.

1 oz. sulphate of iron, 1 oz. sweet oil, 1 oz. sulphuric acid, ¼ lb. ivory black, ¼ lb. treacle, 1 pint vinegar. Dissolve the sulphate first, in a little of the vinegar boiled, and add the sulphuric acid last.

French Polish.

$\frac{3}{4}$ oz. seed lac, 3 drams gum juniper, 2 drams gum mastic, 4oz. spirit of wine. Mix, and set in a warm place.

Livid Fire.

Soak common salt in Spirit of Wine, and set it on fire. All bystanders will look like corpses.

To make Gas.

Put powdered coal into a tobacco pipe, and cover it with Clay. Place it in the fire, and light the smoke as it issues from the other end. Coke will be left in the bowl.

To Make Looking Glasses.

Moisten a piece of tin foil with quicksilver to the thickness of 1-8th of an inch, slide a piece of glass smoothly over it, and press it with heavy books, for 10 or 12 hours. All depends upon sliding the glass instead of laying it.

To Silver Copper.

2 nitrate of silver, 3 alum, 12 cream of tartar, 12 salt, Mix. Clean the copper, and rub it with the mixture. Polish with leather.

To Crystallize Tin.

1 spoonful muriatic acid, 1 nitric acid, 8 water. Mix. Warm a piece of block tin over the fire, and rub it with a cloth dipped into the mixture. Ornament with coloured varnish.

To Boil Water in an Egg Shell.

Pour water into the shell, and set it on the fire.

To Boil Water in Paper.

Twist writing paper to a funnel shape, and pin the sides. Fill it with water, and set it on the fire.

To Melt a Piece of Metal in a Walnut Shell.

1 brimstone, 1 sawdust, 3 nitre. Fill the shell with the mixture; lay a thin piece of lead, copper, &c., upon it; press it down; heap on more of the mixture, and set it on fire.

To Freeze Water in Summer.

10 nitre, 11 muriate of ammonia, 16 sulphate of soda. Reduce them separately to a fine powder. Set a small vial ful of water in the middle of a tumbler; mix the ingredients round the outside, and pour water over them. In a quarter of an hour the water in the vial will be frozen.

In winter, 1 salt, 2 snow, will effect the same very readily.

Instead of a vial, it is more convenient to have a test tube, or a piece of glass tube stopped at one end with a cork; a thin paper tube will answer the purpose. A test tube may be made by cutting off the top of a vial about half an inch below the neck.

To Distil Spirits.

With a penknife and round file make holes in two corks, and fit them into two oil flasks, *a* and *b* fig. 65. Through the holes insert a bent tube of glass, or oiled paper. In *a* put ale or wine, and hang the flasks against the wall by two nails. Place a lighted candle under *a*, and cause the liquid to boil. The spirit will be condensed in *b*. A cloth ought to be wrapped round the flask *b*, and kept cold by being wetted with water.

To Make Oxygen Gas.

Put some black oxide of manganese into a flask, and pour over it as much sulphuric acid as will just wet it. Set it in a sand bath, and make the sand hot; or hang it over a candle. By inserting a pipe through a cork, thrust into the neck, the gas may be collected in a bladder; but a much better way is by a pneumatic trough. To make this, take a large basin, *a*, fig. 66. Cut out a piece of wood, *c*, half an inch thick, 2 or 3 inches broad, and rather shorter than the width of the basin so as to allow it to sink about an inch down. In the middle of the board bore a hole; and on the under-side, as much lead as will cause it to sink in water. This being done, set it in the basin, and pour in as much water as will just cover it. Fill a vial with water, invert it, and set it over the hole. Cause a bent tube, proceeding from the flask *b* containing the manganese, to pass under the side of the board, so as to come exactly under the hole. As the gas comes over, it will rise into the vial, and displace the water. When nearly full, slide the vial to the side of the wood, and cork it. Leave a little water in to protect the bottom. Hot water must be poured upon the manganese directly, to prevent it from becoming solid, or the flask will be spoilt.

Beautiful Experiments with Oxygen.

Fasten a piece of charcoal to the end of a wire, light it, and plunge it in. Hundreds of brilliant sparks fly out in all directions.

Fasten a piece of brimstone to the end, light it, and plunge it in. The wire melts.

Fasten a piece of phosphorus, light it, and plunge it in.

Blow out a candle, and plunge it in.

These experiments are perfectly harmless. Oxygen is a supporter of combustion, not combustible. It causes other things to burn, but does not burn itself.

To set a glass of Water upon a Table, so that a person shall not be able to lift it without spilling the whole.

Place a piece of writing paper on the top, press it with the palm of the left hand, and invert it with the right. As there is now no pressure upon the water to counterbalance the upward pressure of the external atmosphere, the paper will remain after the hand is removed. Set it upon the table, and slide the paper from underneath. To remove it yourself, slide the paper under again and lift it.

Fulminating Mercury.

1 mercury, 7 nitric acid, 10 spirit of wine. Dissolve the mercury in the acid in a flask. When cold, pour the spirit upon it, and hold it over a candle till it boils. A white powder falls to the bottom. In a minute or two remove it from the candle, quickly pour off the liquid, throw cold water on the sediment, and filter it through blotting paper set in a funnel. Dry in the sun. A little laid on a hammer, and struck sharply with another, explodes violently. It is the powder for percussion or copper caps. The sediment must be washed as soon as formed, as the acid, if left upon it, soon destroys its properties.

Fulminating Silver.

1 nitrate of silver, 8 rain water, 8 nitric acid, 16 spirit of wine. Dissolve the silver in the water and acid. Pour in the spirit and boil it over a candle. A white powder falls to the bottom. Remove it quickly from the candle, pour off the liquid, throw cold water instantly on the sediment, and filter it through blotting paper. Do not allow it to get quite dry, as it is extremely dangerous; when wanted to use, dry a small quantity in the open air, but keep it from the sunshine, and the warmth of the fire. It is so extremely susceptible, that the least heat or friction causes it to explode.

Detonating Balls.

Put some sand into a piece of paper, and as much fulminating silver as will lie on the point of a penknife. Roll it up very carefully and fling it on the ground.

Waterloo Crackers.

Powder some glass. Cut two narrow slips of paste-board, and smear the ends with gum; upon one put fulminating silver, upon the other glass dust. Lay them face to face in such a manner, that, when pulled apart, the rough glass may slide over the silver. Bind them carefully round with a piece of pasted paper, and lay them by to dry.

Detonating Mixture.

A piece of chlorate of potash about as small as a vetch or a quarter of a pea, and as much sulphur. Rub them briskly together in a warm mortar.

Gunpowder.

2 charcoal, 3 sulphur, 15 nitre. Mix for a long time. This makes an excellent train.

Fulminating Powder.

1 sulphur, 2 carbonate of potash, 3 nitre; all well dried. Rub together in a mortar. Lay a quantity, about the size of a horsebean, in an iron spoon, closely together, not scattered. Set it over the fire. Walk away and listen.

CAUTION.

Before making any of the following mixtures, the learner should powder all his articles in a clean mortar, sift and bottle them ready for use. All nitrates should be thoroughly dried, bottled, labelled and kept from the damp. They should be laid in a saucer before the fire for an hour or two, and then powdered. Take care always to have the mortar clean, and never rub sulphurets with chlorates, except in very small quantities. Keep nitric acid from contact with essential oils. Brimstone, charcoal, and such things are best ground in an old coffee mill. Meal powder is simply gunpowder bruised. If steel or iron filings are mixed with dust, they may be separated from it by holding a magnet to them; and the appearance they assume in settling round the magnet is very beautiful. If the learner is unprovided with this little implement, he may make himself one sufficiently powerful for the purpose, by holding a straight bar of hard steel upright upon a poker, and giving it a few smart blows with a hammer.

To powder camphor wet it with a drop of spirit of wine. Never use any thing combustible by candlelight, and never, above all things, let off any fireworks in a room where the composition is standing.

Lucifer Matches.

1 chlorate of potash, 1 sulphuret of antimony. Mix cautiously on a sheet of paper, with the feather end of a quill, and stick on matches with stiff gum.

The same may be stuck along the edges of touch paper, and cut into slips.

Instantaneous Fire.

5 chlorate of potash, 7 powdered loaf sugar. Mix on paper, or in an oyster shell, and touch with the end of a stick dipped into sulphuric acid.

The following are some of the most splendid fires that can be imagined; every article must be perfectly dry. They are quite harmless, but it is best to burn them in the open air, as disagreeable vapours rise from the Sulphur and produce head ache.

White Fire.

1 lamp black, 2 red arsenic or realgar, 7 sulphur, 24 nitre. Rub together in a mortar. Fire in a ladle, or iron spoon, held in the hand.

Blue Fire.

1 lamp black, 1 sulphuret of antimony, 2 sulphur, 6 nitre. Rub together in a mortar.

Green Fire.

1 lamp black, 3 clorate of potash, 8 sulphur, 42 nitrate of barytes.

Crimson Fire.

2 lamp black, 4 sulphuret of antimony, 5 chlorate of potash, 13 sulphur, 40 nitrate of strontian. Mix together on paper, with the feather end of a quill, not rub in a mortar, because of the chlorate and sulphuret.

Purple Fire.

1 lamp black, 2 realgar, 7 'sulphur, 24 nitre, 24 nitrate of strontian. Rub together in a mortar; or

2 sulphuret of antimony, 3 nitre, 5 sulphur, 20 nitrate of strontian. Rub together in a mortar; or

1 lamp black, 1 red arsenic, 1 nitre, 2 sulphur, 16 nitrate of strontian.

Touch Paper.

Dissolve ½ an ounce of nitre in half a pint of hot water; soak thin blue paper in it, and dry.

Cases for Squibs, Flower-Pots, Roman Candles, Rockets. &c.

Procure two black lead pencils, one rather thicker than the other, or made so by pasting paper round it. Roll the cases round the thicker, and ram with the thinner. Iron rollers are best. Paste the edges. Before rolling the paper it is best to fold it nearly across the middle. Rocket cases should be rolled round a ruler, and made 6 times longer than broad. The best way of learning to make them, is by buying one, and cutting it open.

To Choke the Cases.

Fix a wire, about 1-12th of an inch thick, into a pencil, *b*. fig. 67. Take another short piece *a*, an inch or two long, with a hole up it to admit the other end of the wire. Fit it on, and pass it up the case. Then having fastened a piece of whipcord to a post, wind it round the part left hollow by the wire, which should be about a quarter of an inch from the end; pull it tight with the right hand, and work the case round with the left. Cut out a piece of touch paper two inches long, and an inch and a half broad; wind it round the choke and tie it on with a piece of fine string. Twist to a point.

The cases are best choked while damp, and the touch paper may be fastened on at the same operation.

Squib Composition.

1 steel filings, 1 charcoal, 1 sulphur, 4 powder.

To Fill the Cases.

Hold one in the left hand, with the twisted touch paper downwards, and with a quill, cut as in fig. 69, put in three measures of composition; thrust in the rammer and drive it down with a flat piece of board, keeping the case in the left hand, and not propping it upon any thing. Put in three more ladles, and so proceed till within an inch of the top. Fill up this with loose gunpowder, not rammed, for a bang and fold in the ends. After filling a dozen or two, melt some pitch in a pipe or oyster shell, and smear the ends with a feather dipped into it.

Flower Pots.

1 filings, 1 charcoal, 1 powdered coal, 1 sulphur, 1 nitre, 5 powder; or

1 sulphur, 1 charcoal, 1 sawdust, 2 filings, 3 coal, 6 powder; or

1 sawdust, 2 charcoal, 2 sulphur, 3 filings, 4 coal, 10 powder; or

1 sawdust, 1 filings, 1 sulphur, 1 charcoal, 1 coal, 8 powder; or

1 rosin, 2 sulphur, 2 charcoal, 2 filings, 4 coal, 10 powder.

The learner can try all, and choose which he likes best. Ram as squibs, with or without bang. They should not be held in the hand when fired, but set upright, in an old candlestick, or in a hole bored into the top of a post. The powdered coal gives beautiful sparks, but excessively hot.

Stars for Rockets and Roman Candles.

1 camphor, 1 sulphur, 2 meal-powder, 2 nitre, or any of the coloured fires at page 59. Moisten them with oil of turpentine, oil of spike, or linseed oil, and

ram them hard into a squib case. When dry, unwind the case, and cut the composition into lumps, about the size of a pea.

Roman Candles, or Fire Pumps.

1 powder, 1 sulphur, 2 nitre; or

1 powder, 1 sulphur, 1 coal, 2 nitre; or

1 powder, 1 sulphur, 1 coal, 1 charcoal, 3 nitre; or

1 sulphur, 1 coal, 1 charcoal, 1 filings, 4 powder, 8 nitre; or

2 glass dust, 2 sulphur, 3 meal-powder, 10 nitre.

To Fill the Cases.

Stop up the choke by driving down a piece of paper. Fill the contrary way to a squib. Put in one quill of gunpowder loose, on this a star, and on the star three quill ladles of composition ; ram hard : then gunpowder, star and composition, and so proceed. Paste touch paper round the top, and twist to a point. In squibs, flower pots, and rockets, the fire plays through the choke ; not in roman candles, because of the stars. Some fill flower pots like roman candles ; the learner can please himself. Try also the flower pot composition with roman candle stars.

Rockets.

1 coal, 1 nitre, 6 meal-powder ; or
3 charcoal, 4 nitre, 16 meal-powder ; or
3 charcoal, 6 sulphur, 8 nitre, 32 meal-powder ; or
3 charcoal, 8 meal-powder ; or
3 filings, 4 charcoal, 8 sulphur, 16 nitre, 64 meal-powder ; or
2 sulphur, 3 charcoal, 8 nitre; or
1 meal-powder, 12 sulphur, 14 charcoal, 24 nitre.

The first are for small rockets, the latter for larger. The cases are to be filled as squibs, see fig. 70. *c* is composition rammed hard, *s* loose gunpowder with 8 or 10 stars upon it, *o* a thin piece of paper pasted on to keep the stars in; *p*, the priming or quick match made by twisting string into port-fire. *t*, touch-paper. Tie the stick on as shown in the plate, and stick it loosely into the ground. Light it at *t*. If the fire burst the case, the charge is too fierce, or the case is too thin. If the rocket does not rise, the charge is too weak. To make the charge fiercer, add meal-powder; to weaken it, charcoal. The cases should be six times the thickness of those for squibs. In filling them, they may be set upon a block *c*, fig. 68.

To cause a fiery shower to fall among the stars, put in with them,

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For a Gold Rain.

1 sawdust, 2 sulphur, 2 meal-powder, 3 glass dust, 8 nitre.

For a Silver Rain.

1 sal prunella, 4 sulphuret of antimony, 4 sulphur, 4 meal powder, 8 nitre.

Blue Lights.

1 powder, 2 nitre, 4 sulphur. Small squib case rammed the contrary way.

Catherine Wheels.

1 camphor, 1 sulphur, 1 nitre, 2 meal powder; or
4 nitre, 7 filings, 32 meal-powder; or
3 filings, 4 sulphur, 12 nitre, 32 meal-powder; or
3 sea-coal, 6 sawdust, 32 nitre, 64 meal-powder; or
1 glass dust, 4 sulphur, 8 nitre, 16 meal-powder; or
2 sulphur, 3 sulphuret of antimony, 8 nitre; or

1 sulphuret of antimony, 2 lapis calaminaris, 2 sulphur, 10 nitre.

Roll the cases round thick wires, and put in a little of different mixtures, so as to have a variety of sparks and colours.

Crackers.

Fold a piece of the very stiffest cartridge paper, 4 inches broad, along the edge, about an inch up. Fold the folded edge up again rather more than a quarter of an inch, and turn the other piece back upon it. Unfold it, and lay meal powder along the channel; fold it up, and paste the edge. Bend backwards and forwards tight round a wire, and tie across the middle. The manner of tying is of no consequence; the turns divide the bangs, not the pinchings of the string. The tying is effected by winding a thread round the whole and bending it in and out among the turns. The form of the cracker is shown in fig. 71.

Port Fire.

1 Meal powder, 2 sulphur, 4 nitre; or,
5 sulphur, 9 nitre, 12 mealpowder; or,
1 nitre, 3 sulphur vivum, 3 mealpowder; or,
1 sulphur, 2 nitre, 3 mealpowder; or,
1 rosin, 1 camphor, 2 sulphur, 3 nitre, 5 mealpowder.
Moisten with oil of turpentine, or linseed oil, and roll string or worsted into it.

Spur Fire.

3 Lamp black, 4 sulphur, 9 nitre. This is very beautiful, but exceedingly difficult to mix. Ram into squib cases the contrary way.

White Fire.

1 Glass dust, 1 sulphuret of antimony, 2 mealpowder 2 nitre. Ram into squib cases the contrary way.

LIST OF ARTICLES

Mentioned in the work, the prices usually charged, and the shops at which they may be procured. C denotes chemist and druggist; Ch, China shop; G, grocer; I, ironmonger, brazier, coppersmith, &c. L, linendraper; P, plumber, glazier,&c. S, stationer; T, toyshop; W, watchmaker.

Acetate of lead, 2 ounces for 1½d C

Alum, 2d per pound, G or C

Antimony, sulphuret of, 6d per pound, C

Arsenic, red, 1½d per ounce, C.

Beads, glass, 1d, W

Blotting paper, 1s per quire, S.

Book muslin, 1s per yard, L

Borax, 2d per ounce, C

Brazil wood, ground, 2d per ounce, C.

Brimstone, or sulphur, 2d per lb, G or C

Bristol board, 1s per sheet, S

Brown paper, 1s per quire, S or G
Cambric, glazed, 10d per yard, L
Camphor, 6d per ounce, C
Carbonate of potash, 3d per ounce, C
Cartridge paper, 1s per quire, S
Charcoal, 1½d per pottle, G or I
Chlorate of Potash, 8d per ounce, C
Cochineal, 1s 4d per ounce, C
Cream of tartar, 1½d per ounce, C
Files, round or flat, 2d, 3d, 4d, each, I
Filings, iron or steel, of the Sawyer, Smith, or I
Flasks, oil, 1d each, G
Gallipots, 1d each, Ch or C
Ginger, 2d per ounce, C or G
Glass Beads, 1d, W
Glass tubes, 6d, 1s, according to weight, C
Glazed cambric, 10d per yard, L
Glue, 7d per pound G or C
Glue-pot, small, 1s, I
Ground Brazil wood, 2d per ounce, C

Gum arabic, 2d or 3d per ounce, C
Gum Juniper, 4d per ounce C
Gum Mastic, 4d per ounce C
Gunpowder, 1s 6d per lb, G
India Rubber, 2d S
Iron Filings of the Sawyer, Smith, or I
Iron Ladle, 6d, I
Iron Mortar, 1s or 1s 6d, I or C
Iron Spoon, 1d, I
Ivory Black, ½d per ounce, C or G
Ladle, 6d, I
Lamp Black, 2 ounces for 1½d, C or G
Lapis Calaminaris, 2d per ounce, C
Lead, 2½d per lb, P
Linseed Oil, 6d per pint, G or C
Logwood, 4d per lb, C
Looking-glass for Kaleidoscope, 4d, T or W
Magnet, 4d, 6d, T, W, or C
Main spring, 1d, W
Manganese, oxide of, 4d per pound, C

Mercury, or quicksilver 4d per ounce, C
Mortar, iron 1s or 1s 6d, I or C
Mortar, stone 1s 2s &c., C
Muriate of ammonia, 4d per ounce, C or Ch
Muslin, book, 1s per yard, L
Muslin, stiff, 1s per yard, L
Naphtha, spirit of 1½d per ounce, C
Net, 1s per yard, L
Nitrate of Barytes, 6d per ounce, C
Nitrate of silver, 5s per ounce, C
Nitrate of strontian, 4d per ounce, C
Nitre, or saltpetre, ½d per ounce, C or G
Nitric acid, 3d per ounce, C
Nutgalls, 3d per ounce, C
Oil flasks, 1d each, G
Oil linseed, 6d per pint, G or C
Oil of spike, 4d per ounce, C
Oil, sweet, 1d per ounce, C or G
Oil, or spirit, of turpentine, 1d per ounce, C

Oxide of manganese, 4d per pound, C

Pasteboard, 3d per sheet, S

Pattypans, 2d each, I

Phosphorus, 1s per dram, C

Pitch, 4d per pound. C or G

Plaster of paris, 2d per quart, G or C

Potash, carbonate of, 3d per ounce C

Potash, chlorate of, 8d per ounce, C

Powder, or gunpowder, 1s 6d per lb G or I

Putty 1d P

Quicksilver, or mercury, 4d. per ounce, C

Quilling net, 1d per yard, L

Realgar, or red arsenic 1½d per ounce, C

Red Lead, 6d per lb. G

Rosin, 4d per lb, C or G

Saltpetre, or nitre, ½d per ounce, C or G

Salt of Tartar 1d per ounce, C

Sal Prunella, 1½d per ounce, C

Seed lac, 2d per ounce, C

Sheet tin, 3d or 4d per sheet, I

Shell lac, 2d per ounce C
Silver, nitrate of, 5s per ounce, C
Spike, oil of, 4d per ounce, C
Spirit of naphtha, 1½d per ounce, C
Spirit, or oil of turpentine, 1d per ounce, C
Spirit of wine, 3d per ounce, C
Sponge, 2d, C, S or G
Spoon Iron, 1d, I
Steel filings, of the Sawyer, Smith, or I
Stiff muslin, 1s yer yard, L
Stone Mortar, 1s. 2s. 3s.&c, C or Ch
Strontian, nitrate of, 4d per ounce, C
Sugar of lead, or acetate of lead, 2 ounces for 1½d C
Sulphate of iron, 4d per pound, C
Sulphate of soda, 2d per ounce, C
Sulphur, or brimstone, 2d per lb, G or C
Sulphur, flour of, ½d per ounce, C
Sulphur vivum, 6d per lb, C
Sulphuret of antimony, 6d per lb, C
Sulphuric acid, 1d per ounce, C

Sweet oil, 1d per ounce, C or G
Tartar, cream of, 1½d per ounce, C
Tartar, salt of 1d per ounce, C
Tin sheet, 3d or 4d per sheet, I
Tinfoil, 3d per ounce, C
Tissue paper, 8d or 10d per quire, S
Treacle, 5d per pound, G
Tubes, glass, 6d or 1s, according to weight, C
Turpentine, oil or spirit of, 1d per ounce, C
Velvet, cotton 2s per yard, L
Vinegar, 5d per pint, G or C
Vermillion, 4d per ounce, C
Wine, Spirit of, 3d per ounce, C
Wire, iron, brass, or copper, I
Writing paper, 8d per quire, S
White lead, 1d per ounce, P
Whiting 1d per lump, G
Zinc, 6d. per lb, P

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Fireworks
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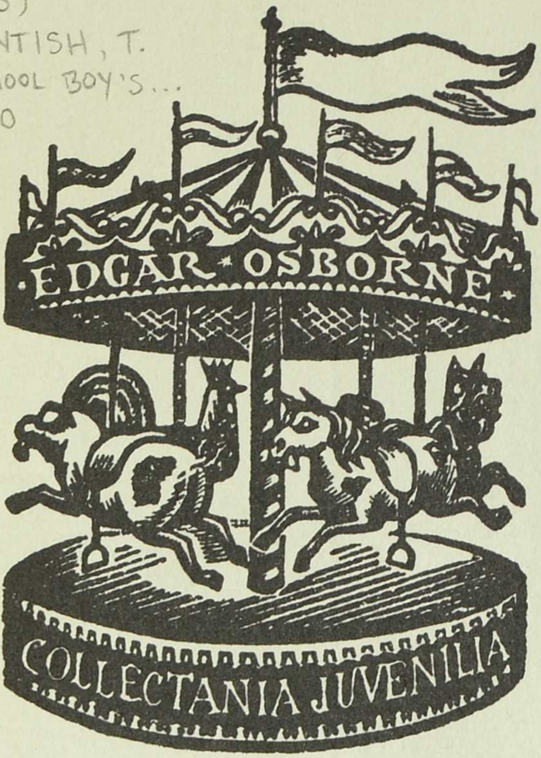
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